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| Page. | Column. | Line. | Description. |
|---|---|---|---|
| | | | *January.* |
| 54 | 2 | 16 | From top: for "Monili" read "Monilia." |
| 54 | 2 | 20 | From top: for "high yeast" read "low yeast." |
| 80 | 1 | 21 | From top: for "substances must now, &c." read "substances must not, &c." |
| 67 | 2 | 12 | From bottom: for "Levoff" read "Lwolf." |
| 67 | 2 | 5 | From bottom: for "are" read "is." |
| | | | *February.* |
| 112 | 2 | 29 | From top: "3½ cwt. of salt per ton of coal" should read as reversed. |
| 113 | 2 | 20 | From top: for "became" read "came." |
| 113 | 2 | 42 | From top: for "preliminacy" read "preliminary." |
| 121 | 2 | 9 | From top: for "quantity" read "quality." |
| 128 | 2 | 22 | From top: after "Oxalate.....54" insert a ruled line. |
| 129 | 2 | 21 | From top: for "to do so" read "in doing so." |
| 131 | 1 | 31 | From top: for "Hyroiodic" read "hydriodic." |
| 205 | 2 | 26 | From top: in table heading, for "1877" read "1887." |
| 205 | 2 | 7 | From bottom: for "Blitong" read "Biltong." |
| 179 | 2 | 8 | From top: for "Zylonite" read "Xylonite." |
| 180 | 1 | 2 | From top: for "Zylonite" read "Xylonite." |
| 190 | 1 | 13 | From top: after "ammonium oxalate" insert "is." |
| | | | *March.* |
| 264 | 2 | 13 | From bottom: for "1892" read "1893." |
| | | | *April.* |
| 378 | 1 | 36 | From top: for "und" read "and." |
| | | | *August.* |
| 765 | 1 | 29 | From top: for "Flurine" read "Fluorine." |
| | | | *October.* |
| 887 | 1 | 14 | From bottom: for "warmed in a flask" read "let stand in a flask." |
| 865 | 2 | 28 | From bottom: for "chloride" read "chlorate." |
| 865 | 2 | 29 | From bottom: for "chlorate" read "chloride." |
| | | | *November.* |
| 980 | 1 | 31 | From top: for "(this Journal, 1895, 337)" read "(this Journal, 1895, 877.)" |

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## NOTICES.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

### Bankers' Orders.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Authors of communications read before the Society, or any of its Local Sections, are requested to take notice that under Rule 43 of the bye-laws, the Society has the right of priority of publication for three months of all such papers. Infringement of this bye-law renders papers liable to be rejected by the Publication Committee, or ordered to be abstracted for the Journal, in which case no reprints can be furnished to the author.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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Thorp, Frank H., Mass. Institute of Technology, Boston, Mass., U.S.A., instructor in industrial chemistry.

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Walker, W. Sloane, Wood Bank, Erith, Kent, tanner.

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"Sucrerie Indigène, La," l/o Rue de Louvois; 14, Rue de Bellefond, Paris.

Turnbull, G. W., l/o North Gate; 88, Westmoreland Street, Darlington.

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Williamson, J. A., l/o Askam-in-Furness; c/o British Explosives Syndicate, Lim., Pitsea, Essex.

Woolley, G. S., l/o Market Street; Victoria Bridge, Manchester.

Young, W. C.; Journals to Laboratory, 19—20, Aldgate, E.C.

### ERRATA.

The changes of Messrs. Erskine and Wingate were wrongly inserted among "Changes Required." September No., 1894, 868.

Mr. T. J. Parker's name was wrongly spelt "Packer" in the monthly list of members elected. October No., 1894, 926.

## Deaths.

Barratt, Alex., Bronheulog, Mostyn, North Wales.

Nahnsen, Dr. R., Domitz, Elbe, Germany.

Parkinson, J. H., Stretford, Lancashire.

Robbins, Herbert, Chemical Works, Gibraltar Walk, Bethnal Green, E.

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### SESSION 1894-95.

February 4th.—Mr. Lewis T. Wright, F.I.C., F.C.S. "Some Matters of Interest in the Manufacture of Coal-Gas."

March 4th.—Mr. A. P. Laurie, F.I.C., F.C.S. "The Durability of Pigments derived from Coal-Tar Products."

April 1st.—Dr. Carl Pieper, of Berlin. "The German Patent Laws and their Relation to Home and Foreign Inventions."

N.B.—The Election of Officers and Five Members to the Local Committee will take place at the Meeting on April 1st. Nominations must be signed by Ten Members and sent to the Hon. Local Secretary not later than Wednesday, March 20th. Members can only sign one Nomination. (*See Bye Laws of Section.*)

*Meeting held Monday, January 7th,* 1895.

MR. B. E. R. NEWLANDS IN THE CHAIR.

## AN INVESTIGATION OF THE NATURAL SOLIDIFIED SODIUM SULPHATE LAKES OF WYOMING, U.S.A.

BY DR. D. HARVEY ATTFIELD, M.A., D.P.H., CANTAB; ENGLISH QUARANTINE MEDICAL OFFICER AT SUEZ, MOSES WELLS, AND EL TOR, EGYPT.

On the admirable 12-mile-to-the-inch map, published by the American Government in 1888, and delineating in great detail the State, or, then, the "Territory" of Wyoming, will be found marked, at about the middle and southern edge of the "Wyoming Oil Belt," certain *dry* lakes. The lake coloured yellow and marked "Soda Lake" in red letters, 60 miles in a straight line across the prairie (70 or more in tracking) west-south-west from the town of Casper, the terminus of the Cheyenne Northern Railway, is the lake to which special attention is drawn in this paper. Early in February 1891 the writer was sent to the district for the purpose of making a thorough investigation of the lake as to chemical composition, quantity of material, proximity of fuel, white sand, and, in this country of small rainfall, that especially important substance—water; as well as to consider the suitability of the site for a community with regard to hygiene, food supplies, and transit by road or rail.

The lake is situated, to employ the official language of the United States Government, in portions of sections 19 and 20 of Township 29 N., Range 88 W., in Natrona County formerly known as Carbon County, Wyoming, U.S.A. In fact, the figures 29 on the map, the number of the township, exactly mark the site of this lake, which occupies the lowest part of a shallow depression in a long valley which is bounded on the north by the Sweetwater or Granite mountains, and on the west and south by the Green, Iron and Ferris mountains, the valley running out eastwards. The Sweetwater River, a tributary of the Platte, drains the valley and flows within a mile of the lake itself. All the mountains just mentioned are outlying spurs of "the Rockies."

The first view one has of this soda lake, or "soda placer" as it is called in the States, gives the impression of a snow-covered area, due to effloresced sodium sulphate, for the lake has long since crystallised into a solid mass. The form of the lake is that of an oval, lying west-north-west and east-south-east, with a long diameter of some 1,200 yards, and having approximately, therefore, an area of 110 acres; not 200 acres, as locally believed.

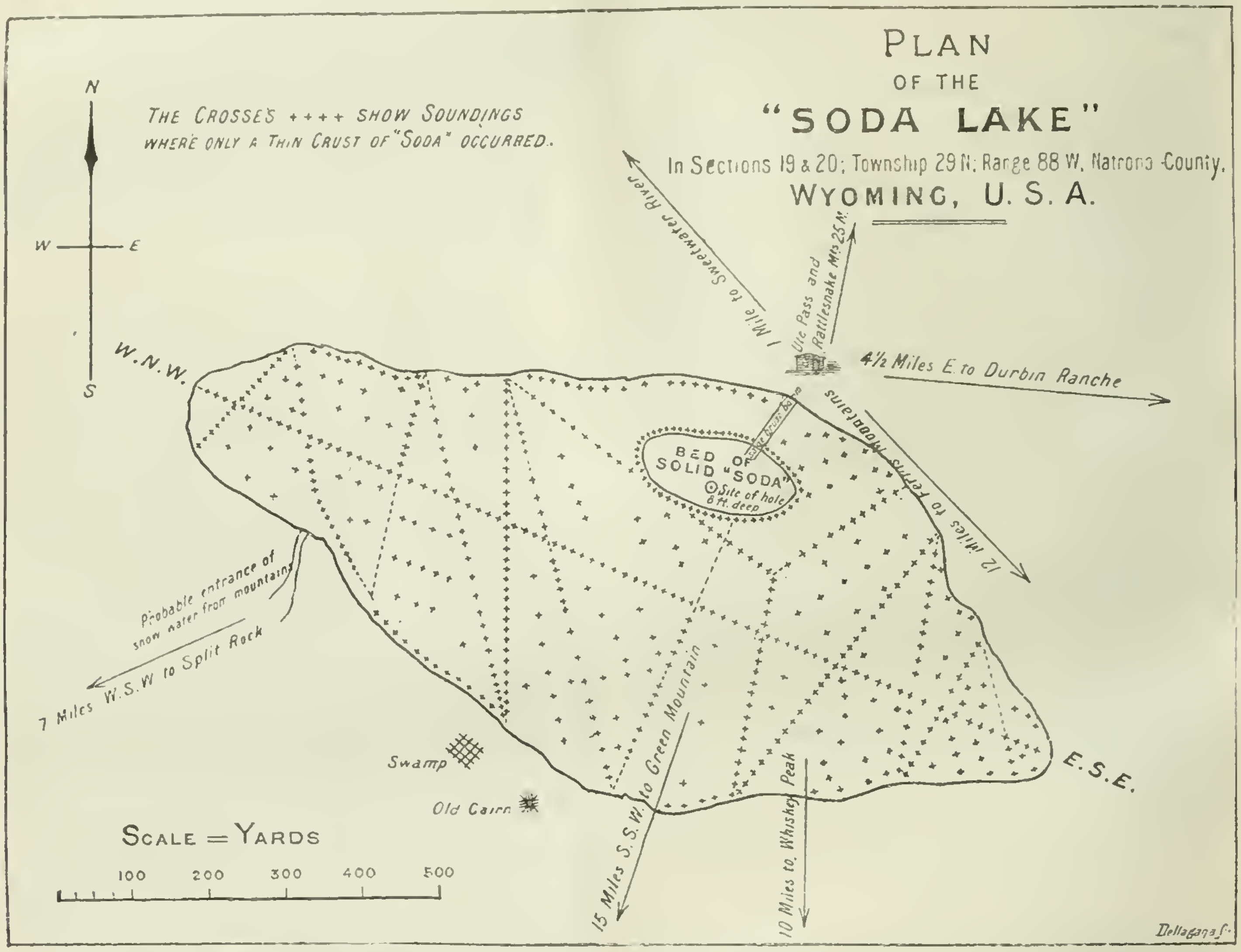
A boom or jetty, formed of cuttings of "sage brush," has been built out nearly 50 yards on to the lake to form a rough footway over some places which are said to be very soft in warm weather, though at the time of this visit they were frozen firmly. At these spots, which are termed "springs," but which are probably mere collections of rain or surface water, the writer was assured that a 20-foot pole would not touch solid ground—a statement he was unable to verify, as during the investigation they were hard with ice, the thermometer frequently being below the zero of Fahrenheit.

Samples were collected from different parts of the surface of the "lake," and from different depths in a large hole or pit some 12 feet square and 8 feet deep, excavated for the purpose beyond the end of the jetty. Some time was then spent over the analyses of the numerous samples.

Here may be stated two or three of the many difficulties by which a chemical operator is liable to be surrounded under such circumstances. The cold was so intense that several fluid reagents froze whenever the stove in the shed or "laboratory" got low in fuel, as it necessarily often did at night. Several pieces of thick glass apparatus, such as graduated measures, were lost by incautiously pouring in water, which, though itself at an ordinary English temperature, was hot compared with the temperature of the glass itself.

Then the "laboratory" was simply an outbuilding of the farm, a mere log hut, used as a smithy, but it had the necessary and indispensable furnace. There was set up the refining plant, consisting of large enamelled iron evaporating and crystallising pans, the fuel being wood.

The following table shows the composition of some of the samples of this natural deposit :—


PLAN
OF THE
"SODA LAKE"
In Sections 19 & 20; Township 29 N; Range 88 W, Natrona County,
WYOMING, U. S. A.
N
W
E
S
THE CROSSES + + + + SHOW SOUNDINGS WHERE ONLY A THIN CRUST OF "SODA" OCCURRED.
1 Mile to Sweetwater River
Ute Pass and Rattlesnake Mts 25 M.
4½ Miles E to Durbin Ranche
12 Miles to Tepee Springs
W.N.W.
E.S.E.
BED OF SOLID "SODA"
Site of hole 8 ft. deep
Probable entrance of snow water from mountains
7 Miles W.S.W. to Split Rock
Swamp
Old Cairn
15 Miles S.S.W. to Green Mountain
10 Miles to Whiskey Peak
SCALE = YARDS
100
200
300
400
500
Dellagana Sc.

PERCENTAGE COMPOSITION OF NATURAL SODIUM SULPHATE OF WYOMING, U.S.A.

| —— | Top Crust. | New Deposit. | Old Deposit. |
|---|---|---|---|
| Sodium sulphate ($Na_2SO_4$)........ | 84·86 | 43·93 | 32·28 |
| Sodium carbonate ($Na_2CO_3$) ...... | 6·23 | 1·00 | 1·17 |
| Water of crystallisation........... | 6·93 | 53·89 | 40·70 |
| Sodium chloride.................. | 1·55 | 0·77 | 0·45 |
| Sand .............................. | 0·25 | 0·17 | 24·18 |
| Chalk, magnesia, alumina, and a very faint trace of iron (by diff.) | 0·08 | 0·16 | 1·02 |
| Soluble silica ..................... | 0·10 | 0·08 | 0·20 |
| Potassium, lithium, bromides, borates, nitrates. | None | None | None |
|  | 100·00 | 100·00 | 100·00 |

The "top crust" of the deposit is effloresced sodium sulphate, each pound containing about one ounce of sodium carbonate. Occasionally, actual crystals of potassium sulphate also could be separated during crystallisations, though there was none in the three samples quantitatively analysed. By "new deposit" is meant the crystals of sodium sulphate which form when a hole made in the mass fills up with fluid oozings from its bottom or sides, the fluid subsequently solidifying. The sample analysed was evidently almost commercially pure Glauber's salt. Two other samples that were damp when unfrozen, yielded rather less than 45 per cent. of the solid sulphate on ignition. The sample of "old deposit" had doubtless become effloresced after collection and before analysis, for the bulk of sand-free rock-sulphate yielded 54 to 55 per cent. of volatile matter. It is unfortunate that frequent wind-storms should so contaminate the sulphate with sand. *Per contra*, most of it is free from more than a trace of iron, and it is quite neutral to litmus paper.

This "dry soda lake" is, clearly, Glauber's salt with 3 or 4 per cent. only of crystalline sodium carbonate, for the larger proportion of carbonate in the "top crust" would be due to concentration, the top layers of fluid crystallising last. Prior and subsequent analysis by my father, Prof. Attfield, F.R.S., confirm the figures I have given.

The total mass of the lake had next to be estimated. Straight lines were drawn across the surface from side to side. These were then intersected by similar lines, one extending from end to end of the lake. This accomplished, a systematic series of probings and diggings over the whole surface of the lake was planned. During this exhaustive examination one soon found that there were places where the thin top crust being the same, the spade or boring-rod found underneath, not more or less sand, as was usual, but a stiff, tenacious, clay-like substance which gave no evidence whatever of having any of the solid sodium sulphate under it. In some places this clay—for analysis afterwards showed it to be clay—was of such a stiff consistency through frost as to render almost impossible the driving of an iron rod more than two or three feet down. But in by far the larger and more outlying and later examined portion of the "placer" a 10-ft. rod could be driven into the clay or mud without any hard bottom, crystalline or otherwise, being reached.

These results indicated a somewhat serious state of affairs in regard to mass, pointing indeed to much of the area of the "placer" being a mere top crust with no solid underlying stratum of sulphate—hitherto asserted to be "many feet thick, except perhaps at quite the edges of the lake."

Finally, these many probings and some small excavations enabled one to map out, as it were, on the surface of the lake the edge of the only deep and therefore only really valuable portion of the deposit. This area, most carefully surveyed, was found to embrace, not the locally asserted "200 acres of deep soda," nor even the truer superficial area of little over 100 acres, but at the most only six acres! It was not until this limited area had been thus located that any surface indications were discovered which might lead one to guess its existence or to guess that there were in any portion of the lake below its nearly uniform top crust, any such important variations in the character or amount of the solid sodium sulphate as was now found. Guided, however, by the foregoing operations, one could see by slight upheavings in the crust here and there, due to what had been apparently slight risings of subsequently frozen fluid, that a faint top outline of the only valuable deep deposit could be just made out, by the eye, on the surface of the lake.

There could be but one outcome of this discovery. The investigator was obviously compelled to conclude that his quest must, from the commercial point of view, be abandoned. Even assuming the whole of the six acres to be fifteen feet thick, it could soon be consumed by the town of Pittsburgh alone, which is only one of the great glass-making and sodium-sulphate-consuming cities of the United States. For the requirements of Pittsburg in this direction had already been ascertained on the way out to Wyoming, and the writer had been presented with samples of excellent glass made there by help of sodium sulphate.

One naturally wonders how this large mass of sodium sulphate was formed. The exact *modus operandi* of the original formation, including the genesis of the small proportion of carbonate, is for the geological chemists to discuss. Vide Sickenberger, Chemiker Zeitung, November 2 and 9, 1892; also Berichte der Deutschen Chemischen Gesellschaft, January 9, 1893; or Brunner's resumé of these papers in the Journal of the Society of Chemical Industry, February 28, 1893, page 116. The presence of the salt in bulk, however, as in this particular lake and in numerous other places in Wyoming is probably due to the large quantities of sulphate with which the soil is apparently impregnated, becoming dissolved out by the melted winter-snows, and becoming collected in clay-bound or other impervious depressions, where summer evaporation causes concentration and where, therefore, crystallisation eventually takes place. All over the district one sees slight and occasionally very obvious efflorescences of sodium sulphate, while analysis readily reveals it in the soil of such places. Dana's mineralogy has a sentence to the effect that an efflorescence of sulphate and carbonate of sodium occurs near the Sweetwater River, Rocky Mountains, and subsequent accounts support the statement. The few persons residing in the neighbourhood assert that the sulphate comes up from springs, fed from a distance, and adduce as evidence that if a pit be dug in the solid sulphate the hole soon fills up with fluid which, in a short time, becomes solid with what they call the "new deposit." But that result is probably due to the percolations of rain passing through fissures of the bed and becoming saturated with the sulphate which afterwards crystallises out. All the local gossip on these and the other "soda" lakes of this country make especial point of this supposed continuous increase, but no real evidence is yet forthcoming of any general increase of this kind. Such reports mislead the average "prospector." It is true, no doubt, that holes dug in the soda fill up with fluid, and that the latter becomes solid by crystallisation, but this is due in all probability to the cause above suggested, and not to new "soda" brought from below or laterally to the lake in any large quantities. If the latter state of things obtained, the lakes would always be increasing in size, which, from all that can be gathered is not the case. Moreover, in his many sporting walks and hunts for table-game in the neighbourhood of the lake, the writer saw no evidence that water-streams large or small ran into the lake, nor any evidence of what might fairly have been termed springs. There was at one end what apparently was the dry bed of a stream, but every one of the few persons resident in the district agreed that this was a mere channel from the adjacent hills for the melted snows, and not for water gathered from the drainage of subsoil. What one does notice here and elsewhere in Wyoming is frequently occurring patches of white efflorescence varying from a square foot up to an acre. The only tenable view respecting them would seem to be the one stated respecting this lake, namely that the falling rain dissolves the sodium sulphate occurring in the soil and the solution percolates away to the lowest available level, there to evaporate its waters during the drought of the long summers, its salt reappearing as a layer of lesser or greater thickness.

On the return journey to Casper, more careful notice was taken of several of the depressions just mentioned as varying in area from a square foot to an acre, all more or less lined with efflorescent sodium sulphate. Under the efflorescence was sandy loam, but in none of these deposits could be discovered any subjacent vitreous mass of sulphate. The writer passed over or near the "Rattlesnake," "Drago," and "Seminoe," petroleum areas, and rested on one night in an oil-searcher's hut, but gathered nothing further respecting saline lakes, liquid or solid.

At Casper he heard of what purported to be another large deposit or soda-placer some 15 miles north-west from the town, and has since found it marked "Soda Lakes" in red letters, and coloured yellow, on the map already mentioned. On driving over, quite a group of lakes of varying area presented themselves, but before they could be examined in detail a blizzard came on, and the visitors had a narrow escape from spending the night on an utterly desolate prairie, without food, fuel, or shelter, and the thermometer standing round about zero. The few samples that were collected proved to be almost identical in composition with the Soda above described, except that they contained rather less sand.

With regard to the total area of this Casper group of "lakes," time and weather prevented an accurate survey, but the impression given was that the deposits, taken as a whole, were considerably larger than the deposit first examined. After two or three days of delay by snow, Cheyenne, a typical western frontier town, presenting no demand for sodium sulphate, was once more gained. There the Union Pacific main railway was rejoined and Denver soon again reached.

At Denver, hearing that there were at Laramie, distant only twelve hours by railway, more solidified soda lakes which had already been wrought for sulphate, and which, from all accounts, seemed worthy of a visit, the writer forthwith inspected them. These deposits or lakes, three in number, and within a stone's throw of one another, have a combined area of some 130 acres. They lie 15 miles south-west of Laramie City in Township 14 north and range 75 West of the sixth principal meridian. Time only allowed of an examination of their general topographical and physical aspects. Fortunately, however, the chemistry and technology of these Laramie Lakes has been dealt with by Pemberton and Tucker, who visited Laramie in 1888, and who read a short paper on the deposits before the Franklin Institute, published in the "*Chemical News*" on July 14th, 1893. While these investigators were there the lakes were entirely covered with water. This water was due, presumably, partially to leakage from an irrigation canal, which runs at no great distance, and partially to several springs. On the occasion of our own visit in 1891, two of the lakes were entirely covered with water, which was frozen to the depth of about two inches on "Big Lake," and about five inches on "Track Lake." The third, known as "Red Lake," was only partially covered with water, which was not frozen.

It is some few years since these lakes were worked. A short branch line from the Union Pacific Trunk Railway runs down to them, and actually over two of them, for in summer the deposit is evidently quite dry, and would sustain a railway. One of the springs just referred to was said to be "quite pure water having no saline or brackish taste, and, while the lakes were being worked, was used as an ordinary supply for a house that had accommodation for 20 people, built between Red Lake and Track Lake, as well as to feed the boiler of a small engine placed in the building." During our visit verification of these statements was impracticable on account of the severe frost, but there was at least, *in situ*, an iron pipe running from the site of the spring to the neighbourhood of the frame-house mentioned. That this spring should be free from sulphate strikes one as particularly interesting, situated as it is within a few feet of the "soda" deposit. On the occasion of our visit, Red Lake was covered with aqueous fluid to the average depth of six inches. Under this was a crop of loose clear crystals of sodium sulphate averaging eight inches in thickness. In places these crystals had a reddish tinge, from which the lake no doubt derives its name, and which is probably due to some low form of life. Sichenberger, *op. cit.*, says that in the springs supplying certain alkali lakes of Egypt, "on the left bank of the Nile, and about 36 miles from it, and 60 miles from the Mediterranean," there were algæ which, under the influence of sulphuretted hydrogen evolved from the water, became of a red colour. To something of this kind may be due the colour of Laramie "Red" Lake, the more so that in it are numerous veins of black mud, which, on being stirred, give off bubbles of gas smelling strongly of sulphuretted hydrogen.

Close to the railway switching track, which runs over this lake, the crop of clear crystals had been raked up just before the cessation of working, into what might be termed windrows, ready to be shovelled into the freight cars for shipment to the Laramie Alkali works. They showed 99·5 per cent. of pure sodium sulphate. Below this crop of colourless crystals came, as in the Durbin deposit, the vitreous mass of solid sulphate. This is asserted to be in places upwards of 30 feet in thickness, the Hon. Colonel Downie, of Laramie, assuring us that some years ago, while he was interested personally in this property, "by means of a special drilling apparatus the deposit was at last pierced at a depth of 40 feet. In 1876 a block weighing some 6,000 lbs. was quarried out and sent *en masse* to the Philadelphia Exhibition of that year."

There are many vertical veins or sheets of mud, as already mentioned, on this lake. They are especially prevalent at the western end. They vary in width from one to two feet, and an iron rod plunged vertically found no bottom at eight feet, though one could scratch as it were the vitreous mass on either side of the vein all the way down. This mud was black in colour and contained a large number of separate crystals of sulphate. It smelt strongly of sulphuretted hydrogen. It was stated that the veins were much warmer than the surrounding sulphate, but a thermometer showed no appreciable difference during our investigations. No theory has hitherto been offered to account for the occurrence of the veins. Perhaps the whole vitreous mass has cracked from time to time and clay-mud has made its way into the resulting crevasses and given the veined appearance to the surface.

On the following day, the Union Pacific Railway Company, having placed at disposal a special train, the lakes were more quickly reached. Track Lake was covered with hard firm ice about four inches in thickness. Below this, which one had to cut through with an axe for the insertion of one's arm and shoulder, was found some ten inches of fluid, and at the bottom of this again a copious deposit of clear crystals of sodium sulphate, under which judging by one's sense of touch (by this time fairly trained) the solid vitreous sulphate was found as in the other deposits.

The difficulty and tediousness of frequently cutting through five or six inches of hard ice precluded further examination of Track Lake. "Big" Lake, which is appropriately so called, being some 70 acres in area, and thus having twice the superficies of either of the other Laramie Lakes, was under more favourable conditions for investigation as the ice covering it was just sufficiently strong to carry the weight of a man, and yet of such a consistency as to allow an iron rod easily to pierce it. With lower extremities enveloped in long india-rubber boots in order to minimise the unpleasantness of dropping through the ice, one could proceed to thoroughly examine the lake. First a few holes were cut in the ice, and then by means of a scoop the layer of loose crystals as characteristic apparently of this as of the other lakes, was found to be as much as 12 to 15 inches in thickness, and the crystals themselves to be particularly clean and bright. A walk all over the lake, driving the rod through the ice every few yards, always gave the same result, namely, first some two inches of rotten ice, then about a foot of fluid with about the same amount of loose crystals, under which came the solid vitreous mass. In only two of these very numerous probings could be found any variation in these layers. In these two instances no hard mass, and no bottom, could be felt, and the rod came up clayey and smelling of sulphuretted hydrogen as in the case of the mud veins of Red Lake. The taking of some photographs ended the investigation of these Laramie Lakes.

The morning of the next day was devoted to an inspection of the now disused Chemical Works constructed for working the Laramie sodium sulphate. They are situated about a mile from the town of Laramie on the banks of the River Laramie. The Union Pacific main line runs alongside the works, and indeed side tracks from it actually run through the yards.

Here was a complete, though not of course the most modern, plant for the manufacture of sodium carbonate and caustic soda. The works had not been commercially successful, owing solely, as one was carefully assured, to mismanagement. Within easy distance of Laramie City are large coal, sand, and limestone supplies, and the Union Pacific Railroad Company are prepared to arrange very reasonable rates for freightage east, so possibly the Laramie Lakes have a satisfactory future in store.

Until these saline masses can be dried at a low cost on the spot and the resulting dry salt be conveyed cheaply to glass works, solidified sodium sulphate lakes will continue to be useless, if not mischievous, chemical curiosities.

## Discussion.

The Chairman having invited discussion:

Mr. **David Howard** regarded the existence of large deposits of a substance like Glauber's salt in a state of almost chemical purity as affording a very interesting insight into the power of natural causes in purifying substances, though their usual tendency was to mix everything up together. As an example of careful technical research under very unfavourable circumstances, the paper was worthy of the most attentive study.

Mr. **Wm. P. Thompson** referred to the geological reports on the district issued by Mr. Powell, which treated very fully of what had been called "the curse of the West"—the sodium sulphate. Sulphate was found over an extent of some thousand miles from north to south, in what was known as the "arid belt," where the rainfall was so much less than was necessary for agricultural purposes that the Governmental Department of Irrigation was making reservoirs in the gathering grounds of all the principal rivers running down from the mountains. There were three zones. On the mountains the well-watered lands yielded good pastures, but the cold was too great for the best crops. A little below that the land could be easily irrigated and had all been taken up. Lower still lay the alkali land, which could only be irrigated by large companies or by the Government. Wherever a river was "lost" in the sands or morasses there was found a large deposit of alkali. Such deposits were no doubt due to the large quantities of alkali from decomposed felspar brought down in solution by the rivers and imprisoned in the soil of the plains. In fact, the alkali lands had been extended and vegetation destroyed by irrigating the ground with water from these mountain streams. In addition to the large deposits there was a widespread supply of alkali in the arid region, in the form of a thin efflorescence on the soil, which soon killed vegetation. It was possible, however, to greatly mitigate the disadvantageous effect of the alkali by treating the soil with lime, but the only real cure was underground drainage, carrying off the water saturated with alkali, this water being supplied by irrigation.

Dr. S. Rideal remarked that some years ago he had occasion to visit some of the alkali districts in the United States, and expressed gratification at the graphic manner in which the physiography of the locality visited by the author had been described. He, however, thought there was very little of "chemical industry" in the paper, and took exception to some of the terms employed, such as "aqueous fluid" instead of water.

Mr. W. F. Reid differed from the last speaker as to the importance of the paper to chemists. Though the particular lake under notice might not be of present interest to England, the time might come when such deposits would supplant certain chemicals now produced here at considerable cost. Although he was not able to contribute anything to the general knowledge of these particular districts, he had examined similar lakes in South America which were of greater interest, as the composition of the salts which they contained was more varied. The nitrate deposits on the west coast were remarkable in one respect, inasmuch as they contained very little, if any, potash nitrate. On the east side of the Andes some of the lakes of Argentina, however, contained a considerable percentage of nitre, in the form of both sodium nitrate and potassium nitrate. It was still a mystery why the less soluble salt should be absent from the deposits of Peru and Chili and yet present on the other side of the Andes, where the rainfall was greater. In many districts of Argentina "salinas" were found—shallow lakes, the waters of which were merely brackish in winter, but in summer almost disappeared, leaving a thin crust of salt and a mother-liquor containing magnesium chloride and potassium or sodium nitrate according to the locality of the particular deposit. The utilisation of these lakes was very difficult, owing to the enormous difficulties and cost of transport. As regarded the origin of the material for these deposits, it would be extremely surprising if such lakes were not found. The decomposition of felspathic rocks set free the alkali from the felspar, yielding on the one hand clay, on the other alkaline carbonate, soluble in water. In the pampas of Buenos Ayres one found hundreds of miles of clay deposit derived from the decomposition of rocks. The clay was one of the products: where was the other—the alkali? It was to be found in such places as Dr. Attfield had described, where there was no drainage of water away to the sea.

Mr. H. de Mosenthal mentioned an instance of nature's chemical industry in South Africa. A deposit of nitrate of potash had been discovered in the Preiska district in the Karoo, where the rainfall is very slight and there is no drainage. The nitrate of potash was found in the soil in the valley and among the sparse vegetation on the hillside. Its presence was explained by the existence of an enormous number of rock rabbits which live on the hills, which consist largely of potash shale. In the course of time the nitrogen from the animal deposits had combined with the potash from the shale. The rainfall was sufficient to bring this about and to gradually wash the nitrate of potash down the hillside into the valley, but insufficient to wash it away.

Mr. H. Sefton Jones had also noticed the occurrence of these natural salts in a dry climate, side by side, where one would expect to find them mixed. Most of the country to the east of the Aral Sea and the Syr Daria River was a salt deposit, and the taste of sodium sulphate pervaded everything. Part of the desert was simply clay covered by a thin crust of chloride of sodium, with small lakes almost circular in form, some containing much sulphate of soda, which could be recognised at once by the absence of birds and of vegetation, while the water of others close to them would be pure, or only slightly brackish. It was a very interesting question how these different lakes became so interspersed in a country where there was apparently no division between them, the land being perfectly flat all around. Another striking fact was that wherever human settlements had existed, nitrate of potash was found in the soil.

Mr. W. Macnab drew attention to the difficulty of conducting chemical operations in a district such as had been described, the evaporation of liquids in open pans where dust storms are regular being attended with many drawbacks. In San Francisco one great trouble in connection with the crystallisation of sodium carbonate was the quantity of sand which is blown about, necessitating the use of screens to protect the liquors during evaporation, but which also interfered with the free circulation of the air.

Mr. Richardson thought that the paper was more or less disappointing, but that a satisfactory discussion might ensue. Mr. Reid had pointed the way to a geological solution of the phenomenon, and there was little doubt that his view was correct. If on one side of a continent potash salts were met with, and on the other side soda salts, the waters containing them would be found to come from rocks containing an excess of potash in the one case and soda in the other. Something might be said as to where the sulphur and the nitrogen came from. His suggestion was that the sulphur was derived from pyrites which had oxidised, forming salts of iron, and these coming into contact with free soda the result would be sulphate of soda with a precipitate of hydrate of iron and free silica. If the rock was not saturated with iron a fine white sand would result. He would like to know where the nitrogen came from which was found in South America. Did it come from changes in animal tissues or from the air direct by electric discharges? Where such took place in a dry atmosphere subject to heavy dews nitrous compounds might be formed, and these passing down in the night dews might possibly account for the nitrates in the alkaline solutions.

Mr. W. Crowder thought that the origin of the soda had been explained, but not that of the nitric acid. The only feasible explanation he had ever heard as to the presence of nitric acid in the deposits was that it had some connection with the crowds of marine birds which had frequented these districts. A fact in support of that assumption was that in the guano deposits a large amount of nitrate of potash was found. Another curious fact was that in the nitrate of soda deposits a certain amount of iodine was always found.

Mr. W. Thompson had always understood that the presence of iodine had its origin in masses of seaweed which had strewed on the beach before the land was raised.

Professor J. Attfield said that as it was nearly four years since his son made his investigations in Wyoming, and as both had had many opportunities of discussing the matter since, he was able to reply much as his son would if present.

Referring to Mr. Howard's observations on the remarkable purity of the salts found in the deposits, he would point out that the author made a hole at the lake 12 ft. square in order to reach all salts that might be present, even at the bottom of the deposit, but the quest had to be abandoned when only a depth of 8 ft. had been reached. With regard to the origin of the deposit, their inquiries had proceeded from a chemical rather than a geological point of view; but feeling sure that felspar occurred in the neighbouring mountains, search was made and it was found. With regard to the sulphatic part of the salt, it seemed clear, as indicated by Mr. Richardson, that the oxidation of iron pyrites had much to do with the matter. Native sulphide of iron oxidised fairly easily, and on the product coming into contact with a felspathic alkaline product, such as had been referred to, the formation of sodium sulphate would be a natural result. He would remind Dr. Rideal that the term "aqueous fluid" was often used in some branches of chemistry to promote accurate distinction; in the present case it had been designedly adopted as descriptive of a liquid that was neither water nor a strong saline solution. The same gentleman's general criticism hardly applied; for in a Society like that surely the Publication Committee had rightly accepted reliable information which might save useless expenditure in attempts to utilise such natural deposits. If Dr. Rideal were ever sent on a similar quest he would realise the value of every hint that had been given. As the reader of the paper, the speaker was sure that the additional light thrown on the subject by the discussion that had taken place would more than repay the author for the care he had taken in preparing the paper for the Society.

The Chairman stated that some time back he had made an analysis of an African shale similar to that mentioned by Mr. De Mosenthal, which he found to contain as much as 7 per cent. of potassium nitrate. It was difficult to account for the way in which it got there, as he was informed that the formation from which the sample was taken was some hundred feet thick. Electric action could not account for it, but the suggestion that animal secretions or remains might have something to do with it was much more feasible. Some other African saline deposits he had examined were, he thought, brought down by the river waters running from the mountains. The soda contained in the Wyoming deposits was probably due, as Mr. Thompson had pointed out, to the weathering of albite. The paper had been the means of initiating a very interesting discussion.

# Manchester Section.

Rooms of the Chemical Club, Victoria Hotel.

*Chairman:* R. Forbes Carpenter.
*Vice-Chairman:* Edw. Schunck.

*Committee:*

G. H. Bailey.
F. H. Bowman.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
I. Levinstein.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
W. Thomson.

*Hon. Local Secretary:*
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

SESSION 1894-95.

February 1st.—Mr. J. Alfred Wanklyn and Mr. W. J. Cooper. "Fractional Distillation and its Results."

*Meeting held Friday, 4th January* 1895.

MR. R. FORBES CARPENTER IN THE CHAIR.

## NOTE ON THE FORMATION OF MAGENTA DURING THE DEVELOPMENT OF ANILINE BLACK ON COTTON.

BY R. J. FLINTOFF, F.C.S.

It is well known that various coloured products are obtained by the oxidation of aniline and toluidine, their colour depending on the extent of oxidation. By their partial oxidation, two colour bases para-rosaniline and rosaniline are produced, which combine with acids to form the colouring matter magenta. Should, however, the oxidation be carried further, the beautiful black, known as aniline black results.

The phenomenon I am about to describe relates to a process for the production of one of these colouring matters on cotton, during which the other was also incidentally formed.

Some time ago we had occasion to print large quantities of cotton cloth in a steam aniline black, the pattern being a small peg. After the steaming process, we noticed in one batch, and one batch only, a peculiar pink appearance. The cloth was tinted in some places for a distance of five or six yards a very light pink, producing an effect similar to padding. In others it took the form of blotches, scattered here and there indiscriminately over its surface, and sometimes no trace of it could be found, the cloth being perfectly white.

The aniline black was produced in the following manner:—

The cloth, after bleaching, was printed with a mixture of aniline hydrochloride, para-toluidine, ferrocyanide, and chlorate of potash, thickened with starch, dried in the usual manner, and steamed 10 minutes in a small steamer, without pressure, in loose folds. And it was after this process that the appearance I have just described was noticed. Although many batches were steamed in exactly a similar manner and printed with similar colour, this peculiar appearance was only noticed in one. During the subsequent process of "gassing," that is, passing the cloth through a compartment containing gaseous ammonia, the colour disappeared, but returned again after some time on exposure to the atmosphere or immediately in contact with acid vapours. Soaping and passage through a very dilute aqueous solution of chlorine also removed the colour.

The phenomenon was of such a peculiar nature as to warrant an investigation of the subject. This was the more difficult as the colour at our disposal was exceedingly limited, and as all further attempts to produce it, although apparently conducted under the same conditions, were futile. The possibilities, however, were naturally narrowed, since the only compounds present were the two amido compounds and an oxidising agent.

Accordingly the small black objects were cut away, and the colour extracted from the remainder of the cloth by immersion in an aqueous solution of alcohol, the solution being afterwards concentrated. This solution was entirely decolorised by reducing agents such as acidulated stannous chloride and sulphurous acid, and also by acids, whilst caustic alkali gave a very slight precipitate, which proved to be the rosaniline bases. Aldehyde turned the solution blue.

The remainder of this solution was evaporated to dryness and the residue dissolved in water. In this bath a small quantity of worsted yarn was immersed, and the temperature gradually raised to the boiling point. The yarn became dyed and extracted nearly the whole of the colouring matter from the aqueous solution, leaving the bath almost colourless. The dyed yarn was now carefully tested and the dye proved to be magenta. In order to prove this conclusively, a small portion was diazotised and passed into an aqueous solution of sodium $\beta$-naphthate, when the characteristic brown azo-colour—resulting when magenta is treated in a similar manner—was produced.

The magenta is obviously formed during the steaming process by part of the mixed bases being volatilised and carried through the various folds of cloth along with the steam; during this there must be certain conditions suitable for their partial oxidation, resulting in the formation of salts of rosaniline and para-rosaniline.

It can be readily understood that the different appearances of the fibre are regulated by certain unknown conditions, depending to a great extent upon the different resistances offered by different parts of the cloth to the passage of the volatilised bases. These resistances must of necessity exist owing to the manner of folding and hanging the cloth in the steaming box.

I have mentioned this phenomenon to an old printer who has had a large and varied experience in the development of aniline blacks, and he tells me that he has neither seen nor heard of it. It would therefore appear to be very rare, and to depend upon some peculiar conditions in the steaming, and probably in the printing colour itself. On this account it seemed to me that the subject would be a source of interest not only to chemists engaged in this particular branch of chemical industry, but to chemists in general.

## Discussion.

Dr. C. Dreyfus recommended the author to study Rosenstiehl's researches on this subject, and to read his paper in the Bulletin de la Soc. Ind. de Mulhouse (XLI. (1871), 217), in which, after recording observations similar to those described by the author, he attributed this pink coloration to acid left in the cloth through imperfect washing after bleaching.

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# THE PREVENTION OF SMOKE ARISING FROM INTERMITTENT FIRING IN VARIOUS PROCESSES OF CHEMICAL AND ALLIED INDUSTRIES.

BY R. LE NEVE FOSTER, F.C.S.

The subject of this paper is one which interests not only those engaged in chemical and allied industries where intermittent firing is necessary, but is of equal interest to all who are engaged in manufacturing industries where coal is employed for the production of heat.

My object is to place before this Section the results of a series of observations made on various chimneys with a view of ascertaining whether the emission of black smoke can be minimised, and whether practical means can be suggested to further the work which the Manchester Chemical and Allied Industries Association has begun.

In most chemical operations, the combustion of coal is found to be the cheapest and most suitable means of producing heat; consequently it is to the firing by coal that we must direct our attention, as in these days of keen foreign competition, economy is highly essential if we are to maintain our position as manufacturers.

In regular firing, coal can be used in such a manner as to produce little or no smoke, and thus almost perfect combustion is secured; and, though the products of this combustion when issuing from a chimney would be invisible to the eye, they would consist principally of carbonic acid (with perhaps a small amount of carbonic oxide) and an amount of sulphurous acid proportionate to the quantity of sulphur contained in the fuel.

No unconsumed or uncombined carbon would escape in the form of smoke; thus the maximum heating value of the coal would be secured without the contamination of the air by uncombined carbon.

We must not, however, assume that unconsumed carbon (both free and in the form of hydrocarbons) is the sole vitiator of the atmosphere issuing from a chimney, for the invisible products of even perfect combustion are in themselves large factors in the contamination of the air.

In chemical and allied industrial operations, regular firing is an impossibility, and we have there what is termed intermittent firing, *i.e.*, firing which has to be regulated not only according to the nature of the process, but also according to the various stages of the operation.

No matter what appliances may be employed, or how carefully the fireman may attend to his fires, the process regulates the firing in these varied operations.

In addition to the intermittent firing in the processes, even the firing of steam boilers in this class of works is a much more complex matter than in an ordinary factory.

In a chemical works steam is required with the utmost irregularity, in contrast to an ordinary factory, where a regular and constant supply of steam is used solely for motive power.

Further, in most chemical operations the apparatus or vessel has to be cooled on finishing and before it can be charged for a fresh operation. Then, when heat has again to be applied, the fires have to be started *de novo* in order to heat a mass of cold brickwork and flues, entailing great difficulty in preventing the emission of black smoke at the commencement of each operation.

Again, where a small leakage occurs in distilling operations, which can only be detected during working, the emission of black smoke cannot be prevented till the entire charge is worked off.

It is therefore evident that works where intermittent firing is necessary are at a very great disadvantage as compared with ordinary factories in the prevention of smoke.

In spite of all these disadvantages, I am convinced, from the observations made under my direction, that, while no hard and fast line can be laid down for the emission of black smoke where intermittent firing is necessary, each individual manufacturer can do much by strict supervision and careful construction of his plant.

It is not possible for anyone to advise as to the best means to be adopted, even when knowing the nature of the manufacture carried on, unless fully acquainted with the exact method used, and this one manufacturer is hardly likely to tell another.

It is apparent, however, that in many cases of intermittent firing, much may be done to prevent the emission of black smoke, provided the fireman does his duty.

In addition to what I may term the preventable instances, there are exceptional cases where the "black smoke" is not produced solely from the combustion of coal, as in the making of "black ash," where volumes of smoke necessarily escape—a difficulty which, unless some means of washing or absorbing the carbon be devised, is not to be overcome.

In spite, however, of the utmost care, there are times when, even in well-managed works, black smoke is unavoidably emitted for a longer period than that allowed by the city authorities, though the average of a series of observations in that particular works would be below the allowance.

The Public Health Act, 1875, sec. 91, sub-sec. 7, says:—"The emission of black smoke sent forth in such quantity as to be a nuisance shall be deemed to be a nuisance liable to be dealt with in a court of summary jurisdiction, but the court shall hold that no nuisance is created within the meaning of this Act and dismiss the complaint if it is satisfied that the fire-place or furnace is constructed in such a manner as to consume as far as practicable, having regard to the nature of the manufacture or trade, all smoke arising therefrom, and that such fire-place or furnace has been carefully attended to by the person having the charge thereof."

In different towns there is a remarkable difference in construing what is a sufficient quantity of black smoke to be a nuisance.

Manchester, for instance, fixes 1 minute per half-hour, and, so far as I am aware, makes no discrimination whatever as regards the nature of the manufacture carried on.

Oldham allows 9 minutes per hour.

St. Helens.—A five minutes' continuous emission of black smoke is deemed a nuisance.

Widnes has no fixed time, but, as it stands in a somewhat different position to other towns on account of the peculiar nature of its manufactures, except in very flagrant cases no attention is given.

Rochdale has no fixed limit.

Wolverhampton.—Left to the medical officer of health, and depends upon the situation and height of the chimney and the trade carried on.

Newcastle-on-Tyne.—Five minutes is allowed for the emission of black smoke from factory chimneys before it is deemed a nuisance.

Leeds.—Five minutes in the hour. The average dense smoke from factories in Leeds during the last two years has been two minutes in the hour.

Birmingham.—The inspectors watch the chimney for an hour. They report the way in which the emission is made up, whether continuous or several emissions. The town clerk says he does not remember any summons being taken out against any person where the emissions were not over 15 minutes in the hour. Further, for a first offence, or where a long time has elapsed between offences, letters of caution are sent out.

Sheffield allows 6 minutes in the hour, but, where there are not more than three steam boilers and no furnaces, 4 minutes in the hour only.

Stoke-on-Trent.—If black smoke is emitted for a longer period than 15 minutes proceedings should be taken.

Bolton allows 2½ minutes in the half-hour.

Our Association has caused 1,827 half-hourly observations to be made of various chimneys of our members, and the result of these observations shows that black smoke issued therefrom for 3,224 minutes, an average of 1 minute 46 seconds per half-hour.

### The Manchester Chemical and Allied Industries Association.

*Smoke Observations.*

| Chimney. | Half-hourly Observations. | Total Black Smoke. | Average per Half-hour. | | Coal used per Month. | Highest Emission of Black Smoke. | Number of Times above 1 Min. per 30 Mins. |
|---|---|---|---|---|---|---|---|
| | | Mins. | Mins. | Secs. | Tons. | | |
| No. 1 | 90 | 905 | 10 | 0 | 900 | 43 mins. 20 secs. in 60 mins. | 90 in 90 observations. |
| No. 2A | 85 | 427 | 5 | 0 | 1,000 | 11 mins. in 30 mins. | 83 in 86 ,, |
| No. 2B | 89 | 363 | 4 | 0 | | 11½ ,, ,, | 84 in 89 ,, |
| No. 2C | 25 | 33 | 1 | 20 | | 6 mins. 10 secs. in 60 mins. | 18 in 25 ,, |
| No. 2D | 31 | 42 | 1 | 21 | | 10 ,, 40 ,, ,, | 16 in 31 ,, |
| No. 3 | 92 | 406 | 4 | 25 | 250 | 13 mins. in 30 mins. | 76 in 92 ,, |
| No. 4A | 76 | 7 | 0 | 6 | Not ascertained. | 1 ,, ,, | None in 76 ,, |
| No. 4B | 77 | 10 | 0 | 8 | | 2 ,, ,, | 1 in 77 ,, |
| No. 4C | 59 | 82 | 1 | 24 | | 4 ,, ,, | 29 in 59 ,, |
| No. 5 | 96 | 148 | 1 | 32 | 125 | 4 ,, ,, | 49 in 96 ,, |
| No. 6 | 94 | 174 | 1 | 52 | 400 | 14 mins. 50 secs. in 60 mins. | 56 in 94 ,, |
| No. 7A | 91 | 19 | 0 | 12 | 250 | 9 ,, in 120 mins. | 5 in 91 ,, |
| No. 7B | 92 | 54 | 0 | 35 | | 4 ,, in 60 ,, | 17 in 92 ,, |
| No. 7C | 89 | 2½ | 0 | 2 | | Nil | None in 89 ,, |
| No. 8 | 64 | 64 | 1 | 0 | 120 | 5 mins. 40 secs. in 30 mins. | 27 in 64 ,, |
| No. 9 | 58 | 129 | 2 | 14 | 180 | 23 ,, 40 ,, 60 ,, | 28 in 58 ,, |
| No. 10 | 84 | 43 | 0 | 30 | 160 | 7 ,, 50 ,, 60 ,, | 10 in 84 ,, |
| No. 11 | 33 | 11 | 0 | 20 | 130 | 1 ,, 30 ,, 30 ,, | 4 in 33 ,, |
| No. 12A | 47 | 18 | 0 | 23 | 800 | 8 ,, in 60 mins. | 6 in 47 ,, |
| No. 12B | 46 | 15 | 0 | 19 | | 3 mins. 20 secs. in 60 mins. | 1 in 46 ,, |
| No. 12C | 47 | 79 | 1 | 41 | | 19 ,, 40 ,, ,, | 14 in 47 ,, |
| No. 13 | 36 | 4½ | 0 | 8 | 70 | 30 secs. in 30 mins. | None in 36 ,, |
| No. 14 | 70 | 117 | 1 | 40 | 100 | 10 mins. 30 secs. in 60 mins. | 34 in 70 ,, |
| No. 15 | 57 | 31 | 0 | 32 | 80 | 5 ,, 50 ,, ,, | 11 in 57 ,, |
| No. 16 | 48 | 14 | 0 | 18 | 50 | 3 ,, 30 ,, ,, | 6 in 48 ,, |
| No. 17 | 25 | 7½ | 0 | 18 | 50 | 3 ,, 10 ,, ,, | 3 in 25 ,, |
| No. 18 | 13 | Nil | Nil | | All coke fires | Nil | None in 13 ,, |

To give some idea of the varied nature of firing in a chemical works, I would like to call your attention to No. 7 in the list. This I may say is the works with which I am connected.

We have the following :—Nine iron stills of varying size; three nitric acid cylinders; 57 pots; and two 30 ft. × 6 ft. 6 in. boilers, all served by chimney B, and using from 200 to 230 tons of coal per month.

The steam from the boilers is taken in a most irregular manner, by 11 close steam coils, 14 open coils, 6 injectors, 6 engines, 8 pumps, and 16 steam-jacketed pans. Our record is, I think, not a bad one—an average of 35 seconds black smoke per hour.

This result has been obtained entirely by very careful firing, though at times, with the utmost care, we find it impossible to get below the minimum allowed by the City authorities, and from this result I think that the average of a number of observations should be taken as the criterion as to the care bestowed on firing in a works where intermittent firing is necessary, and that a single observation conveys an erroneous impression, and is unfair. I further find that a great deal depends on the class of coal used.

It has been suggested that an increased number of chimneys would minimise the emission of black smoke, but this would only divide the smoke over a number of outlets without in anywise altering its volume, though apparently it would lessen its volume to the eye.

In the results given, No. 1 chimney has the worst record, but I am not at all sure that if each separate fire instead of ascending No. 1 chimney went up separate small chimneys, there would not be 55 chimneys (for I am told that the smoke of no less than 55 different fires goes into that chimney), which would satisfy the eye of a corporation inspector, though they were polluting the air to a much greater extent than at present.

This opens out a point for consideration, viz., the present unsatisfactory method of inspection. A chimney is watched, and the time during which black smoke issues is noted—no particulars are ascertained as to the height of the chimney or the quantity of coal used.

These are most important factors,—for instance, A and B are two manufacturers, each using 200 tons of coal per month, and each obtains an equal combustion of his coal—A has three chimneys each 40 yards high; B has one chimney 60 yards high; A's smoke never appears black; B's smoke constantly appears black; yet B contaminates the air less than A, as the products of combustion escaping at a much higher altitude are more widely diffused.

The present methods of inspection are extremely fallacious, and in order to fairly estimate the exact combustion in ration to the coal consumed, the proportion of uncombined carbon in ratio to the volume of the smoke should be determined. The height of the chimney, the situation of the works, and the nature of the processes should then guide as to whether the best means were being employed.

I have placed before you a few considerations with respect to intermittent firing, and I think the points which need the attention of all those engaged in manufactures are—

1st. To see that the plant is constructed in such a manner as to consume the coal to the best possible advantage with a view of minimising the emission of black smoke.

2nd. To fire as carefully as is consistent with the processes carried on.

3rd. To consider whether a number of chimneys is advantageous or not.

4th. To devise some method whereby the ratio of unconsumed carbon can be readily gauged in ratio to the volume of smoke emitted and the coal used.

5th. Whether the inspection of chimneys should not be in the hands of a competent Government inspector, who could scientifically ascertain whether or no manufacturers were doing what was reasonably practicable, having regard to the nature of the processes and the care bestowed.

I throw these out as suggestions, and shall be glad of the greatest amount of criticism, as my object is to help as far as possible in a practical solution of the smoke question.

## Discussion.

The Chairman said the interesting paper which they had just heard was the natural sequel to the one read by him at the June meeting of the Section in 1891, which paper arose from the action taken by the city authorities against certain chemical manufacturers in the newly incorporated districts of Clayton and Bradford. The chimney at the works of the late highly esteemed Mr. Christopher James Schofield was then chosen for indictment as a typical case by the Corporation. They would doubtless remember the result of this case, heard before Mr. Headlam, the stipendiary. The action of the Divisional Court (Mr. Baron Pollock and Mr. Justice Day, in the case of Weekes *v.* King, May, 8, 1885) precluded Mr. Headlam from hearing any evidence from Mr. Schofield, as the summons was taken under the *second* sub-section, the qualifying proviso having been held by the court to apply the *first* paragraph only. The Clayton Manufacturers' Association could not succeed, even in the Court of Appeal, in obtaining a mandamus for the stipendiary to hear evidence bearing on the qualifying proviso. It was therefore clear that until Parliament intervened the health authority would issue its summonses so as to exclude evidence under the proviso qualifying the first sub-section only, as held by the Divisional Court, which drew a distinction between a *furnace* and a *chimney*, and manufacturers would be at the mercy of the smoke inspector. It was useless to expect authorities to do otherwise than administer the law as it now stood. That was their duty, though as reasonable men they would put no obstacles in the way of a common-sense amendment of the wording of the clause in question.

He reminded the meeting that in a correspondence in the columns of the "Manchester Guardian" in December 1888 and January 1889, he stated that he had in mind certain operations know as intermittent firing, in which it seemed to him the strict enforcement of the smoke provisions of the Public Health Act would result in manifest injustice to manufacturers. As long as there were cold surfaces of brickwork, smoke *must* follow when bituminous coal was used. It was perfectly true that the admixture of coke with coal had been found to be desirable in every way so long as the price of coke admitted its use.

He could from practical experience bear testimony to the complete efficiency of the Frisbie grate and feeder described in Mills and Rowan's Chemical Technology, Fuel, pp. 527—529, both as a heat producer and smoke preventer, and available for furnace operations where high heats were needed, such as chrome-ore reduction furnaces used in bichrome manufacture. Sowerby Bridge, in Yorkshire, used to be, in the day of the existence of the works of Messrs. W. and J. Norris, a model of what a manufacturing district should be. He saw the efficiency of the Frisbie feeder on black ash and chrome furnaces tested on several occasions, and once Mr. G. E. Davis accompanied him and could add his testimony.

The drawback of it was that the work was harder than ordinary firing, and it required excellent discipline in a work to prevent these machines being strained and purposely put out of order. Another method in use, formerly at a St. Helens work, was described to him for smoke prevention in black ash furnaces: a secondary air supply was taken through the walls of the furnace from the sides of the fire, emerging at the end of the *back bed*. He tried this plan himself once at the *working bed*, and succeed in making some beautiful red burnt balls, through not having control of the heat. He stopped there and did not experiment further. This plan of taking hot air for combustion and smoke produced on top bed before the gases reached the boiling-down pan, was, he was assured on good authority, quite successful.

With regard to the practicability of gaseous firing by gas producers of Wilson type, he knew that this system was in use for tar distilling, when the operation went on regularly day by day; and as no smoke provisions existed in the locality where this work was placed he gathered that the installation of the gas producer was dictated by the superior control of the firing given in this operation. Otherwise, as regards steam boilers and small rectifying still fires, coal was used, and that by no means smokelessly. Also for nitric acid cylinders gaseous firing was a successful operation where it was aided by the nitro-cake being run off liquid, because the free acid continued could be otherwise made available: the cylinder therefore was never really cold.

The question therefore resolved itself rather into one of size of works, where operations of intermittent firing went on with daily regularity. Such an installation where there was ground space for it would probably prove commercially successful, if not directly, yet indirectly in the greater control obtained over the plant.

As regards the third of Mr. Foster's points, he was decidedly against the multiplication of chimneys. One large chimney was more efficient and aided in diffusion of gases at a higher level, though in Mr. Schofield's case it led to his being selected for prosecution by the City authorities.

He should be glad to hear contributions from the meeting on the fourth point raised—it was desirable, if possible; but not only the tonnage but the quality of the coal would need to be taken into account.

As regards No. 5, he had already pointed out that until a rational revision of the wording of Clause 95 in the old Act of 1875 by the only competent authority, *Parliament*, was attained, no other action but that at present adopted by the sanitary authorities need be looked for.

In conclusion, he hoped to hear something from those representing the health authorities and the Manchester and Salford Sanitary Association, which might aid in arriving at a *modus vivendi* on this question, if no complete solution were possible.

Mr. Ivan Levinstein said that if the Act were properly worked, manufacturers would have no reason to complain. The latter did not claim an unlimited licence to turn out black smoke, and be a nuisance to their neighbours. They did all they could to diminish the quantity of smoke from their chimneys; but it should be understood that there were many operations in which the emission of black smoke could not be prevented; and what they wanted was that the authorities should discriminate between cases in which smoke could be prevented absolutely, cases in which it could not be so easily prevented, and cases in which it could not be prevented at all.

Mr. H. Grimshaw agreed with Mr. Levinstein that there were cases in which the emission of black smoke could not be avoided. With regard to the Manchester and Allied Trades Association, on whose behalf Mr. Foster had been speaking, he could entirely bear him out that it was formed for the object of ascertaining the best means of preventing the emission of black smoke, and to show the local authorities that chemical manufacturers were doing all that was possible in this direction. That this was the case was shown by the rules of the Association, which provided that no member should be defended by the Association unless the Committee and an expert approved by them should be satisfied that the member was using the best known available means for preventing the emission of black smoke. No manufacturer had a prescriptive right to emit black smoke; at the same time, there were cases in which black smoke could not be prevented entirely, no matter what means were adopted. A good deal depended upon the quality of coal used; but a manufacturer had to use that class of fuel he could best afford, and which was available. The only efficient method of dealing with the smoke nuisance in absolutely every instance would be to wash out the sulphur impurities and carbon, but this would be too expensive a process. As time went on appliances might be improved, and the present minimum of smoke reduced; but certainly it was not to the real interest of any commercial community to exact from its manufacturers a state of perfection which was commercially impossible.

The Chairman then invited Mr. Councillor McDougall, Deputy Chairman of the Sanitary Committee of the Manchester Corporation, to address the meeting.

Mr. McDougall desired to express his gratification that the chemical manufacturers within the city were making serious efforts to prevent the emission of black smoke from their works. Since the deputation to the Sanitary Committee 14 months ago, there had been an improvement, showing that the manufacturers had not allowed the matter to rest. He believed that there would accrue from earnest efforts to obviate the smoke nuisance similar commercial advantages to those realised years ago, when the emission of chemical gases and vapours into the atmosphere was resolutely dealt with.

Dr. B. W. Gerland said one of the greatest difficulties in the prevention of the smoke nuisance was the use of the so-called Lancashire boilers, which he considered most difficult to manage in the suppression of smoke. He knew of certain chemical works abroad where tubular boilers were used, and where they had no difficulty in keeping down the smoke. It was not the solid particles in the smoke which did the mischief to health, but the hydrocarbon compounds which got on to the lungs.

Dr. Simpson said he might venture to say that his colleagues of the Manchester and Salford Sanitary Association were not so foolish and so unpatriotic as to put hindrances in the way of successfully carrying out chemical manufactures, but they did wish that they should be conducted in such a manner as to cause the least offence to the public and with as little injury as possible to health. It seemed to him that if the members of this Society would exercise their chemical skill in discovering some means for the better combustion of coal than they had at the present time, they would hear less of the smoke nuisance. He thought that it was a sad confession of failure if the present state of things was the best that could be effected.

Mr. Fred Scott (Secretary of the Manchester and Salford Sanitary Association) said he had for some time regarded the Chemical and Allied Trades Association as one of the most powerful allies of the Sanitary Association, inasmuch as its members had exerted themselves to reduce the volume of smoke to a minimum; but a great deal more might be done if manufacturers would go to the necessary expense of additional boiler space. His Association objected to the public health being always treated as a secondary matter and manufacturer's profits of more importance. They were bound to administer the law, and if the law were unjust it was for the manufacturers to get it put right. At the same time, he must give them credit for having done a good deal to minimise the evil. The chimneys of Mr. Foster's own works were a good illustration of this, and if all did as well, there would be comparatively little cause of complaint.

Mr. Foster, in reply, said: If inspectors were appointed by the Government, the law would be more evenly administered all over the country, and it would not be left to the local authorities to prosecute. A smoke inspector should be a gentleman who could advise as to whether the methods they were using were the best for minimising the smoke nuisance.

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## Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
J. Cohen.
T. Fairley.
W. Leach.
W. McD. Mackey.
A. G. Perkin.
C. Rawson.
F. W. Richardson.
G. W. Slatter.
Thorp Whitaker.

*Hon. Local Secretary:*
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

### SESSION 1894–95.

February 4th:—
Communications from the Leather Industries Laboratory of the Yorkshire College:—
1. Mr. H. R. Procter, F.I.C. "A Modified Form of Tintometer or Colorimeter."
2. Dr. J. Gordon Parker and Mr. H. R. Procter. "The Estimation and Numerical Expression of the Colour of Tanning Materials."

March 4th:—
Mr. Carlton B. Heal and Mr. H. R. Procter, F.I.C. "The Examination of used Chrome Tanning Liquors."

April 1st:—
Prof. Hummel and Mr. W. M. Gardner, F.C.S. "The Chroming of Wool. Part IV."
Mr. A. G. Perkin, F.R.S.E., and Prof. Hummel. "The Tinctorial Properties of some Indian Dyestuffs."

# Journal and Patent* Literature.

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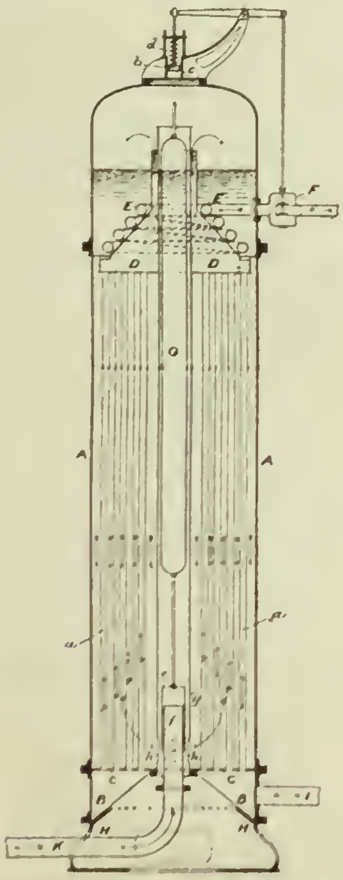
## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Apparatus for Heating Liquids under Pressure.* L. R. L. Squire, London. Eng. Pat. 22,425, November 23, 1893.

The accompanying illustration represents one form of the apparatus, which consists of a vertical iron or copper cylinder A, closed at the top and separated from the chamber B by a perforated plate C. Into the perforations of this plate, tubes *a* are fixed, which open above into the chamber D, surrounded by a steam coil either perforated, or provided with a steam trap. By means of a balance valve F, operated by the piston *b*, working in a cylinder *c*, and controlled by a spring *d*, a regular and automatic supply of steam is admitted. G is a float which opens or closes the slits on the small closed cylinder *f*, and so automatically regulates the outlet of the liquid. Surrounding the float is a tube *g*, fixed into the bottom of the conical chamber, through which it passes and opens above. At the bottom of this tube a number of openings *h* are made, through which the liquid passes from the outside of the tubes to the sleeve valve and outlet pipe K. The liquid to be treated is pumped through the pipe I, into the chamber B, from whence it rises through the tubes into the chamber D, and overflows into the upper portion of the cylinder A, where it is heated to the requisite temperature by the steam coil. The liquid then descends outside the tubes (giving up its heat to the inflowing liquid) through the slits *h* and sleeve valve *f* to the outlet K. In this way the temperature of the fresh liquid is raised by the heat of the outflowing liquid. The float regulates the outlet valve, and therefore the rate of flow through the apparatus, whilst the pressure is regulated by the steam valve and levers working the steam inlet balance cock F. Another modification of the apparatus is given in the specification, in which two cylinders placed horizontally are employed, one containing the tubes and the other the steam coil; the float arrangement being outside the apparatus.—S. P. E.



*Improvements in and connected with Apparatus for Cooling, Solidifying, and Drying Substances in a Liquid or Viscous State.* A. F. Beyer and A. G. Beyer, both of Paris, France. Eng. Pat. 22,736, November 27, 1893.

The apparatus is intended for the treatment of such substances as soap, fatty matters, sweetmeats, sugar, and the like, and consists of a thin endless metallic band encircling two drums, the lower one of which has a number of spiral gutters or channels upon its periphery, and is encircled by a thin metal casing, so that hot or cold air or water can traverse this closed passage. The material is fed on to the band in a thin uniform layer by means of a suitable spreading arrangement, and after being subjected to the heating or cooling fluid as the band wraps round the pulley, it is carried over to the second pulley and deposited into a suitable receptacle, or it may be still further treated by a crushing mill and afterwards passed into a drying-chest containing endless bands, upon which the substance is carried from the top to the bottom of the chamber, and dried by means of an upward current of hot air.—E. G. C.

*Improvements in Apparatus for Drying or Evaporating Viscous, Semi-solid, or other Materials at Low Temperatures.* J. B. Alliott, Nottingham. Eng. Pat. 358, January 6, 1894.

With this apparatus viscous or semi-solid materials may be dried in a partial vacuum, while subjected to heat and to motion, whereby fresh portions are being constantly brought into contact with the heating media and exposed to conditions favourable to the removal of vapour. The apparatus consists of a cask-shaped vessel or drum 1, provided with a jacket 1*a*, and carried at the overhanging end of the hollow shaft 2, which latter is carried in bearings 3, 4, and revolved by the worm 12 and worm-wheel 9. A vacuum pipe 13, carried by suitable glands 14 and 14*a* within the hollow shaft 2, projects into the drum 1, and carries a cotton-wool strainer 21, for preventing dust being drawn into the vacuum pump. Various heating fluids may be circulated through the jacket 1*a*, by way of the inlet pipe 6,

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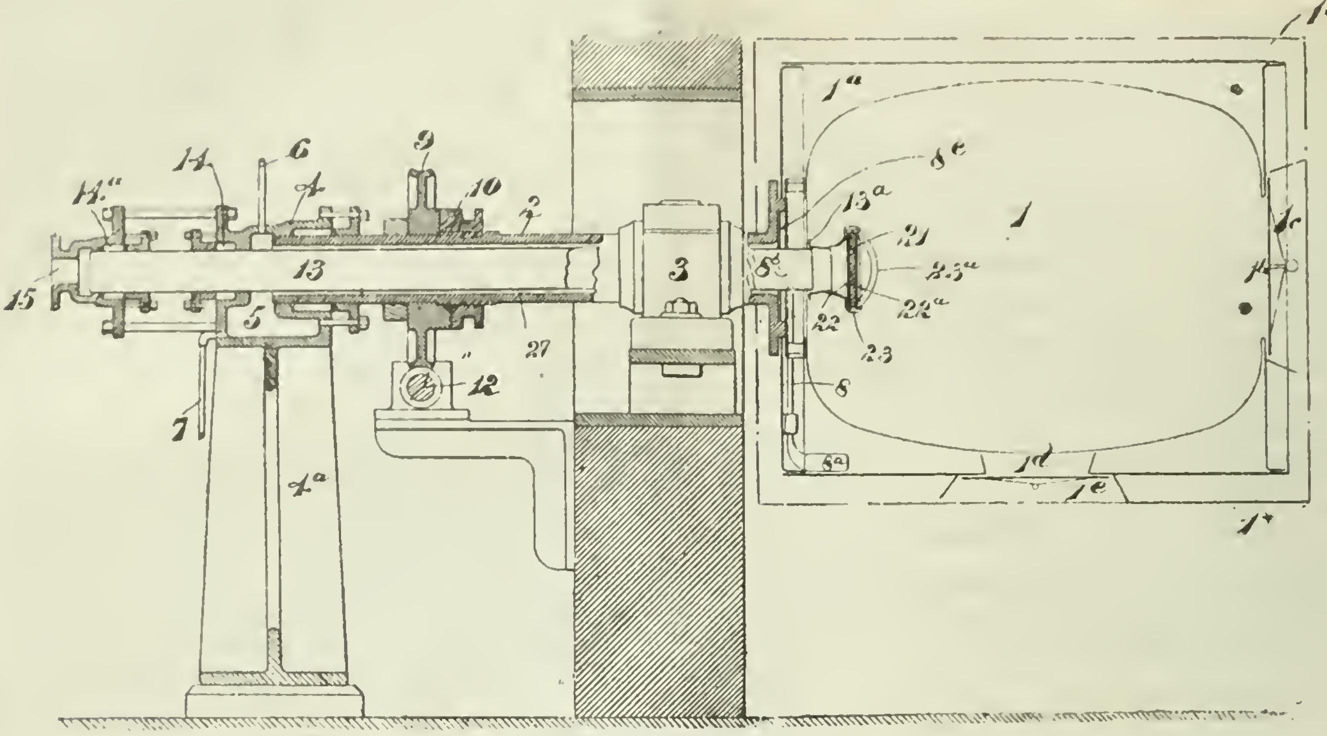
* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

the annular space 27, and the outlet pipe 7. The material to be treated is fed into the drum 1 by a door 1c, and it can be discharged after treatment by means of the door 1d. Steam or other heating fluid may be introduced into the jacket 1a at a pressure below the atmosphere by means of a reducing valve, and afterwards exhausted by an air pump or an equivalent contrivance.—E. G. C.



Drying and Evaporating Apparatus.

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*Improvements in or connected with Apparatus for Drying, Roasting, or Calcining Organic Matter and other Materials.* B. Foster, W. Foster, and B. S. Foster, all of Leeds, Yorkshire. Eng. Pat. 828, January 13, 1894.

Within a cylindrical brick chimney a number of horizontal plates are fixed at regular intervals, and having holes therein in the form of sectors, so that the material can be carried from one plate to another in a downward direction, while subjected to the action of steam, hot air, or gases, injected in at the sides. The holes are arranged spirally to prevent the material dropping straight through, and a central vertical shaft, provided with rotating vanes, keeps the materials constantly in motion from one plate to another, and thereby exposes fresh surfaces to the drying, roasting, or calcining process. The material is fed in at the top, and after traversing all the plates it falls into a receiver at the base.—E. G. C.

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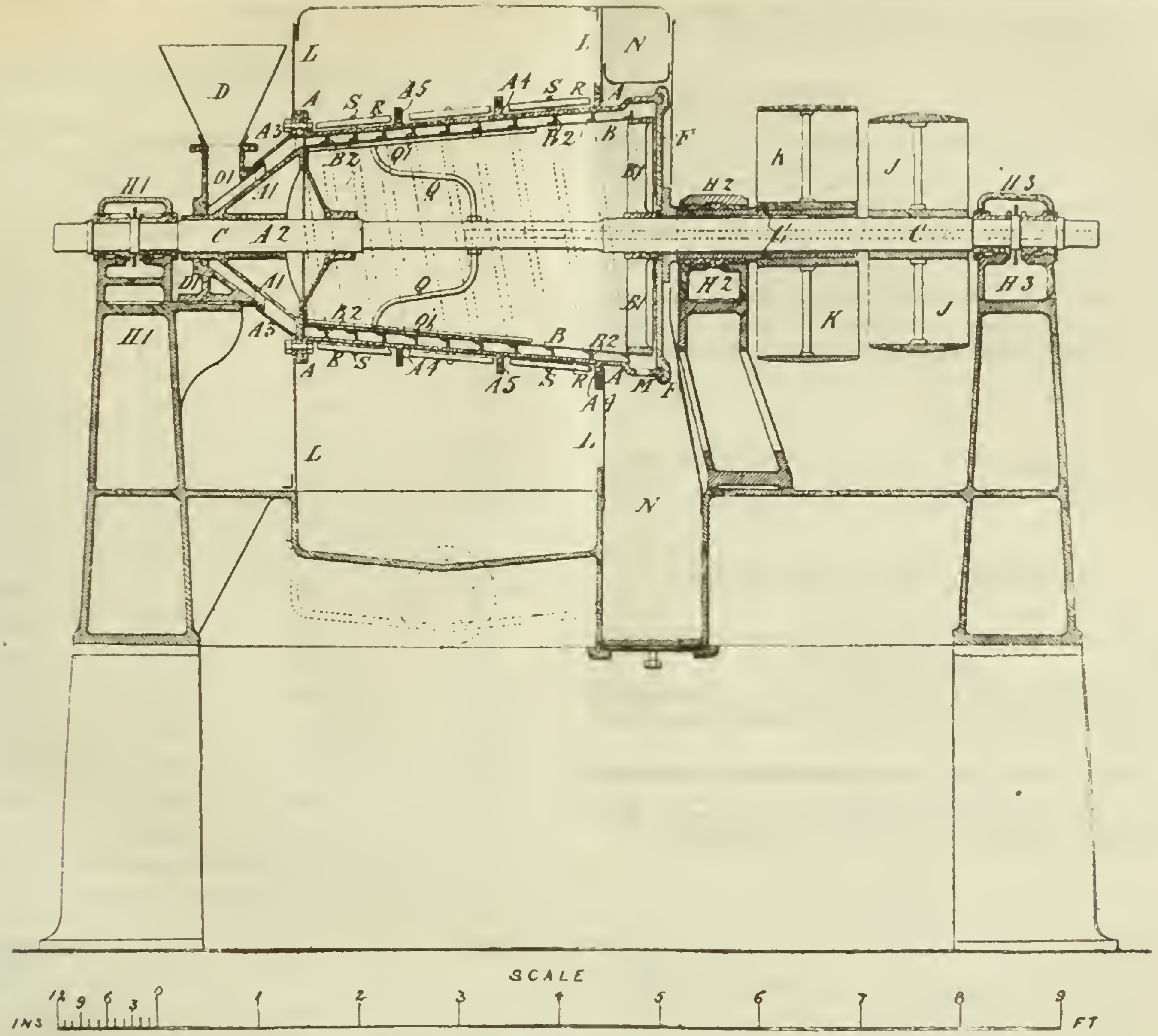
*Improvements in Centrifugal Apparatus for Drying and Purifying Sugar or other Crystalline or Granular Matters.* D. Stewart, Glasgow. Eng. Pat. 1790, January 27, 1894.

This invention relates to the construction, combination, and arrangement of centrifugal apparatus of the kind previously patented by the same inventor (Eng. Pat. No. 13,655 of 1888) with the object of continuously drying and purifying sugar or other crystalline or granular matters.

The following is a description of the apparatus shown in the figure :—The turbine A is placed with its axis horizontal, and within it a hollow drum B is arranged on a central shaft C, leaving an annular space between its outer surface and the inner surface of A. Both A and B are made taper, and the moist material is introduced between them at the smaller end. To ensure the proper distribution of the material under treatment, it is fed from a stationary hopper D into a kind of gland $D^1$ which encircles a cone $A^1$, having fixed to it an outer conical shell $A^3$. Between $D^1$, $A^3$, and $A^1$ there is an annular conical space communicating with the feeding hopper D, and also with the space between the turbine A and inner drum B. The material entering the smaller part of the cone $A^1$ is spread over the cone by the centrifugal action and carried into the space between A and B. On the outside of the inner drum B, helical blades $B^2$ are fixed, their object being to control the movement of the material under treatment from the smaller to the larger end of the turbine A. These helical blades are made of a large pitch at the larger part of A so that the material may move quickly over that part. A is fixed at its larger end by a disc F on a tubular shaft G, through which the central shaft C extends. C and G are supported in the bearings $H^1$, $H^2$, and $H^3$, and each has on it a separate pulley J, K, for a driving belt, J being made smaller, so that the speed of B may be greater than that of A, to allow the action of the helical blades already mentioned. A is preferably constructed of cast brass, turned with the greatest possible accuracy; it is encircled by flanges $A^4$, bound by steel rings $A^5$, the end flanges projecting in such a manner so as to prevent the escape of liquid through the end openings in the casing L, which encloses the turbine and receives the liquid thrown through the walls thereof by centrifugal action. The material being dealt with is delivered at the larger end of A, through circumferential openings M, into a separate compartment N.

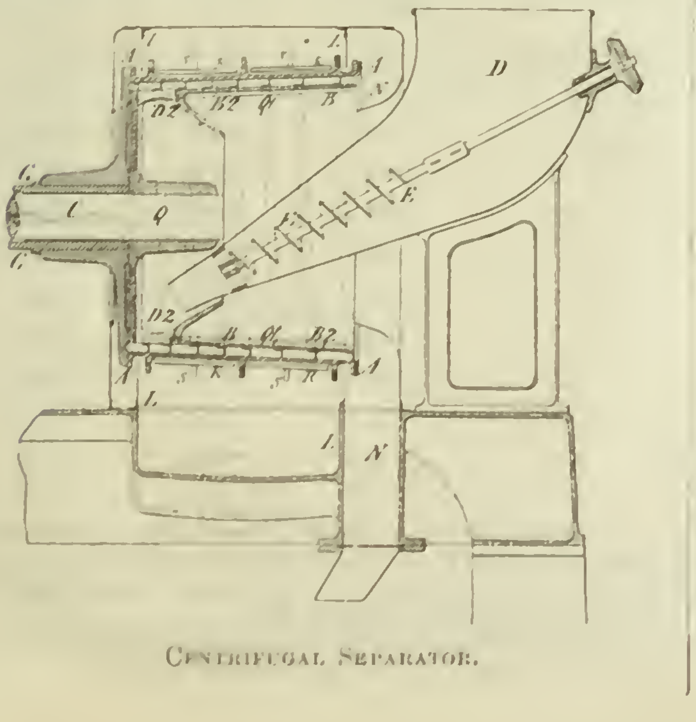
Provision is made for causing a spray of water, with or without steam, or other suitable liquid to act internally on the material undergoing treatment within the turbine; sprays are also directed on the outside of A in order to keep the perforations P (not shown) through the sides of the turbine clear. For the internal spray, liquid is introduced through the tubular part of the central shaft C, whence it is led by branch pipes Q and $Q^1$; whilst for the external sprays, sets of longitudinal pipes R are arranged at a suitable distance from A, and they are perforated so as to direct the sprays upon the turbine. The turbine shell A is preferably perforated.—A. R. L.



Improved Centrifugal Apparatus. —A. R. L.

*Improvements in Centrifugal Apparatus for Separating Liquid and Solid Matters.* D. Stewart, The London Road Iron Works, Glasgow. Eng. Pat. 1962, January 30, 1894.

Two slightly conical drums A and B, keyed on to their respective shafts G and C, are enclosed by a suitable casing L. The shaft G is hollow and encircles the solid shaft C, both shafts being driven at different speeds by suitable pulleys keyed thereon. The inner drum carries a number of spiral blades $B_2$, so that when the material to be treated is fed through the apertures $D_2$ by the conveyor E, it is forced to traverse the narrow annular space between the two drums, and the contained liquid is carried through the perforated shell A by the centrifugal action, into the outer casing L, from which it is led away by a suitable outlet, while the solid matters fall into the pipe N. Sets of perforated pipes R, S, are arranged upon the outside shell A, in order to keep the perforations of the shell clear, and there are also other perforated pipes Q, $Q_1$ within the inner drum for cleaning the solid matters.—E. G. C.



Centrifugal Separator.

*Improvements in Apparatus for Effecting the Absorption of Gases by Liquids and for Cooling Gases.* A. Müller, Berlin, in the German Empire. Eng. Pat. 19,085, October 8, 1894.

In order to effect intimate contact between a gas and its absorbing liquid, the gas is led into a closed chamber containing a layer of the liquid, which latter is atomised by means of a number of perforated buckets attached to vanes arranged spirally upon a rotating shaft, so that only one bucket dips into the liquid at a time. As the buckets revolve, the liquid is picked up and forced by the centrifugal action through the perforated ends, whereby it becomes finely divided, and in that state readily absorbs the gas flowing into the chamber. It is evident that the apparatus will serve for cooling gases by using a suitable liquid. —E. G. C.

*Improvements in or relating to Spatulas, Ladles, and the like.* C. Hildebrand, Biberach, Würtemburg. Eng. Pat. 20,049, October 20, 1894.

The apparatus, which is a combination of spatula and thermometer, is intended for use in boiling and evaporating fruits, juices, sugar, and such substances as require stirring during the operation, and the temperature continually watched. The spatula may be made of wood or any other suitable substance and of any convenient shape. The thermometer is sunk in a groove with the bulb at the distal or bowl end, where a slot through the spatula is made to allow a better contact with the boiling substance. The thermometer is removable for cleaning, and upon the stem various coloured lines are marked to indicate the boiling points of the different substances operated upon.—S. P. E.

## II.—FUEL, GAS, AND LIGHT.

*Welsbach Incandescent Burners.* E. G. Love. Progressive Age, 12, 323—324.

The author gives the results of a series of photometrical tests of six of the latest form of the Welsbach incandescent burners.

Table A shows the results obtained with a carburetted water-gas of 30·5 candle power; two tests being made with each burner, and the supplies of gas and air being adjusted so as to obtain the best illuminating effect.

Table A.

| Burner. | | Consumption. | Candle Power. | Candle Power per Foot of Gas. |
|---|---|---|---|---|
| | | Feet per Hour. | | |
| No. 1 | *a* ....... | 1·968 | 48·74 | 24·77 |
| | *b* ....... | 1·800 | 43·83 | 24·35 |
| No. 2 | *a* ....... | 2·000 | 47·11 | 23·55 |
| | *b* ....... | 1·884 | 44·02 | 23·36 |
| No. 3 | *a* ....... | 1·850 | 44·47 | 24·04 |
| | *b* ....... | 1·870 | 43·10 | 23·05 |
| No. 4 | *a* ....... | 2·000 | 48·66 | 24·33 |
| | *b* ....... | 1·890 | 42·81 | 22·65 |
| No. 5 | *a* ....... | 2·050 | 41·71 | 20·35 |
| | *b* ....... | 2·010 | 38·62 | 19·21 |
| No. 6 | *a* ....... | 2·010 | 44·28 | 22·03 |
| | *b* ....... | 1·980 | 42·13 | 21·28 |

The results set forth in Table B were obtained with a carburetted water-gas of 29 candles, and a mixture of carburetted water-gas and coal-gas of 23 candles. The tests marked (*a*) were with a reduced supply of gas, and the air-supply was adjusted so as to get the best light. Those marked (*b*) were with both gas and air at full pressure; while those marked (*c*) were with the gas at full pressure, and the air-supply so regulated as to give the greatest illumination.

Table B.

Carburetted Water-Gas = 29 Candles.

| Burner. | | Consumption. | Candle Power. | Candle Power per Foot of Gas. |
|---|---|---|---|---|
| | | Feet per Hour. | | |
| No. 1 | *a* ....... | 2·14 | 43·81 | 20·47 |
| | *b* ....... | 2·46 | 43·33 | 17·61 |
| | *c* ....... | 2·48 | 46·83 | 18·88 |
| No. 2 | *c* ....... | 2·07 | 49·05 | 23·70 |
| | *b* ....... | 2·35 | 39·82 | 16·95 |
| | *c* ....... | 2·47 | 51·75 | 20·95 |
| No. 3 | *a* ....... | 2·23 | 47·35 | 21·23 |
| | *b* ....... | 2·53 | 42·67 | 16·87 |
| | *c* ....... | 2·52 | 44·15 | 17·52 |
| No. 4 | *a* ....... | 2·20 | 50·00 | 22·73 |
| | *b* ....... | 2·62 | 44·63 | 17·04 |
| | *c* ....... | 2·67 | 56·16 | 21·03 |
| No. 5 | *a* ....... | 2·44 | 45·91 | 18·82 |
| | *b* ....... | 2·79 | 44·56 | 15·97 |
| | *c* ....... | 2·81 | 48·01 | 17·08 |
| No. 6 | *a* ....... | 2·13 | 40·83 | 19·17 |
| | *b* ....... | 2·31 | 33·35 | 14·44 |
| | *c* ....... | 2·34 | 46·39 | 19·82 |

Mixed Gas = 23 Candles.

| Burner. | | Consumption. | Candle Power. | Candle Power per Foot of Gas. |
|---|---|---|---|---|
| | | Feet per Hour. | | |
| No. 1 | *a* ....... | 2·46 | 40·84 | 16·60 |
| | *b* ....... | 2·90 | 41·70 | 14·38 |
| | *c* ....... | 2·93 | 44·23 | 15·10 |
| No. 2 | *a* ....... | 2·36 | 47·42 | 20·09 |
| | *b* ....... | 2·78 | 47·42 | 17·06 |
| | *c* ....... | 2·78 | 49·10 | 17·66 |
| No. 3 | *a* ....... | 2·39 | 43·74 | 18·30 |
| | *b* ....... | 2·75 | 41·24 | 15·00 |
| | *c* ....... | 2·76 | 49·74 | 18·02 |
| No. 4 | *a* ....... | 2·44 | 52·67 | 21·58 |
| | *b* ....... | 2·89 | 48·13 | 16·65 |
| | *c* ....... | 2·88 | 54·37 | 18·88 |
| No. 5 | *a* ....... | 2·82 | 46·17 | 16·37 |
| | *b* ....... | 3·07 | 43·51 | 14·17 |
| | *c* ....... | 3·07 | 47·43 | 15·45 |
| No. 6 | *a* ....... | 2·38 | 43·14 | 18·12 |
| | *b* ....... | 2·45 | 32·97 | 13·46 |
| | *c* ....... | 2·45 | 43·29 | 17·67 |

The results given in Table C were with a carburetted water gas of 30·4 candles, and show the effect of change of pressure on the burners. The air-supply was adjusted in each test so as to give the best light.

The pressures were taken by a gauge placed below the burner, and while the burner was being used.

Table C.

| Burner. | | Pressure. | Consumption. | Candle Power. | Candle Power per Foot of Gas. |
|---|---|---|---|---|---|
| | | Inches. | Feet per Hour. | | |
| No. 5 | a .. | 0·8 | 1·61 | 28·59 | 17·76 |
| | b .. | 1·4 | 2·15 | 49·84 | 23·18 |
| | c .. | 2·2 | 2·71 | 54·61 | 20·15 |
| No. 6 | a .. | 0·8 | 1·26 | 14·41 | 11·44 |
| | b .. | 1·4 | 1·73 | 40·03 | 23·14 |
| | c .. | 2·2 | 2·15 | 49·88 | 23·20 |

The author mentions that these results were obtained under the most favourable conditions.

The tests recorded in the foregoing tables show that the Welsbach burner, in its present form, develops an unusual amount of light per foot of gas consumed. Its efficiency depends upon the degree of intensity to which the mantle is heated, and anything which lowers this temperature naturally results in impairing the efficiency of the burner. Hence, the introduction of an unnecessarily large amount of air to the Bunsen flame is detrimental.

### *Variations of Temperature in Gas-Holders.* W. Leybold. J. f. Gasbeleuchtung, **37**, 653—656.

The author carried out a long series of observations, extending from June 1893 to June 1894, on the temperatures of the gas in a gas-holder of 312,000 cub. ft. capacity. The readings were taken daily at 8 a.m. and 2 p.m., and very often more frequently, the temperature of the surrounding air being simultaneously taken by means of a thermometer placed near the gas-holder and about 5 ft. above the ground. Short series of experiments were also made with hourly readings during the very hot and the very cold weather. The results are given in a series of curves.

In the observations taken at 8 a.m., the difference between the temperature of the gas and that of the surrounding air was generally very slight, except that, in midsummer and in the coldest winter weather, the gas was slightly warmer (4—8° C.) than the air. The gas was only once or twice observed to be colder than the air, and then only when there had been a sudden rise in the temperature of the latter.

At the 2 p.m. observations, the conditions were quite different. The temperature of the gas was then almost always higher than that of the air. The difference was least on dull and overcast days, and greatest in bright, sunny weather, in which the difference rose to as much as 36° C. Thus in March, with an atmospheric temperature of 10°—11° C., the gas had a temperature of 36° C., and in July the temperatures were 31° and 67° C. respectively. The temperature of the gas even reached a maximum of 72° C. When the gas was at these high temperatures a temporary clouding over of the sun was accompanied by a great fall in the temperature of the gas, a fall far in excess of that of the air.

These results show that between sunset and sunrise the temperature of the gas in the holder closely follows that of the surrounding air, but that as soon as the sun has risen so as to form an appreciable angle with the horizon, the temperature of the gas begins to rise above that of the surrounding air, even although there is no visible sunshine. The excess of the gas temperature over that of the surrounding air is greater the higher the altitude of the sun and the brighter the sun's rays, the maximum excess being reached at mid-day on bright, sunny days in June, July, and August.

This effect is due to the iron (of the holder)—of low specific heat and of a colour favouring the absorption and radiation of heat—readily absorbing the heat of the sun's rays, and transmitting it to the gas, which also has a low specific heat.

Though the holder gas varies thus in temperature, the temperature of the gas at the outlet from the holder only varied during the year between 9° and 14° C., and was very close to the temperature of the water of the holder well. The passage through the outlet pipe surrounded by water is thus sufficient to cool or heat the gas to nearly the temperature of that water. The temperature of the iron of the holder varies (between winter minimum and summer maximum) at least 80° C.—L. T. T.

### *Non-Carburetted Water-Gas for Lighting Purposes.* H. Strache. J. f. Gasbeleuchtung, **37**, 637—641.

The author points out that while the old Fahnejelm comb and Auer (Welsbach) mantle were useless for ordinary lighting purposes, the improvements recently effected in their construction have rendered them available. Perhaps the greatest difficulty in the use of water-gas for incandescent lighting has been the presence therein of traces of iron-carbonyl, as the resulting deposit of iron on the mantle destroyed its illuminating power in a few hours. This iron-carbonyl is removed, however, if the water-gas be purified by passing it through concentrated sulphuric acid. The importance of this purification is shown by trials made. The life of a Fahnehjelm comb was increased from 15 hours with impure water-gas to 300 hours with the same gas purified by means of sulphuric acid. With the Auer mantle the effect was still more marked, purification of the gas increasing the life of the mantle from about seven hours to over 400 hours.

| Burner. | No. of Lights to give 1,000 Candles. | Light per Burner in Candles. | Consumption per Hour per 1,000 Candles. | Consumption of Incandescent Bodies per Hour. | Cost per Hour of the Incandescent Bodies consumed. | Total Cost per Hour. | Heat evolved per Hour (Calories). |
|---|---|---|---|---|---|---|---|
| Water-gas: | | | Cub. Ft. | | d. | d. | |
| Fahnehjelm comb. .... | 28 | 36 | 158 | 0·280 | 1·4 | 5·6 | 14,000 |
| Auer mantle VA....... | 36 | 28 | 82 | 0·072 | 1·8 | 4·0 | 7,250 |
| ,, IVB ..... | 20 | 50 | 71 | 0·010 | 1·0 | 2·9 | 6,256 |
| ,, IVB ..... | 10 | 100 | 51 | 0·020 | 0·5 | 1·9 | 4,500 |
| Carburetted, cold ..... | 53 | 19 | 300 | .. | .. | 16·4 | 16,000 |
| Coal-gas: | | | | | | | |
| Flat flame ............ | 67 | 15 | 266 | .. | .. | 22·3 | 47,000 |
| Argand ............... | 42 | 24 | 238 | .. | .. | 20·0 | 12,000 |
| Regenerative ......... | 5 | 200 | 141 | .. | .. | 11·9 | 25,000 |
| Auer mantle .......... | 17 | 60 | 48 | 0·034 | 0·85 | 4·9 | 8,500 |
| Electricity: | | | Watts. | | | | |
| Incandescent ......... | 53 | 19 | 2,650 | 0·053 | 0·65 | 25·5 | 3,710 |
| Arc.................. | 0·8 | 1,200 | 800 | 0·080 | 0·1 | 7·6 | 1,728 |

In view, therefore, of the use of water-gas, and incandescent lighting having become practicable, the author has carefully compared the cost and advantages of this method of illumination with those now in use. The results for an illumination equal to 1,000 standard candles are given in the table on page 17, in which all expenses—such as interest on and depreciation of plant, renewal of burners, &c.—are taken into account in each case. The calculations are based on the following (Vienna) prices of materials :—1,000 ft. of water-gas, 1*s.* 9*d.*; ditto of coal-gas, 5*s.* 7*d.*; Fahnehjelm comb. 5*d.*; Auer mantle, 2*s.*; 1 kilo. benzene, 10*d.*; 100 watts electric current, 0·9*d.*; incandescent lamp, 1*s.*; carbon for arc-light, 1¼*d.*

Under the Vienna conditions and with the high price of coal-gas, the advantage is thus very greatly with the use of water-gas and the Auer (Welsbach) mantle, and even if the cost of coal-gas were reduced to one-half, the advantage would still be marked. A further improved form of Welsbach mantle just coming into use should give yet more favourable results. There is, however, one drawback to the introduction of water-gas in the need for the pipes being glazed or tarred internally to prevent the production of iron-carbonyl. It is, however, possible that piping systems which have been some time in use would be sufficiently coated with tarry matter, &c., to prevent the action of the carbonic oxide on the iron.—L. T. T.

## PATENTS.

*Improvements in Liquid Fuel, and in Means or Apparatus Employed in the Manufacture thereof.* F. E. Baron and C. C. Fry, Hampton Wick, Middlesex. Eng. Pat. 21,926, November 16, 1893.

The ingredients of the liquid fuel of the patentees are—

| | Parts. |
|---|---|
| 1. Suitable petroleum or like hydrocarbon oil...... | 80 |
| 2. Water ........................................ | 60—80 |
| 3. Soap of the character commonly described as a masked soap or a petroleum soap. | 4½ |

The petroleum employed is also described as "ordinary commercial petroleum oil" and as "petroleum oil of low value"; while as to the saponaceous matter employed, the inventors state that, though they have obtained their best results with Lever Bros.'s "Sunlight" soap, they do not confine themselves to this material.

"The quantity of water, if it exceeds or falls short of the range of proportion given, has not been found to produce the desired result."

The liquid fuel is conveniently manufactured by injecting the petroleum, by means of a steam jet, under the surface of the greater part of the water, in which the soap has been dissolved. The solution may be contained in any suitable vessel, fitted with a condensing arrangement returning any water escaping as steam during the manufacture. The steam furnishes the necessary agitation and temperature (202°—212° F.).

The temperature should not exceed 212°, or unsatisfactory results will ensue, but otherwise, upon proper admixture, "a change takes place and all frothing subsides, leaving a greenish transparent liquid, which is ready for use."

As to its use, the patentees state that "the improved fuel may be burned in a suitable receptacle, in a suitable sheet or body constantly supplied, and with a properly applied natural draught."

The composition, manufacture, and use of the fuel are all claimed.—E. R. B.

*Improved Fuel for Domestic and Steam Purposes.* F. McNamee, Dublin. Eng. Pat. 22,169, November 20, 1893.

The manufacture of compressed-fuel blocks, by submitting certain mixtures to a high temperature and then to pressure, is described and claimed.

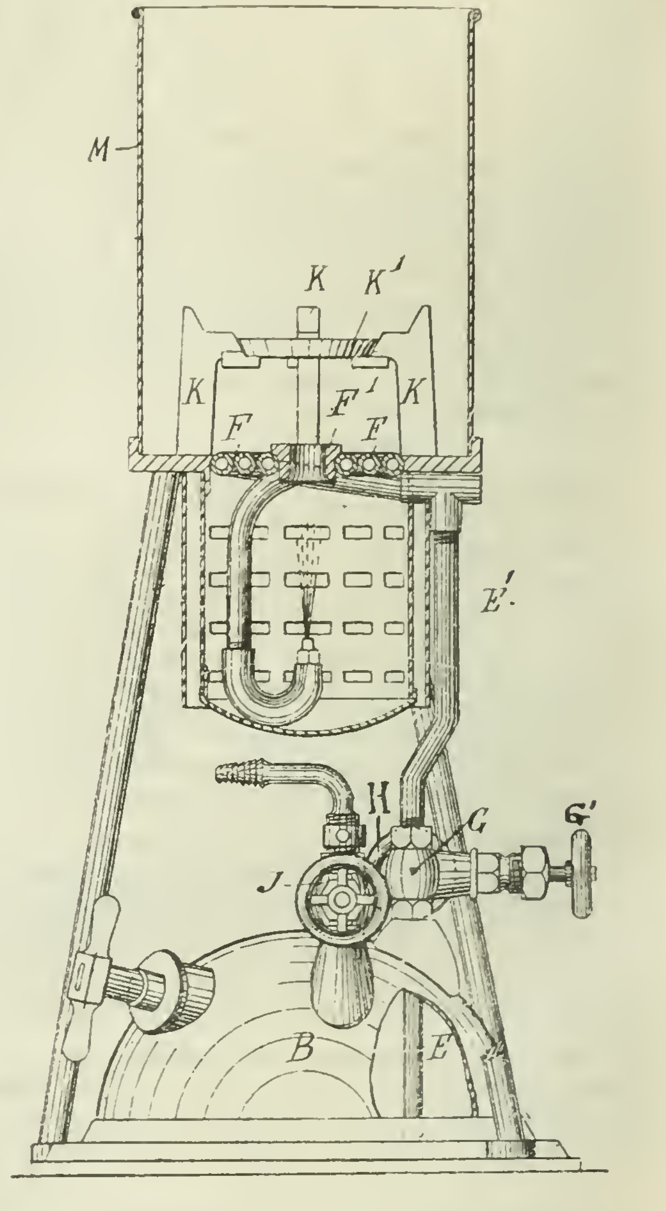
The mixtures are composed of any, or all, of the following substances :—Crushed raw limestone, dried peat, coal-slack, marl or clay, shale, pitch, tar, waste oils, naphtha, paraffin, or other extract of peat.—R. B. P.

*Improvements in or relating to Oil Furnaces.* F. Tyers, Carrington, Nottingham. Eng. Pat. 22,497, November 23, 1893.

This patentee has further improved his oil furnaces, described in Eng. Pat. 16,036 of 1888, and now employs the construction shown in Fig. 1.

When the furnace is in operation, the oil, which lies in the reservoir B under compressed air, passes by E, G, E¹ to the horizontal vaporising coil F, F, and thence to the burner. The framing K carries a removable grating K¹, while M is a removable protective cowl. The foregoing arrangement is that employed where metal pots, vessels, &c., are to be heated; but when a long and fierce flame is required—*e.g.*, for heating articles which cannot be conveniently placed in the furnace, and for brazing and like purposes—then the arrangement shown in Fig. 2 is employed, where L is a cylindrical casing with asbestos lining L¹.

Fig. 1.



There are claimed, besides the foregoing general arrangements, the following novelties :—

1. *The sleeve* F¹ (Fig. 1) is to have a diameter such that the pressure of the vapour coming from the jet is partially checked, otherwise the latter is liable to extinguish itself when the upper part of the stove is open.

2. The end of the *compression-pump* (A, in Fig. 3) has an upper and a lower valve chamber, the two being connected by a short vertical passage. The lower chamber communicates with the cylinder of the pump and is closed by an ordinary check-valve, while the upper chamber communicates with the reservoir and is closed by a screw-down

valve D, operated from the outside. By this arrangement, after sufficient pressure has been obtained in B, all pressure may be taken off the check-valve and leakage thus effectually prevented.

Fig. 2.

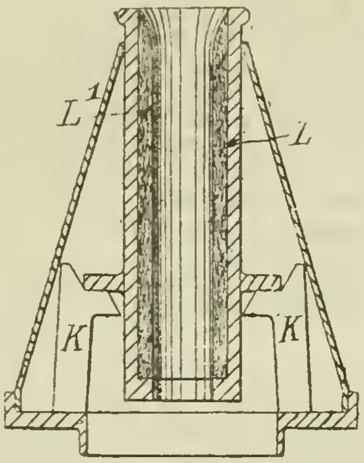
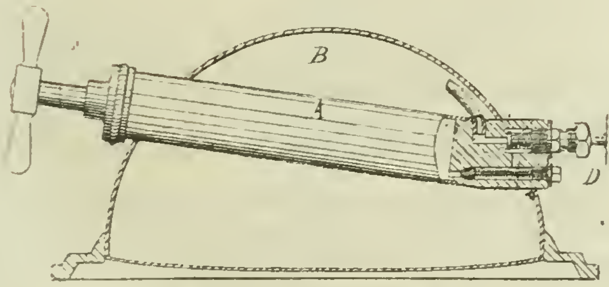


Fig. 3.



Improved Oil Furnace.

In order that the compressed air in B may be utilised for general purposes, such as testing leakages in pipes, &c., the inventor adds the cock and union J (in Fig. 1) and a pressure-gauge (not shown).

3. The *control of the liquid hydrocarbon* is effected in the following manner:—

Figs. 4 and 5 are median vertical sections through G, in Fig. 1; Fig. 4 being in the plane of the paper, while Fig. 5 is at right angles to it and passes through H. From Fig. 4 it will be seen that the passages leading from the reservoir and to the coil, respectively, communicate with a common chamber, in which works the screw-down $G^2$, operated by $G^1$ (Fig. 1). By approximating $G^2$ to its seat less hydrocarbon passes to the burner.

Fig. 4.

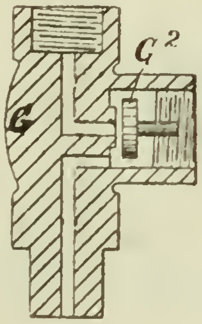
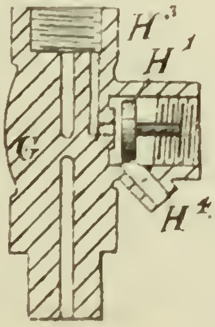


Fig. 5.



When, upon ceasing work, the supply is entirely cut off by $G^2$, there still remains hydrocarbon in $E^1$ and in the coil; this, if allowed to remain, would give rise to smoke and nuisance. It can be drawn off by the drain-cock (see Fig. 5), where $H^1$, operated by H (in Fig. 1), can permit the passage of the hydrocarbon, by $H^3$ and through $H^4$, to the exterior. $H^4$ is, of course, always in free communication with the atmosphere.—E. R. B.

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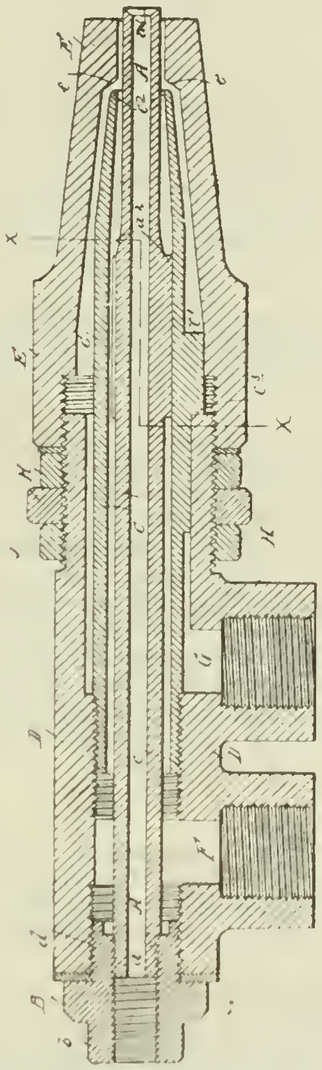
*An Improved Burner or Sprayer for Burning or Spraying Coal Tar or other Liquid Hydrocarbons.* Bertram Haworth Peacock, Mortlake, Sydney, New South Wales. Eng. Pat. 23,162, December 2, 1893.

The inventor's apparatus is illustrated in longitudinal section by Fig. 1, Fig. 2 being a section at *x x*. It consists essentially of three tubes, A, C, and D (carrying respectively air, tar, and steam), and a specially adjustable nozzle E. Tar and steam, under constant pressure, are supplied at F and G; air being usually sucked through A by the escaping fuel, though the inventor claims to employ also "a constant pressure of heated or other air in lieu of or in addition to" the steam pressure.

Fig. 1.



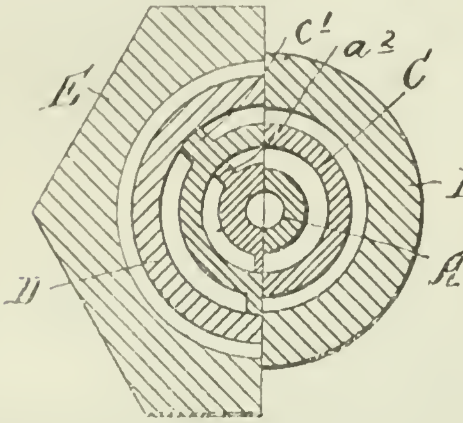
The following appear to be the more important of the novel features of the apparatus:—

1. The tubes are maintained concentric by the six wings $c^1$ and $a^2$ (Fig. 2).

2. The adjustment of the parts is accomplished as follows: D is fixed, and all other parts are screwed to it. A is adjustable at *a* by operating the nut *b*, or removable at *d*

by operating the nut B; C being adjusted at *c* and E at $c^3$. H is a back nut for permanently preserving the adjustment of E when this is once arrived at.

Fig. 2.



3. The regulation of the tar and steam supplies is effected in the following manner:—The surface $c^2$ at this end of C is bevelled, while the surface *e* of E is so bored that it constitutes a valve seating. Upon screwing E backwards or forwards the space between *e* and $c^2$ may be diminished or augmented with great accuracy, and thus the volume of steam and its effective pressure controlled. This effective pressure of the now escaped steam is also the sole regulator of the volume of tar delivered at the orifice of *c*; for, it will be remembered, the tar is, normally, tending to escape here, impelled by constant back pressure, and if the pressure of steam be increased the quantity of tar passed will be decreased and conversely. These peculiar regulating structures constitute three of the patentee's five claims.—E. R. B.

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*Improvements in Apparatus for the Utilisation of Petroleum and other Combustible Fluids as Fuel in Furnaces.* J. C. Hudson, London. Eng. Pat. 23,178, December 2, 1893.

This apparatus consists of a burner in which a jet of the oil fuel is met at an angle by a jet of air, or superheated steam, and thereby reduced to a fine spray. The stream of oil-spray and air, or superheated steam, is injected into the furnace and there ignited. The apparatus is illustrated as applied to a steam fire-engine. The arrangement of oil-spraying apparatus is hinged for moving out of the way of the ordinary fire-hole. Moreover, besides an arrangement for supplementing the compressed air by "live steam" when steam has been raised in the boiler for spraying the oil, the compressed air in the oil reservoir, by a further arrangement, may be supplemented by water from the fire-pump when the engine has been started.—R. B. P.

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*Improvements in the Composition of Oils for Feeding Vapour-burning Lamps.* La Compagnie Internationale pour l'Exploitation des Procédés Adolphe Seigle, Lyons, France. Eng. Pat. 24,955, December 28, 1893.

Vapour-burning lamps are defined by the patentee as those in which the combustible fluid, after circulating in channels heated by the lighting flame itself, arrives at the burner in the state of vapour.

Although excellent luminiferous effects are obtained with these lamps, their use is attended by the grave inconvenience that the metallic heating passages become clogged with deposits, arising from the dissociation of the hydrocarbons of the oils employed. This is especially the case with "coal-oils," while "petroleum and schist oils" are only dissociable with difficulty. On the other hand, the former has "about twice" the illuminating power of the latter.

Ascertaining the temperature of dissociation of the different oils, and taking into account the phenomenon of the mechanical drawing over of non-vaporised portions of liquids of higher vaporising point by the vapours of liquids of lower vaporising point, which are formed in the first instance, and bearing in mind the lowering of the maximum vaporising temperature of a given mixture, which is the direct consequence of the said phenomenon, the patentee has been able to make mixtures of oils, such that, for each mixed oil, the maximum vaporising temperature is found to be lower than the minimum temperature of dissociation of the most readily dissociated of its ingredients. Thus, he mixes 50 per cent. of "ordinary petroleum oil" with a "coal oil," which commences to dissociate at 260° and which distils at 210°—300° under $1\frac{1}{2}$ atmospheres pressure, and finds that the maximum temperature of vaporisation of the mixture is about 220°, under like pressure. Such mixtures make no deposits in the lamp passages and give flames almost equally as luminous as are those of coal-oil.

The patentee claims both the method detailed above and the improved compositions of the oils.—E. R. B.

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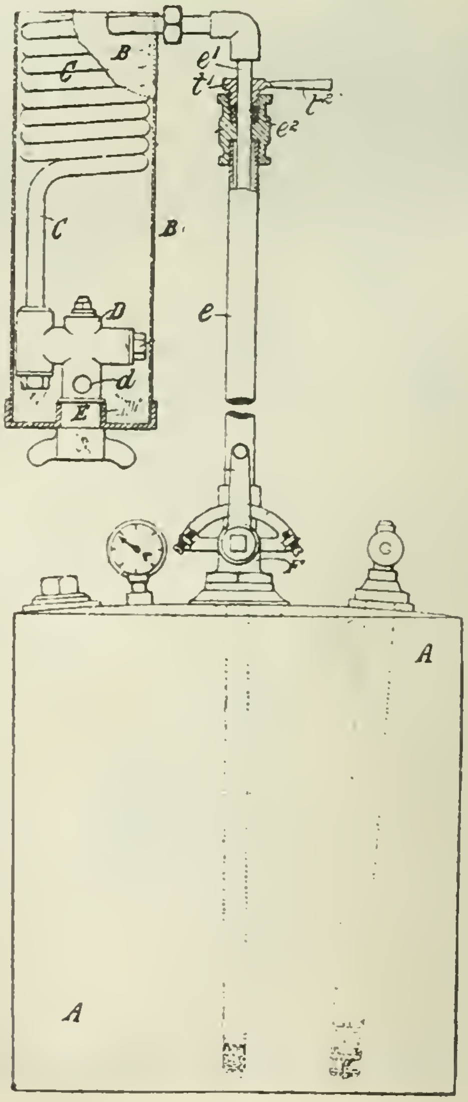
*Improvements in Apparatus for Vaporising and Burning Hydrocarbons for Lighting and Heating Purposes.* The Gas Lighting Improvement Company, Limited, London, and A. H. Crockford, Dartford, Kent. Eng. Pat. 235, January 4, 1894.

In the apparatus of the patentees, which is illustrated by Fig. 1, the hydrocarbon contained in the reservoir A, is forced by pressure up the stand pipe *e*, and through the coil C to the burner D. During its passage through the heated coil the hydrocarbon is vaporised.

The following are the principal novelties claimed by the patentees:—

1. The air necessary for combustion enters through the apertures *d* of the hollow stem E of the burner, and impinges against the hot walls of the casing B; it cannot

Fig. 1.



therefore impinge directly on the jet of vapour, with the consequence of cooling, and, in windy weather, extinguishing the jet. This is often the case with the vapour lamps hitherto constructed where the air enters through apertures in the casing.

2. The cock F is so constructed that either oil or a blast of the compressed air, supernatant to the oil in the tank, can be sent through the coil and burner; the air-blast is useful in cleansing the lamp.

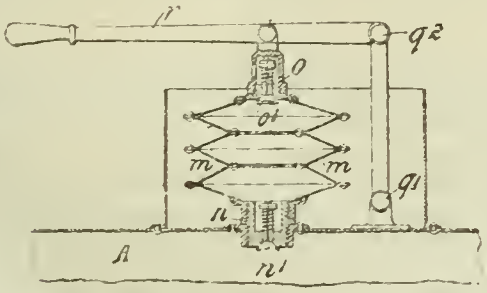
3. Raising or lowering the lamp is accomplished by moving up or down the telescopic extension $e^1$ of the stand-pipe $e$, and upon screwing down the nut $t^1$ by means of the handle $t^2$, the india-rubber ring $e^2$ is compressed and fixes the extension at any desired height; moreover, this arrangement effectually prevents leakage at the joint.

4. Solids suspended in the liquid hydrocarbon, are removed by an asbestos plug filter in F; by a similar arrangement in the horizontal part of D, they are removed from the gaseous hydrocarbons.

5 The peculiar air-pump or bellows of the patentees shown in Fig. 2, is constructed of annular pieces, $m$, of sheet steel or other suitable metal, joined together in pairs alternately around their inner and outer edges. The lower casting $n$, which contains the spring valve $n^1$, is screwed into the top plate of the reservoir A; the upper casting contains the valve $o$, which admits air into the bellows. By operating the lever and link mechanism, $r$, $q^2$, $q^1$, the bellows are alternately expanded and caused to collapse.

—E. R. B.

Fig. 2.



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*Improvements relating to the Burning of Hydrocarbons for Heating and Lighting Purposes, and to Apparatus therefor.* F. B. Hill and R. D. Brett, both of London. Eng. Pat. 1231, January 19, 1894.

The object of this invention is the production, with the consumption of only a comparatively small quantity of hydrocarbon, of a very hot flame, suitable either for heating or illuminating purposes, which is unaccompanied by the noise usually created by such burners. The liquid hydrocarbon is first volatilised in an annular chamber heated by the flame from the burner. It is fed into this chamber under a small head, set up either by gravity or any other suitable means. A pipe conveys the vaporised hydrocarbon downward to the first mixing chamber, which consists of a conical or bell-mouthed piece of pipe. This. in turn, leads to one end, also bell-mouthed, of an inverted siphon tube forming a second mixing chamber. The pipe from the vaporising chamber enters the wider end of the first mixing chamber for a short distance, leaving an annular space between the two, through which air is sucked in by the hydrocarbon vapour passing through the tube into the first mixing chamber. The same happens at the point where the smaller end of the first mixing chamber enters the bell-mouth of the second one. The other end of the inverted siphon forming the latter, passes into a flat cylindrical box, in which the vaporising chamber is situated. The upper surface of this box is perforated in a suitable manner to allow the vaporised hydrocarbon and the air, which has been sucked in and intimately mixed with it in its passage through the mixing chambers, to burn in a series of jets, when ignited.

To enable the apparatus to be used as a source of light, a perforated hood, or mantle, formed of magnesium slag, or other suitable material, is placed over the jets. This mantle is rendered incandescent by the burning jets, and furnishes the required light. A chimney of mica or other suitable material may be used when the apparatus is so employed.—R. B. P.

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*Improvements in or relating to Coke-Ovens.* A. J. Boult, London. From F. J. Collin, Dortmund, Germany. Eng. Pat. 12,467, June 27, 1894.

This invention relates to an improved method of constructing coke-ovens, such as are described in Eng. Pat. 4205, 1893 (this Journal, 1893, 746). The improvements consist in the arrangement of parallel flues, two by two, in such a manner that they pass separately, without any partition, through the wall of the oven, so that the gases mingle together only in the channels below the oven walls, thus heating conjointly the hearths of two adjacent ovens. A damper is fitted to control the admission of gas into the lower end of the upper wall flues. A second improvement consists in arranging the horizontal and vertical wall flues in such a manner that the middle wall of the oven contains only vertical channels, whilst the two outer end walls have only horizontal channels in them, or only one upper and one lower horizontal channel connected to each other by vertical heating chambers. The oven is adapted either for making coke alone, or for also producing tar and ammonia.

—R. B. P.

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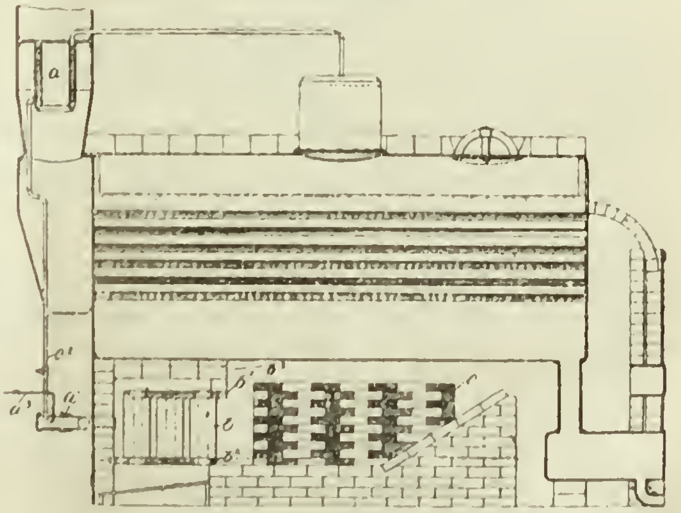
*Improvements in and relating to Regenerative and other Furnaces.* S. M. Trapp, Maywood, co. Cook, Ill., U.S.A. Eng. Pat. 13,761, July 17, 1894.

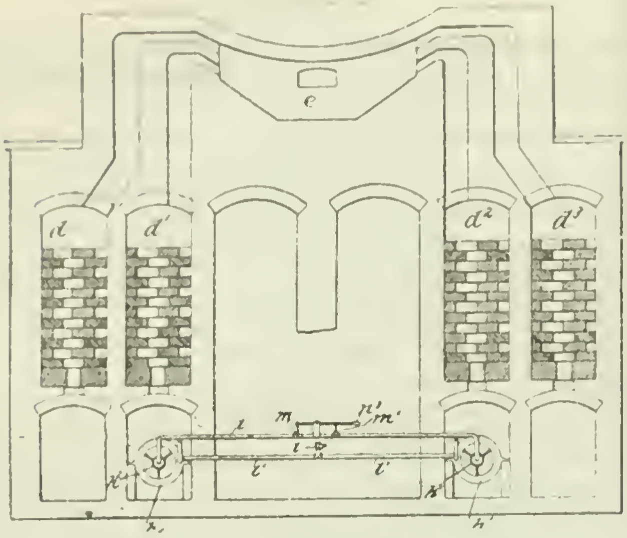
The object of this invention is to enable furnaces to be heated by the combustion of gas produced from oil, in such a manner that heat which would otherwise be lost is utilised. Fig. 1 illustrates its application to a steam generator. Steam, from the generator itself, is superheated in the coil $a$, by the waste products of combustion, and then passes to the mixing chamber $a^1$, where it mingles with the oil issuing from $a^3$. The mixing chamber divides into two branches, which enter the fire-box. The mixed jet of oil and steam strikes against highly heated hollow cylinders $b$, which are made of refractory material, and arranged between two plates, $b^1$ and $b^2$, also of refractory material. Making the cylinders $b$ hollow serves a double purpose: firstly, the air entering the fire-box passes through them, and is thereby highly heated; and, secondly, this flow of air through them prevents them being burnt out. The products of combustion, after having passed round the cylinders $b$, flow through the checker-work $c$, which absorbs heat and conducts it to the boiler. Fig. 2 shows the application of this invention to a hearth furnace. The regenerating chambers $d$, $d^3$, may be put in communication with the smoke stack or the external air, whilst $d^1$, $d^2$, may be sealed or thrown open to the stack; all four communicate with the hearth. $h$ and $h^1$ are the steam superheaters, concentric with which are the mixing chambers $h^2$, $h^3$. In the latter the oil and steam

Fig 1.



ducts meet to produce a spray. The chamber *d* is opened to the air, $d^2$ and $d^3$ opened to the stack, and $d^1$ sealed. The left-hand oil apparatus $h^2$ is started, and the mixed spray of oil and steam from it passes upwards through the heated checker-work, where it is converted into gas. The latter enters the hearth, where, meeting heated air from the chamber *d*, it burns. The products of combustion pass first through the chamber $d^2$ and heat the checker-work therein, and then round the superheater. At the end of a run the action is of course reversed.—R. B. P.

Fig. 2.



Improved Regenerative Furnaces.

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### *Improvements in Self-generating Oil-Gas Burners and Furnaces applicable for Lighting or Heating Purposes.* J. Johnston, Dundee. Eng. Pat. 17,623, September 17, 1894.

In this apparatus oil is poured into a cylinder containing a valved spring piston by which the oil is forced through a needle-valve and into a descending coiled tube carrying the jet. To start the fire a little oil is forced through the jet and allowed to fall on the bottom of the containing vessel, where it is lighted and begins to heat the jet and coil, so that in a short time the oil in these is vaporised and issues from the jet as a gas. Above the flame is fixed a furnace in which soldering bolts, &c. may be heated, and the whole is in a portable form.—C. S.

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### *Improvements in Illuminating Apparatus for Burning the Vapour of Mineral Oil.* La Compagnie Internationale pour l'Exploitation des procédés Adolphe Seigle, Lyons, France. Eng. Pat. 18,679, October 2, 1894.

This patent claims important constructions modifying the large portable hydrocarbon burners used for supplying light during engineering operations, &c. carried on by night.

In most existing apparatus the oil reservoir serves as a base and the burner is carried at the top of a long vertical pipe, and for lighting, cleaning, or adjustment purposes can only be reached by means of steps arranged along a stay, or by having the vertical pipe jointed at some point, so that it can be bent down, or by constructing it with telescopic joints.

To avoid these inconvenient arrangements the inventor provides the reservoir with trunnions resting in a frame, so that at will the reservoir may be tipped into an inclined position, thus bringing the burner within easy reach. The frame may be mounted on rollers, for convenience of transport. Inside the reservoir the vertical tube is continued by a flexible metal tube ending with a heavy leaden ring, so that its end is always kept under the surface of the liquid, whatever the position to which the reservoir may have been tipped —E. R. B.

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### *Improvements in Atmospheric Gas Burners.* T. Fletcher, Warrington, W. Russell, Pendleton, and Fletcher, Russell, and Co., Warrington. Eng. Pat. 18,896, October 5, 1894.

The improvement consists in the interposition, in the tube lying between the mixing tube and the burner nozzles, of a partition or diaphragm perforated by slits of about one-sixteenth of an inch in diameter. The diaphragm may be either directly below the nozzles or at a distance from them in order to prevent the slits becoming clogged by falling dirt. This arrangement forms a safety chamber, preventing "lighting back" and the explosions that are likely to occur on lighting and extinguishing the burner.—C. S.

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### *An Improved Mantle for Incandescent Gas Lamps.* M. Epstein, Stolberg, Germany. Eng. Pat. 19,864, October 18, 1894.

A cylinder for gas glow-lights of fluted glass rods of star section, fixed side by side perpendicularly in a frame, the flutings thereby gearing in one another like the teeth of cogwheels, so as to form a circular shell surrounding the glow-light.—C. S.

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### *A New or Improved Process for Manufacturing Bodies which are to be raised to Incandescence.* O. Tiegs, Berlin. Eng. Pat. 20,735, October 30, 1894.

Lime or calcium carbonate is dissolved in hydrochloric or other suitable acid, and ammonia may be added to the solution, which is used, either in a saturated state or somewhat diluted, to impregnate suitable absorbent materials, which are then calcined or burned; after which treatment they are capable of "assuming a high state of incandescence and giving an intense white light." The light may be coloured by the addition of suitable salts.—E. S.

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## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### *Bitumen from Park County, Montana.* W. C. Day and A. P. Bryant. J. Franklin I. **138**, 149—152.

The sample examined was of a brownish-black colour, liquid enough to flow very slowly at ordinary temperature, and possessed a pronounced and unpleasant odour. The following is the result of the analysis and also that of a sample of Trinidad asphalt for comparison:—

| —— | Trinidad.* | Park Co., Montana. |
|---|---|---|
| Water | .. | 6·76 |
| Carbon | 85·89 | 79·81 |
| Hydrogen | 11·06 | 9·29 |
| Oxygen | 0·56 | 0·62† |
| Nitrogen | .. | Trace. |
| Sulphur | 2·49 | 2·83 |
| Ash | .. | 0·69 |
| | 100·00 | 100·00 |

* Bowen, analyst. † By difference.

The above figures are only approximately comparable, since those for the Trinidad material are calculated on the pure and dry asphalt, exclusive of earthy and foreign organic matter. The sample contained 95·00 per cent. of bitumen soluble in carbon bisulphide, 4·99 per cent. of foreign organic matter (fragments of birds' feathers, leaves, insects, &c.), and 0·276 per cent. of material insoluble in carbon bisulphide. The portion soluble in $CS_2$ was treated with gasoline, and the percentage of petrolene, amounting to 80·00, was thus determined. Of the sample, 0·74 grm. was distilled from a flask by the direct heat of a Bunsen flame; considerable frothing took place until the temperature reached 98° C. (the thermometer being placed with the bulb in the vapour), and 2,250 cc. of gas were given off. The distillates obtained were as follows:—

| | Grms. |
|---|---|
| Between 98° and 110° C. | 6·75 |
| „ 110° „ 170° C. | 2·3 |
| „ 170° „ 225° C. | 8·75 |
| „ 225° and limit of thermometer | 22·5 |

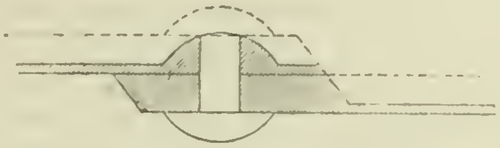
Between 98° C. and 225° C. only 1,000 cc. of gas were given off, but with the last fraction a considerable increase in the evolution took place, amounting to 2,500 cc., thus making a total yield of 5,750 cc. This gas on burning proved to be a good illuminant. A number of tests for aromatic hydrocarbons yielded negative results.—S. P. E.

*Notes on the Distillation of Coal-Tar.* H. Köhler. Zeits. angew. Chem. 1894, 513—516.

1. *Causes and Prevention of Corrosion in Tar Stills.*—It is well known that wrought-iron stills corrode mostly in the upper parts, where they do not come in contact with the tar, but are exposed to the action of the distillation products. When the interior of a tar still, which has been worked for several years, is subjected to close examination, it will be found that up to the height of the usual charging line, but little action, if any, has taken place; the dome, however, will have suffered considerably, more especially at the points where the mountings have been riveted to the top. The iron being more exposed in those parts, condensation of the vapours takes place, the resulting liquid flowing down the walls of the still. The corrosion of the iron is therefore not due so much to the impingement of the vapours as to the passage of the condensed liquid. The same destructive action is noticeable in wrought-iron condensing worms, the distillate, as it flows down the condenser gradually cutting a groove into the iron, extending along the entire length of the worm. From the nature of this groove, which was found to resemble a quill in size, it is inferred that the corrosion is mainly brought about by the "first runnings" fraction, which comes over in a very thin stream. As the distillation of the tar proceeds, the fulness of the stream increases, so that if the grooving were due to higher boiling fractions it would require to be of larger dimensions. This view is strengthened by the condition in which the stills and condensers used for the redistillation of the heavier oils, *e.g.* anthracene oil, are found. These, after many years' working, fail to show signs of corrosion to any appreciable extent. As further proof of the correctness of this assumption the author mentions the following incident:—Two horizontal stills of similar origin, each holding a charge of 125 hectolitres, were worked for five years. One was used for the distillation of tar down to pitch and the other for the dehydration of tar for a special purpose. Although the bottom plates of the former required certain repairs during this period, the latter stood well during the whole time; suddenly, however, the top seams began to leak to such an extent as to necessitate the stoppage of the still. It was then found that the thickness of the dome plates had been reduced from 12 mm. to 3 mm. The rivets had apparently not suffered, but on closer examination it was discovered that the corrosion of the rivet heads had gone on in the same proportion as that of the plates, the action having proceeded with such regularity as to retain the shape of the rivet head (see Fig. 1).

A soft black film 3 to 4 mm. thick had been deposited on the corroded plates. On ignition in a platinum crucible it burnt with a smoky flame, emitting a pitchy odour, and leaving a large dark-coloured residue which was found to consist of ferric oxide and a small quantity of carbon. On extracting the original substance with hot benzene and dissolving the residue in dilute hydrochloric acid, a greenish-yellow solution was obtained, from which ammonia separated a blackish-brown precipitate, whilst potassium ferricyanide and ferrocyanide gave bluish-green and deep blue precipitates respectively. The substance would therefore appear to be a ferrosoferric oxide present in the form of an easily soluble hydrate. Analysis gave the following numbers:—

Fig. 1.

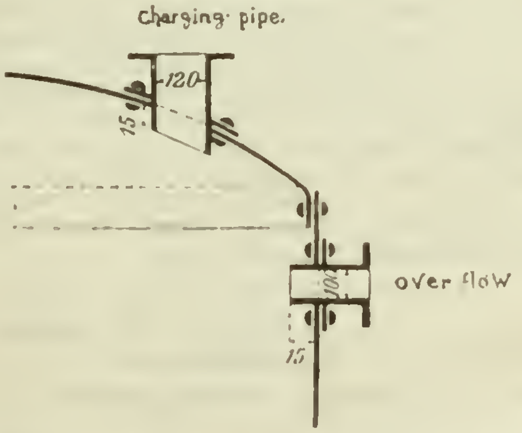


| | |
|---|---|
| Moisture and tar constituents soluble in benzene | 18·16 |
| Free carbon | 42·15 |
| $Fe_3O_4.H_2O$ | 39·40 |
| | 99·71 |

The first runnings obtained in the distillation of tar consist of light oils and ammoniacal water. The former contain aromatic hydrocarbons, phenols, and organic bases, all of which are known to exercise no corrosive action on iron. It is, however, different with the ammoniacal water. This contains, besides ammonia, hydrogen sulphide and carbonic anhydride, which are all capable of dissolving iron. The external appearance of the ammoniacal water affords additional proof of the fact that to its presence must be ascribed the chief cause of the corrosion. The red coloration of the liquor, which increases in intensity with the progress of the distillation, is undoubtedly due to interaction of dissolved ferric oxide and ammonium thiocyanate, which latter passes over with the aqueous vapour.

In dealing with the methods of preventing this corrosive action, the first thought which suggests itself is the dehydration of the tar prior to its introduction into the still. This operation is, however, attended with practical difficulties not easily surmounted, especially in the case of some kinds of tar, and it was therefore sought to adopt means to prevent the distillate from flowing down the walls of the stills. Attempts made in this direction have given highly satisfactory results. Instead of riveting the charging pipe and other connections to the external part of the dome, the author proposes to allow the pipe to enter the still to a depth of about 15 cm., as shown in the annexed Fig. No. 2. He also recommends protecting all mountings with a suitable non-conducting covering.

Fig. 2.



2. *Spontaneous Ignition in the Manufacture of Disinfecting Powders.*—These powders, which are known in commerce as carbolate of lime, are prepared by mixing slaked lime with crude carbolic acid or carbolic oil. They are manufactured on a large scale in tar distilleries by

slaking lime with one-third its weight of water and treating the resulting powder with crude carbolic acid. The mixture is then passed through a sieve. It represents a dirty brown powder, which, after storing for some time, assumes a bright red colour, due to the formation of corallin. Although the red colour is insisted upon in most contracts for the sale of the powder, it is of little value as indicating the disinfecting properties of the same. The reddening of the powder cannot, however, always be relied upon, and for this reason colouring matters are frequently added. It is also known by tar distillers that the formation of the red colour is facilitated by treating the slaked lime whilst hot with carbolic acid. The author has prepared large quantities of disinfecting powders in this way, but on a recent occasion it was noticed that a mass of powder which had been stored for 48 hours, was still sending out clouds of steam as freely as at the commencement of its preparation. On turning the mass over it suddenly took fire. The bottom and sides of the wooden box in which it was kept, had been charred to a considerable extent. It is very probable that but for the discovery of this incident a fire might have resulted, the cause of which it would have been impossible to explain.—D. B.

### *The Employment of Quicklime as a Substitute for Caustic Soda in the Refining of Kerosene.* Chem. Zeit. **18**, 1424.

Quicklime having recently been used instead of caustic soda in the refining of burning oil at several Baku refineries, the question of its economy and suitability was raised and relegated to a special commission, which reported that of the two methods of applying the quicklime practised in Baku, that of treating the distillate with this substance before the addition of sulphuric acid is unadvisable as entailing a waste of reagents and deteriorating the quality of the oil. The alternative method is to mix the lime—which has been brought into a finely-divided state by careful slaking—with the distillate, after removal of the "sludge acid," in an agitator in quantities varying between 3 per cent. in the dry summer months and 5 per cent. in winter. This difference, attributed to the varying percentage of moisture in the lime, probably depends more on the temperature, as the amount of moisture is affected rather by the manner of slaking and length of storage than by the atmospheric conditions prevailing at the time of using. Unfortunately, owing to the scarcity of fresh water, the oil is not washed between the acid and alkali treatments, except by Nobel, who brings water as return freight in his tank steamers.

The lime, being less effective towards the kerosene acids, requires more time than caustic soda, the soaps taking two or three days to subside, and about 0·05 per cent. of caustic soda must be added to ensure their complete removal, or an inferior burning oil of bad colour results. One member of the commission, referring to the researches of Lissenko and others on the insolubility of these lime soaps, attributes this unfavourable effect to dissolved quicklime itself.

The only saving appears to be in the reduction of the cost of the reagent per pood of petroleum from 3 roubles (for 72 per cent. NaHO) to about 0·29 kopeck. The drawbacks are: increased difficulty of manipulation, diminished production both in point of time and absolute percentage of oil, the loss of burning oil being, as nearly as can be ascertained, 5 per cent., compared with $2\frac{1}{2}$ per cent. lost by the soda process. The commission therefore concluded that the use of lime is scarcely suitable for the conditions at present obtaining in Baku.—C. S.

### *Disinfecting Value of Pine-Tar.* W. Adolphi. Pharm. Zeit. 1894, **39**, 429.

*See under* XVIII. C., *page* 57.

### *Disinfecting Action of Guaiacol.* J. Kuprianow. Centralbl. f. Bakteriol. 1894, **15**, 933 and 981.

*See under* XVIII. C., *page* 57.

### *Testing So-called Prepared Tar.* G. Lunge. Zeits. f. angew. Chem. 1894, **15**, 450.

*See under* XXIII., *page* 77.

## PATENTS.

### *Improvements in the Treatment of Tar, and in obtaining Useful Products therefrom.* J. H. W. Stringfellow, London. Eng. Pat. 736, January 12, 1894.

The tar, say, 1 ton weight to be treated, is put into a suitable vessel and about 1 per cent. of an alkali or other saponifying agent is then added and the compound well mixed with 1 ton of water. Before the water has time to separate from the tar, about one-fifth of a ton of petroleum oil of sp. gr. 0·820 is added and slowly stirred into the tarry compound until the free oil becomes of a reddish colour. It will then be found that the compound has been separated into three parts, namely:—(1) A red oily extract of light gravity, not miscible in water; (2) a substance of soft unctuous pitch, containing some water and resembling Stockholm pitch in appearance and general characteristics; and (3) a discoloured watery liquor. While the separating action is progressing, the light oily extract and the water can be drawn from the vessel, so as to promote the exudation from the pitch which remains in the vessel. After a certain point of separation has been attained, the exudation of oil from the pitch proceeds very slowly, and, moreover, the last oily extract appears to be of a heavier character; hence it is desirable to draw off the liquid after the stage of rapid separation has terminated and then again after the slow stage has ended. The pitch is now removed to a press to express as much free oil and water remaining in mechanical suspension as may be desired. If the compound of tar, water, and oil is taken directly after mixing and before separation has begun, it may be thoroughly mixed with an earthy matter consisting of 1 ton of dried powdered clay and 4 cwt. of dry powdered lime, to form an asphalt corresponding approximately to the natural asphalt used for paving and other purposes. The solid residuum may also be pressed into blocks and used as fuel, for gas-making or for firing and other purposes. As these solid compounds contain all the benzene and naphtha of the tar, if desired, a proportion of the volatile matters may be driven off by heat in the usual manner. The red liquor may be treated in stills in the usual way to obtain the various constituents.—D. B.

### *Improvements relating to the Carbonising of Wood for the Production of Charcoal and in the Utilisation of the Products given off in the Process of Carbonisation.* T. Hill Jones, London. Eng. Pat. 1485, January 23, 1894.

It is proposed to conduct the carbonising process, to save cost of carriage of the wood, at, or in proximity to, the site of growth of the timber. The wood to be carbonised is stacked in heaps or mounts, covered with turf, and generally plastered over externally with a mixture of earth and charcoal dust. The heap is surrounded with a metal casing, which for the convenience or portability for transmission from place to place, is constructed in separate pieces, so that it may be readily put together on the spot. Openings are formed in the turf cover for the escape of the vapours into the interstitial space formed by the metal casing. The latter is provided with an outlet for conducting the vapours given off during carbonisation to a still head and thence to suitable condensing vessels. The stacks of wood may also be carbonised within a casing of brickwork. Inspection tubes may also be inserted to ascertain the progress of carbonisation. By the above mode of procedure the utilisation of the products given off during the process of carbonisation is said to be secured without impairing the quality of the residual charcoal, the fuel value of which is materially depreciated when the carbonisation is carried on in retorts.—D. B.

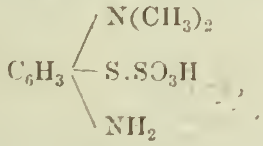
# IV.—COLOURING MATTERS AND DYES.

*The Atomic Grouping which distinguishes the Colourless from the Coloured Derivatives of Di- and Triphenylmethane.* A. Rosenstiehl. Bull. Soc. Ind. Mulhouse, 1894, 181—200.

In 1888 V. von Richter observed that certain nitro and other derivatives of diphenylmethane, which are themselves colourless, form coloured sodium salts. He concluded that the condition for colour is the union of the acid group $C_6H_4NO_2$ and the metallic radical to the carbon atom of the same methane nucleus. The author, considering von Richter's conclusions to be capable of much wider application, has experimented with a large number of di- and triphenylmethane derivatives. In attempting to define the conditions which determine coloration he was at first baffled by a number of apparent exceptions, *e.g.*, acid magenta, in which all the four groups united to the central carbon, are of an acid nature. He is able at last, however, to formulate these conditions, and to the laws as here laid down, he has as yet met with no real exception. The coloured and colourless derivatives have two characteristics in common, and the former are differentiated from the latter by a third characteristic. The points of resemblance are ; (1) of the four valencies of the central carbon, not more than three can be satisfied by phenyl ; (2) of the two or three phenyl groups, one at least, more often two, is substituted in the para position with respect to the central carbon. The point of difference is : (3) when the radical in the para position possesses a similar chemical function to that satisfying the fourth valency of the central carbon (*e.g.*, two OH groups), the compound is colourless ; when these two radicals are of opposite functions (*e.g.*, an acid and a basic group such as OH and $NH_2$) the compound possesses colour, and this is the case whatever groups are substituted further for hydrogen in the phenyl.—R. B. B.

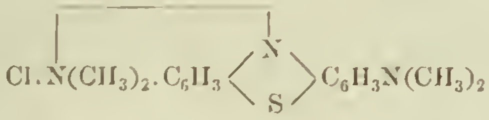
*Some Derivatives of the Series of Oxazines and Eurhodines.* C. Lauth. Bull. Soc. Ind. Mulhouse, 1894, 203—206.

Since the classic researches of Bernthsen on the colouring matters containing sulphur, discovered by the author in 1876, these bodies have been prepared by the oxidation of the sulphonated mercaptan of amidodimethylaniline—



$$C_6H_3\left\langle\begin{matrix}N(CH_3)_2\\ S.SO_3H\\ NH_2\end{matrix}\right.,$$

in presence of tertiary amines. Thus, with dimethylaniline, methylene blue—

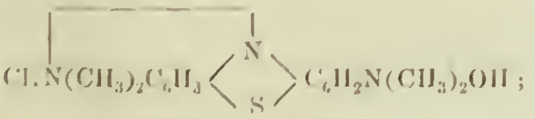


$$Cl.N(CH_3)_2.C_6H_3\left\langle\begin{matrix}N\\ S\end{matrix}\right\rangle C_6H_3N(CH_3)_2$$

results.

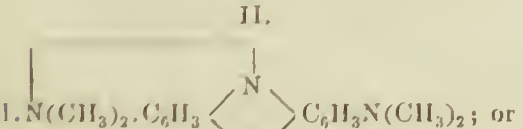
In the present case (and starting from nitrosodimethylaniline hydrochloride) dimethylaniline was replaced by dimethyl- or di-ethylmetamidophenol, to obtain, if possible, a hydroxylated methylene blue, or to discover which of the three following bodies would be produced :—

I.



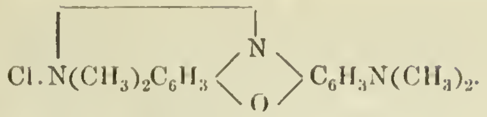
$$Cl.N(CH_3)_2C_6H_3\left\langle\begin{matrix}N\\ S\end{matrix}\right\rangle C_6H_2N(CH_3)_2OH\ ;$$

II.



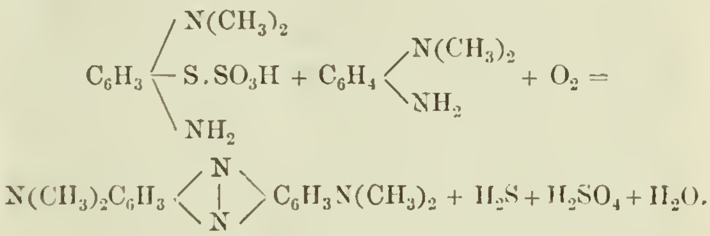
$$Cl.N(CH_3)_2.C_6H_3\left\langle\begin{matrix}N\\ S\end{matrix}\right\rangle C_6H_3N(CH_3)_2\ ;\ \text{or}$$

III.



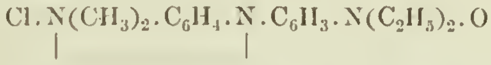
$$Cl.N(CH_3)_2C_6H_3\left\langle\begin{matrix}N\\ O\end{matrix}\right\rangle C_6H_3N(CH_3)_2.$$

The body actually obtained from di-ethylmetamidophenol is a bluish-violet colouring matter, fairly soluble in water and alcohol, less soluble in alkalis with a red-violet colour. Its solution in concentrated sulphuric acid is red-violet, in concentrated hydrochloric acid, olive-green, and in dilute acids blue. It dyes wool, silk, and tannin-mordanted cotton a bluish-violet colour. It is found to contain no sulphur, and therefore does not belong to the thionines, but is probably an oxazine corresponding to formula (III.) above. That the substance is an oxazine is made still more probable by the following facts :—When one molecule of metamidodimethylaniline is oxidised in presence of one molecule of the sulphonated mercaptan of paramidodimethylaniline, and after half an hour's boiling the product of the reaction is extracted with very weak soda, a red solution is obtained, and from this, on precipitation with common salt and zinc chloride, a red-violet colouring matter possessing the characteristic properties of the eurhodines. With HCl it gives a blue, with $H_2SO_4$ a green solution, both restored to red by dilution ; its aqueous solution is not changed by ammonia. Doubtless the body is a tetramethylated eurhodine, and the reaction giving rise to it, analogous to that producing the oxazine, is the following :—



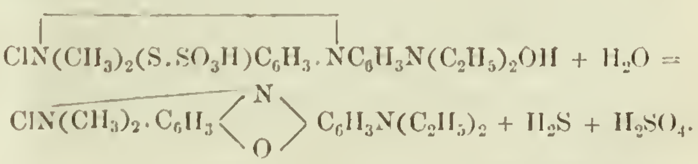
$$C_6H_3\left\langle\begin{matrix}N(CH_3)_2\\ S.SO_3H\\ NH_2\end{matrix}\right. + C_6H_4\left\langle\begin{matrix}N(CH_3)_2\\ NH_2\end{matrix}\right. + O_2 =$$
$$N(CH_3)_2C_6H_3\left\langle\begin{matrix}N\\ |\\ N\end{matrix}\right\rangle C_6H_3N(CH_3)_2 + H_2S + H_2SO_4 + H_2O.$$

Since the oxazine first described contains no sulphur, it was sought to prepare the same compound by the simple oxidation of a mixture of amidodimethylaniline and di-ethylamidophenol. The product, however, is a substance readily soluble in alkalis, very sensitive to acids, and decomposed by boiling water, with the formation of a red compound. On boiling with aniline acetate and potassium bichromate, it yields a safranine, and must therefore be an indamine of the formula—



$$Cl.N(CH_3)_2.C_6H_4.N.C_6H_3.N(C_2H_5)_2.OH$$

The reactions by which the oxazine is produced are now clear. The first product of oxidation is a thio-sulphonated indamine, and, on boiling with water, the group $S.SO_3H$ is eliminated, thus :—



$$ClN(CH_3)_2(S.SO_3H)C_6H_3.NC_6H_3N(C_2H_5)_2OH + H_2O =$$
$$ClN(CH_3)_2.C_6H_3\left\langle\begin{matrix}N\\ O\end{matrix}\right\rangle C_6H_3N(C_2H_5)_2 + H_2S + H_2SO_4.$$

—R. B. B.

*The Manufacture of Orthonitraniline.* J. Pokorny. Bull. Soc. Ind. Mulhouse, 1894, 280—284.

The preparation of orthonitraniline—

$$C_6H_3NH_2.NO_2[NH_2: NO_2 = 1:2]$$

has hitherto been a difficult and extremely costly process, the only source of this product being the small quantities obtained during various operations which yield paranitraniline $[NH_2:NO_2 = 1:4]$. Thus, Noelting prepares it from the mother-liquors resulting from the manufacture of paranitraniline from acetanilide. Nietzki transforms acetanilide into the corresponding sulphonic acid ; this product nitrated, de-acetylised, and heated with HCl under pressure, yields orthonitraniline, but in very small quantities. Merz attempted its preparation by the action of ammonia on orthonitrophenol under pressure. All these methods yield merely traces of the product, and are not available for its manufacture on the large scale at a reasonable price. C. Turner has described (Ber. 1892, 985) improvements in Nietzki's method, and in the same year two German patents were taken out by the firm of Wülfing for the manufacture of orthonitraniline from oxanilide.

The process described below is the first by which orthonitraniline can be made on the large scale at a price (6 frs. per kilo.) not exceeding that of the paranitraniline used in the manufacture of colouring matters. Briefly, the process consists in nitrating acetanilide at a high temperature, and separating the nitranilines formed by the difference of dissociation of their salts by water, the hydrochloride of orthonitraniline being more easily dissociated than that of the para compound.

Several experiments were made to ascertain the most favourable conditions for the formation of the largest possible quantity of orthonitraniline on a commercial scale. The process as finally improved, is as follows:—40 kilos. of acetanilide well dried and ground, are dissolved gradually in 80 kilos. $H_2SO_4$ at 66° B. with continual stirring. The temperature of the liquid rises rapidly, but should not be allowed to exceed 50° C. For nitration, use a mixture of 36 kilos. of nitric acid at 36°—37° B. and 40 kilos. of sulphuric acid at 66° B. Allow this mixture to flow slowly into the solution of acetanilide, maintaining the temperature at 40°—50° C. The operation lasts five hours. The next day pour into this liquid, which weighs about 200 kilos., 200 litres of hot water. A yellowish precipitate is obtained, consisting of ortho- and paranitracetanilide. To de-acetylise the mixture, it is heated directly by steam, or on a water-bath, to complete solution of the precipitate. Allow the liquid to cool to 50° C., and pour it on to 200 kilos. of ice with constant stirring. Orthonitraniline is precipitated and easily obtained in a pure state by filtration, washing, pressing, and recrystallisation from boiling water.

The mother-liquors containing the paranitraniline are precipitated by the addition of 180 kilos. of caustic soda at 36° B., the temperature being kept below 30° C. The product is purified in the same way as the ortho compound. The average yield of dry products is 25 per cent. of ortho- and 60 per cent. of paranitraniline. The melting point of the former is 71·5° C., of the latter 147° C.

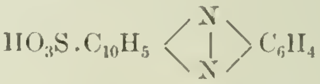
The de-acetylisation may also be accomplished by means of hydrochloric acid, or with caustic soda.—R. B. B.

### *Process for Rendering the Basic Aniline Colours soluble in Benzene, Bisulphide of Carbon, &c.* Reimann's Färber Zeit. **30,** 1894.

The colours for this purpose are, according to Müller-Jacobs, converted into their resinates, whilst Persoz makes use of their oleates for blue, and of other fatty acids, or ordinary soap, for the other colours. The latter method is preferable, and when applied to the production of Methylene blue soluble in benzene, the following quantities are given:—Two solutions are prepared, containing respectively 32 grms. of white Marseilles soap and the same quantity of Methylene blue, so that when mixed the bulked solution measures 4 litres. After boiling and standing half an hour on the water-bath the solution is allowed to stand over night. The precipitated blue is then collected on a linen filter, dried in the air, and, if necessary, melted on the water-bath, the addition of a little oxalic acid rendering it more fluid. The yield is about 48 grms. The method of working up the product may have to be modified. In some cases the addition of a little hydrochloric acid is necessary to complete the precipitation, whilst another method is to evaporate the solution completely to dryness. Colouring matters insoluble or sparingly soluble in water are ground up with a small quantity of spirit before being added to the soap solution. According to the oleate method, the dry colour base is dissolved in an alcoholic solution of oleic acid, when, after distilling off the alcohol, the oleate soluble in benzene remains behind. The oleates of the basic colouring matters, when dry or in presence of water, are stable at 100° C., whereas in benzene they are decomposed at a temperature below the boiling point of that solvent; induline is, however, an exception. The writer of the article is of opinion that the reaction of soap with the basic colouring matters, and the solubility of the oleates in this medium, form explanations of the reason why these colours will not stand soaping, and especially hot soaping, when not fixed with a mordant as is the case on wool.—T. A. L.

### *Monosulphonic Acids of Phenyl-β-naphthylamine and Azo Colouring Matters therefrom.* R. Lesser. Ber. **27,** 2363—2370.

By sulphonating phenyl-β-naphthylamine according to Ger. Pat. 53,649 (Eng. Pat. 10,934 of 1889; this Journal, 1890, 853), two monosulphonic acids are produced which have the constitutions (2.4′) and (2.1′) $C_{10}H_6(NHC_6H_5)SO_3H$. The same acids are obtained by phenylating the corresponding β-naphthylamine sulphonic acids by heating them with aniline in presence of an acid (Eng. Pat. 7337A of 1892; this Journal, 1893, 350). The former of these two acids combines easily with diazobenzene sulphonic acid to form a colouring matter, the sodium salt of which crystallises from dilute brine in red needles. The free acid can be obtained from this by the careful addition of hydrochloric acid to a cold solution of the sodium salt, when it separates in black needles. On boiling it, however, with hydrochloric acid it is converted into phenonaphthazine sulphonic acid—



$$HO_3S.C_{10}H_5 \left< \begin{matrix} N \\ | \\ N \end{matrix} \right> C_6H_4$$

This substance crystallises in shiny brown needles easily soluble in water and alcohol, and giving a red coloration with sulphuric acid. On fusion with potash the potassium salt of the corresponding eurhodol is obtained in greenish crystals, which dissolve in water to a red solution, from which acetic acid precipitates the eurhodol as a flocculent brown precipitate. The colouring matter of which the sodium salt crystallises in red needles as described above, has the constitution—

$$(2.4'.1).C_{10}H_5(C_6H_5NH)(SO_3H).N=N.C_6H_4.SO_3H(1.4)$$

and yields on reduction with stannous chloride in hydrochloric acid solution the corresponding phenylnaphthylene diamine sulphonic acid, of which the sodium salt gives a green coloration with ferric chloride. By acting with diazobenzene sulphonic acid on (2.1′)-phenylnaphthylamine sulphonic acid, a colouring matter is also obtained, of which the sodium salt crystallises in orange-coloured matted needles, forming a bluish-violet precipitate of the free acid on the addition of hydrochloric acid. On reduction with stannous chloride an acid is obtained which, however, has not the characteristics of an *o*-diamine, since it will not condense with benzil or dioxytartaric acid, nor does it give the green coloration with ferric chloride. Further investigation showed it to be a substituted *p*-diamine of the benzene series, since it gave an indophenol when oxidised in a neutral solution with potassium ferricyanide in presence of α-naphthol, and hence the azo group of the diazobenzene sulphonic acid must have entered the benzene ring para to the substituting naphthylamine nucleus, and the constitution of the colouring matter is:—

$$(1'.2).C_{10}H_6.SO_3H.NHC_6H_4.N:N.C_6H_4.SO_3H(1.4).$$

This view received a further confirmation by a comparison of the colouring matter with phenylamidobenzene sulphonic acid (Tropæolin 00), which possesses an analogous constitution. This apparently abnormal behaviour of the (2.1′)-phenylnaphthylamine sulphonic acid will be better understood when it is remembered that it is a derivative of the (2.1′)-naphthol sulphonic acid (croceïn acid), which only combines slowly with diazo compounds, whilst the corresponding (2.1′)-naphthylamine sulphonic acid does not form an azo colouring matter at all, but only a diazo-amido compound.—T. A. L.

*The Colouring Principles of Ventilago Madraspatana.* A. G. Perkin and J. J. Hummel. J. Chem. Soc. (Trans.) 1894, 923—944.

*Ventilago madraspatana* is a large climbing shrub belonging to the order Rhamnaceæ, the root bark of which furnishes a dyestuff much valued in Southern India. The annual production is given as 1—3 tons, and the price as 1½*d.*—7½*d.* per lb. It is mentioned under the name *Souroulputtay* in Gonfreville's "L'art de la Teinture des Laines," 1849, 539; also by Dymock, Warden, and Hooper in the Pharmacographia Indica, i. 355, and by many other writers. The root bark appears as dark purplish-brown scales, ribbons, or filaments, the dust from which, when powdered, irritates the throat. Treated with boiling water or alcohol, it gives a red solution, changed by caustic alkali to a deep crimson. The authors find that it contains a colouring matter differing from all others at present known. On treating the dyestuff with carbon bisulphide, fine crystalline substances were obtained, together with a wax, and the resinous colouring matter. These were separated by mixing the extract with alcohol, by fractional crystallisation, and by other means, details of which are given in the paper. The following are the substances obtained:—

(1.) $C_{16}H_{12}O_5$, a methyl ether of a trihydroxy-α-methylanthraquinone. It crystallises in orange-red needles, melting at 200° C., and when heated with sulphuric acid to 160° C. it gives a trihydroxy-α-methylanthraquinone crystallising in orange-red needles, melting at 254° C., and apparently identical with emodin from *Rhamnus frangula.* Hence the substance $C_{16}H_{12}O_5$ is probably emodin methyl ether.

(2.) $C_{16}H_{14}O_4$(A), probably a trihydroxy-α-methylanthranole methyl ether. It dissolves in alkalis with a yellowish-brown coloration, and is converted on gentle oxidation into the above-described emodin methyl ether.

(3.) $C_{16}H_{14}O_4$(B). A second trihydroxy-α-methyl anthranole methyl ether, crystallising in pale yellow needles, melting at 173° C., and also yielding emodin methyl ether on oxidation. The only compound of the anthracene group previously isolated from natural sources and nearly related to the substances (2) and (3), is the chrysarobin obtained from Goa powder, and examined by Liebermann and Seidler (Annalen, **212**, 29). Analysis, however, proves that these substances have not the complicated constitution assigned to chrysarobin. The effect of the quinone group on the colour of these substances is well marked, for whilst A is colourless, and B nearly so, emodin methyl ether has a distinct orange-red tint.

(4.) $C_{16}H_8O_8$. This is an orange-red crystalline powder which melts and carbonises at 275°—280° C., and is distinguished from the foregoing substances by its sparing solubility in most solvents. Its acetyl derivative crystallises in yellow needles and melts at 216°—220° C., and when heated with zinc dust it yields a hydrocarbon which is probably α-methyl-anthracene. This substance is probably an α-methyl-anthraquinone derivative containing more than one quinone group.

(5.) $C_{17}H_{12}O_5$. This forms a chocolate-coloured crystalline powder.

(6.) The wax $(C_9H_{16}O)_n$ consists of needles melting at 72° C.

(7.) The colouring matter is a reddish-brown brittle resin, $C_{15}H_{14}O_6$, melting at 100°—110° C., and has not been obtained in a crystalline form. It is soluble in dilute alkalis with a purple-violet coloration, and the salts are obtained from these solutions by precipitation with salt as amorphous violet precipitates. On distillation with zinc dust it yields β-methylanthracene, and when reduced with zinc dust in an alkaline solution it behaves as a derivative of methylanthraquinone. The authors propose to name this colouring matter *Ventilagin.* It would appear to be allied to alkannin, $C_{15}H_{14}O_4$, the colouring matter of the roots of Anchusa tinctoria investigated by Liebermann and Römer, Ber. **20**, 2428 (this Journal, 1887, 723). Ventilagin may be alkannin containing two additional hydroxyl groups. On mordanted cotton it gives shades more purple than brazilëin and faster to soap. The following specific dyeing properties of the root bark are given. On cotton mordanted with alumina it gives a purplish-red much bluer and duller than that given by Lima-wood; with an iron mordant it gives a grey to black. On oil-prepared calico with aluminium, chromium, and iron, rich claret-red, purplish-brown, and purplish-black colours respectively are obtained. Similar colours are obtained on wool and silk. In general, the ventilago colours are somewhat similar to those obtained from Camwood or Lima-wood; like the latter they are fugitive to light, but are decidedly faster to soap, although they are not equal in this respect to the alizarin colours. The shades are very different from those given by alkannin, although chemically, as already noted, the two colouring matters appear to be closely related.—T. A. L.

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*Sulphonated Colouring Matters Derived from Triphenylmethane.* M. Prud'homme. Bull. Soc. Ind. Mulhouse, 1894, 400—405.

According to Rosenstiehl (Bull. Soc. Ind. Mulhouse, 1894, 1881; see also this Journal, 1894, 798, and 1893, 591 and 748) trisulphonated *p*-rosaniline can exist in three forms:—

(1.) $(H_2N.SO_3H.C_6H_3)_3 \equiv C—Cl$, a red colouring matter.

(2.) $(ClH.H_2N.SO_3H.C_6H_3)_3 \equiv C—Cl$, a slightly coloured acid salt.

(3.) $(H_2N.SO_3Na.C_6H_3)_3 \equiv C—OH$, a colourless substance.

Now, according to the author, (3) is the acid magenta of commerce in a pure state, and is well known to give an intense red solution. Caustic soda destroys this colour, forming $(H_2N.SO_3Na.C_6H_3)_3 \equiv C—ONa$. Sodium carbonate also destroys the colour if heated with the solution, and carbon dioxide is given off. This proves that in acid magenta the hydroxyl attached to the methane carbon has not the same function that it has in rosaniline, having in fact acquired an acid or electro-negative character by the introduction of the sulphonic acid group. Therefore the fact that the so-called colourless body (3) is really coloured is quite in accord with the "law of opposite chemical functions," for the grouping $NH_2.SO_3Na.C_6H_3$ is unquestionably positive. The presence of $SO_3H$ in the molecule also influences the amido groups, neutralising them to some extent and weakening their attraction for acids. Thus a 1 per cent. solution of sulphonated rosaniline (acid magenta) requires five times as much sulphuric acid to decolorise it as ordinary magenta does of the same concentration. Formaldehyde also, which readily attacks the amido groups of magenta, changing them to $N = CH_2$, only reacts with difficulty with acid magenta, the sulphonic acid groups appearing to protect the amido groups (Bull. Soc. Chim. **9**, 566; see also this Journal, 1893, 752). Since, then, the hydroxyl in acid magenta has itself a negative function, the law of opposition of functions is satisfied, and it is not necessary to suppose, as must be supposed in the case of ordinary magenta, that Cl is substituted for OH when the body is treated with acid. If, however, this substitution does take place the hydroxyl of acid magenta must be considered to be both alcoholic and phenolic, and the colouring matter comparable to those metallic oxides which are capable of combining either with acids or alkalis. The author also discusses Rosenstiehl's work on patent blue.

His conclusion, that in colours like patent blue the tertiary alcoholic function resembles that of the fatty alcohols, inasmuch as saponification and etherification are effected much more slowly than in the corresponding unsulphonated bodies, is not borne out by experimental facts described in detail by the author. So far as the saponification is concerned it would appear that in the case of the sulphonated colouring matters it takes place instantaneously. Thus the end product of the sulphonation of rosaniline diluted with a sufficient quantity of water is—

$$[H_2N.SO_3H.C_6H_3]_3 \equiv C—O.SO_2.OH,$$

which on saturation with soda becomes—

$$[H_2N.SO_3Na.C_6H_3]_3 \equiv C.OH.$$

But in the case of patent blue the action of soda is not one of saponification, for it takes place in the same manner whether applied to the commercial product itself or to the same after treatment with acid. Because the saponification of sulphonated derivatives is immediate it does not follow that etherification takes place as quickly; there is no proof of that. In the case of patent blue decolorised by soda the action of acids is not upon the OH attached to the central carbon. The phenomenon of the slow return of colour does not indicate a simple replacement of OH by an acid residue, and is not a case of etherification proper. The paper concludes with some remarks on the action of ammonia on sulphonated colouring matters. Sulphonated alkali blue and malachite green behave towards caustic soda like acid magenta with slight differences. Ammonia decolorises them in the cold and the colours return on heating or mere exposure to air. Patent blue is slowly decolorised by strong ammonia and the blue colour partially returns on heating. The conclusion is that the OH attached to the methane carbon becomes $NH_4O$ in presence of ammonia, and this change involves loss of colour in conformity with the law of opposite functions. The group $NH_4O$ is, however, very unstable, splitting up into $NH_3$ and OH by the action of heat or other conditions, and regenerating the colour proportionately to the loss or neutralisation of the ammonia.—T. A. L.

*Etherification of Sulphonated Colouring Matters derived from Triphenylmethane.* M. Prud'homme. Bull. Soc. Ind. Mulhouse, 1894, 406—407.

Alkali blue treated with caustic soda is slowly decolorised in the cold, the action lasting several days. Heated, the solution quickly becomes red and in a few minutes colourless. Now, if a slight excess of cold caustic soda be added to a solution of alkali blue to which a little mineral acid has immediately before been added, a red solution is at once obtained just as though heat had been applied. To account for this the author supposes, firstly, that the acid when added to alkali blue immediately determines etherification, the group OH being replaced by Cl; and secondly, that when this Cl is attacked by NaOH, the OH in the act of migrating from the group NaOH to join the methane carbon is in a peculiarly unstable condition and readily transformed in the presence of caustic soda into ONa, a transformation which, under other circumstances, takes a long time. From the considerations advanced in this paper and the preceding one, the author draws the following conclusions:—

1. The sulphonated colouring matters of the magenta group are immediately etherified by the same means as rosaniline and analogous bases.

2. The saponification of the etherified colouring matters is also immediate.

3. The transformation of hydroxyl attached to methane carbon into ONa by caustic or carbonated alkalis is more or less rapid according to the nature of the three benzene groupings united to the same carbon. In certain cases (*e.g.* patent blue) the reaction is more complicated. Ammonia seems always to act by substituting $NH_4O$ for OH.

—T. A. L.

*The Formula of the Acid Magentas: A Reply to the Foregoing.* A. Rosenstiehl. Bull. Soc. Ind. Mulhouse, 1894, 408—413.

The author has already shown that there are two characters which are common to coloured and colourless compounds of the magenta class:—(1.) Of the four valencies of methane only three can be satisfied by phenyl. (2.) In the two or three phenyl groups forming part of the molecule, one at least (but more often two) contains a substituent para to the methane carbon. There is, however, one character which differentiates them. (3.) When the substituent in the para position in the phenyl has the same chemical function as that which satisfies the fourth valency of the methane carbon the compound is colourless, but when these two radicals are of opposite functions the compound is coloured. Thus in magenta, $(NH_2.C_6H_4)_3 = C.Cl$, the radicals $NH_2$ and Cl are respectively basic and acid, and the substance is therefore coloured. When by the action of alkalis Cl is replaced by the basic radical OH the colour disappears. On the other hand, an excess of acid converts $NH_2$ into $ClNH_3$, a neutral radical, and there results the compound $(ClNH_3C_6H_3)_3 \; C.Cl$, in which there is little opposition of functions and accordingly little colour. In the acid magentas it might be imagined that the group $SO_3H$, preponderating over the $NH_2$ in the same phenyl, would confer upon it an acid or electro-negative function, and that in consequence the acid magenta—

$$(NH_2SO_3HC_6H_3)_3 \; C.Cl$$

would in neutral or slightly acid solution be colourless. But that is not so. The acid magentas behave towards acids and alkalis just like the unsulphonated magentas. The fact is, the introduction of the acid radical $SO_3H$ makes no change in the function of that side of the molecule because it enters in the ortho- or meta-position, the para-position being occupied by the basic $NH_2$. Prud'homme has criticised the author's formula (3) (see above) under the impression that it was intended to represent commercial acid magenta, which is of course a coloured substance. But in the manufacture of the latter the sodium salt, which is a deliquescent substance, is half neutralised with hydrochloric acid, the product being a half-saturated salt which may have the formula $(NH_2.SO_3Na.C_6H_3)_3 : C.Cl$, and such a body would naturally decompose sodium carbonate, as Prud'homme finds is the case, and his argument founded on that experiment is therefore invalid. As a matter of fact the formulæ of the acid magentas have not been scientifically ascertained.—T. A. L.

*Reduction Products of Alkylated Azo-Colouring Matters of the Naphthalene Series.* O. N. Witt and H. v. Helmolt. Ber. **27**, 2351—2357.

In a previous communication (Ber. **25**, 1013; see also this Journal, 1892, 901) on the reduction of the ethyl ether of aniline-azo-α-naphthol, Witt discussed the constitution of one of the bases obtained, which was proved to be ethoxyphenyl-*o*-naphthylene diamine. A second base which occurred in the mother-liquors has now been isolated and has been identified as (1.4)-ethylamidonaphthol. Its presence does not result from the molecular change which gives rise to the first base obtained, but it is another example of a decomposition during reduction, already observed by Grandmougin and Michel (Ber. **25**, 979). A method is now given which practically converts the whole of the ethyl ether of aniline-azo-α-naphthol into the desired base. About 25 grms. of the ether are warmed with 50 cc. of alcohol and 45 grms. of stannous chloride until a reaction sets in, which proceeds until a colourless solution is obtained. After filtering, 200 cc. of 12 per cent. hydrochloric acid are added, and on standing, the solution solidifies to a mass of white crystals of the hydrochloride of ethoxyphenyl-*o*-naphthylene diamine. The same reaction has now been tried with *p*-toluidine-azo-α-naphthol ethyl ether, a new method also being given for the etherification of *p*-toluidine-azo-α-naphthol, which can only be etherified with great difficulty by heating with alkyl haloids. A yield of 80 per cent. of the theoretical is, however, obtained by heating 1 part of *p*-toluidine-azo-α-naphthol on the water-bath for about half an hour with 5 parts of absolute alcohol, into which 1 part of hydrochloric acid gas has previously been passed. On cooling, *p*-toluidine-azo-α-naphthol ethyl ether crystallises out, and, after recrystallisation from toluene, melts at 125° C. It forms scarlet prisms with a bluish metallic lustre. On reduction by the method given above, it yielded a base which, after crystallisation from petroleum spirit, formed groups of stellate needles melting at 118°—119° C., which proved to be ethoxy-*p*-tolyl-*o*-naphthylene diamine—

$$(1.4.2)C_{10}H_5.OC_2H_5(NH_2)NH.C_6H_4.CH_3(1.4).$$

On heating with benzil in acetic acid solution it forms the condensation product *p*-tolyl-ethoxy-naphthostilbazonium chloride, which, on further heating with alcoholic ammonia to 130° C., yields a safranine having the formula—

$$C_{31}H_{24}N_3Cl + H_2O.$$

This forms red plates slightly soluble in water, easily soluble in alcohol, the latter solution possessing a greenish yellow fluorescence. The colouring matter dyes silk red, and the dyed article exhibits a similar fluorescence.—T. A. L.

### *Reduction Products of Alkylated Azo-Colouring Matters of the Naphthalene Series.*

O. N. Witt and A. Buntrock. Ber. **27**, 2358—2363.

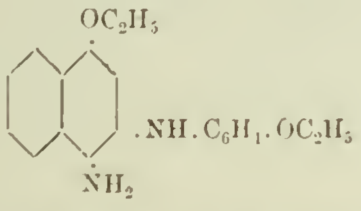
This work is a continuation of that referred to in the preceding abstract and describes the preparation of phenetidine-azo-α-naphthol ethyl ether, its reduction products and derivatives thereof. The ether referred to—

$$(1.4)C_2H_5O.C_6H_4.N:N.C_{10}H_6.OC_2H_5(1.4)$$

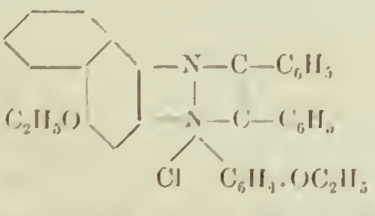
was prepared by ethylating (1) amidophenol-azo-α-naphthol, (2) amidophenol-azo-α-naphthol ethyl ether, and (3) phenetidine-azo-α-naphthol. Of the mono-ethylated ethers described, amidophenol-azo-α-naphthol ethyl ether—

$$(1.4)HO.C_6H_4.N:N.C_{10}H_6.OC_2H_5(1.4),$$

prepared by combining the diazotised ethyl ether of (1.4)-amidonaphthol (naphthophenetidine) with phenol, forms a yellow compound which after crystallisation from dilute alcohol melts at 171° C. It is soluble in dilute potash and gives on ethylation the above-mentioned phenetidine-azo-α-naphthol ethyl ether. Phenetidine-azo-α-naphthol $C_2H_5O.C_6H_4.N:N.C_{10}H_6.OH$ is obtained by diazotising *p*-phenetidine and combining it with α-naphthol. It forms bronzy crystals, which can be purified by crystallisation from dilute alcohol or acetic acid. The substance melts at 168° C., is easily soluble in benzene or ether, and dissolves with an orange-red colour in dilute potash. Phenetidine-azo-α-naphthol ethyl ether prepared from any of the above compounds crystallises in yellowish-red needles from alcohol, ether, or benzene, and melts at 123° C. It is insoluble in water and alkalis and dissolves in concentrated sulphuric acid with a bluish-violet colour. On reduction with stannous chloride and hydrochloric acid the ether yields *p*-amidophenetol and *p*-amidonaphthol ethyl ether, but on reduction in an alcoholic solution with stannous chloride without hydrochloric acid an intermediate hydrazo compound is formed which undergoes molecular transformation yielding di-ethoxyphenyl-*o*-naphthylene diamine, of the formula—



An alcoholic solution of 4 grms. of the ether and 12 grms. of stannous chloride is heated under an inverted condenser until the solution has become colourless, when 300 cc. of boiling 12 per cent. hydrochloric acid are added. The hydrochloride of the new base separates, and on adding sodium acetate to the alcoholic solution of the hydrochloride the base precipitates in white scales which, after crystallisation from petroleum spirit form long white matted needles melting at 103° C. On heating the hydrochloride with benzil in an alcoholic solution, diethoxyphenyl-naphthostilbazonium chloride is produced, having the following formula—



It is precipitated from an aqueous solution by hydrochloric acid in shining yellow crystals and dissolves easily in alcohol and water with a yellow colour and greenish-yellow fluorescence, the latter being destroyed by an excess of hydrochloric acid. On heating with an excess of alcoholic ammonia to 130° C., the ethoxyl group in the naphthalene ring is replaced by the amido group yielding a safranine which forms small red needles soluble in water and alcohol with a yellowish red colour, and greenish-yellow fluorescence. In concentrated sulphuric acid it dissolves with a violet colour which, on dilution, passes through green to pink. It dyes silk red with an orange-yellow fluorescence. From the similarity of this safranine with that already obtained (Ber. **25**, 2004; this Journal, 1892, 901) it would appear that it is the ethoxyl group in the naphthalene nucleus which is replaced. There are, however, indications of the presence of a bluish-red colouring matter in the mother liquors, pointing to the possibility of the substitution of the second ethoxyl group and experiments with the object of thus obtaining a diamido safranine are in progress.—T. A. L.

## PATENTS.

### *Improvements in the Production of Aromatic Bases containing Sulphur, and of their Sulphonic Acids.*

O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 406, January 8, 1894.

The bases referred to are products obtained by the action of sulphur on *p*-amido-benzaniline—

$$C_6H_5.NH.CH_2.C_6H_4.NH_2.$$

When *p*-amido-benzaniline is heated with three atoms of sulphur a reaction with evolution of sulphuretted hydrogen takes place according to the equation—

$$C_{13}H_{14}N_2 + 3\,S = 2\,H_2S + C_{13}H_{10}N_2S$$

forming what is termed "Thiobase I." When this product is further heated more sulphuretted hydrogen is evolved and there results "Thiobase II." Both these bases contain a diazotisable amido group, but the two compounds differ widely in their chemical and physical properties. The working proportions are given as follows: A mixture of 190 kilos. of *p*-amidobenzaniline and 50 kilos. of sulphur is heated to about 175° C. until a sample of the melt on cooling, becomes brittle and soluble in acetone. The whole melt is then dissolved in 1,000 litres of water and 65 kilos. of hydrochloric acid, filtered and precipitated with soda-lye. The base thus obtained is a yellow crystalline powder melting at about 80° C., insoluble in water, but sparingly soluble in other solvents, with the exception of acetone, in which it is easily soluble. The sulphate is nearly insoluble in water. If the thiobase I. be dried and heated to about 245° C. a further quantity of sulphuretted hydrogen is given off, and when the reaction is complete the new base is found to be insoluble in acetone. It is of course not necessary to perform the operation in two stages as the melt for obtaining the thiobase I. may be subsequently heated to 245° C. until a sample is insoluble in acetone. The thiobase II. is an orange-yellow powder melting at about 200° C., and is insoluble in all the usual solvents. It does not form stable salts with acids. Both these thiobases may be sulphonated by adding 100 kilos. of either base to 400 kilos. of fuming sulphuric acid containing 20 per cent. of anhydride at a temperature of about 55° C. When a sample is completely soluble in dilute alkali the melt is poured into 1,500 litres of ice-water, heated to boiling, the sulphonic acid filtered off, washed free from acid and converted into an alkali or ammonia salt. The sulphonic acid of thiobase I. is yellow and slightly soluble in water, the salts being easily soluble in water with a yellow colour. Thiobase II. sulphonic acid is a brown powder insoluble in water, the salts are easily soluble in water with an orange-yellow colour. Both these sulphonic acids contain a diazotisable amido group.

—T. A. L.

### *Improvements in and relating to the Manufacture of Azo Dyestuffs.*

J. Y. Johnson, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pat. 515, January 9, 1894.

According to this patent $1.4'.4.3'$-amido-naphthol disulphonic acid, of which the preparation is described, is a new substance, and combines with the diazo-derivatives of monamines, diamines, and their amido-azo compounds to form new azo-dyestuffs. The combinations can take place either in an acid or alkaline solution and in the latter case the dyestuffs obtained can be further diazotised, either in solution or on the fibre, and combined with amines, phenols, and their sulphonic and carboxylic acids. The dyestuffs resulting from combinations in an acid solution will combine further with diazo or tetrazo compounds. The new colouring matters appear to cover a large variety of shades, and some of them are said to possess valuable properties as regards fastness to washing and light. The new acid which is termed amido-naphthol disulphonic acid K is prepared as follows: 10 kilos. of (1.4′) naphthalene disulphonic acid are stirred into 40 kilos. of 100 per cent. sulphuric acid and mixed at 40° C., with 9 kilos. of 70 per cent. anhydride. The melt is then raised to 80°—90° C. until it becomes liquid, and a test dissolved in water is not precipitated by salt. After cooling, 9·2 kilos. of nitro-sulphuric acid containing 25 per cent. of $HNO_3$ are run in below 60° C., and the melt is allowed to stand a short time, after which it is stirred into five times its bulk of water, and reduced with iron borings. The excess of sulphuric acid having been removed by lime, the calcium salt is converted into the sodium salt and the filtered solution is acidified with hydrochloric acid when the acid sodium salt of naphthylamine trisulphonic acid crystallises out in fine white needles. This is fused with 15 kilos. of caustic soda, and 5 litres of water at about 140° to 200° C. Towards the end of the reaction, which may be performed in an open or closed vessel, the melt turns from a yellow to a reddish-brown; it is then dissolved in 200 litres of water, and the acid sodium salt of the amido-naphthol disulphonic acid is precipitated by hydrochloric acid.—T. A. L.

### *Improvements in Marking Ink Pencils.*

J. Hickisson, Hackney. Eng. Pat. 958, January 16, 1894.

A marking ink pencil having the solid colour at one end in the usual manner and at the other end a receptacle for a liquid mordant.—W. E. K.

### *The Manufacture or Production of Anthraquinone Derivatives.*

H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co." Elberfeld, Germany. Eng. Pat. 973, January 16, 1894.

The nitro- and amido-anthraquinones when heated with concentrated sulphuric acid in presence of boric acid are converted into hydroxyanthraquinones, and it has now been found that anthraquinone itself and certain hydroxyanthraquinones react in the same manner. In the case of anthraquinone a considerable amount of quinizarin is formed which, on further oxidation, yields purpurin. For this purpose 10 kilos. of anthraquinone, 10 kilos. of crystallised boric acid, and 200 kilos. of sulphuric acid (66° B.) are heated together. A reaction sets in at about 270° C., sulphur dioxide being evolved. The conversion into quinizarin is complete within a comparatively short time, but the oxidation into purpurin necessitates longer heating. The end of the reaction is determined by a spectroscopic test. The melt is then poured into water, when the hydroxyanthraquinone separates out, and can be purified by redissolving in alkali and precipitating with an acid. Under certain conditions sulphonic acids are obtained simultaneously. These can be separated by salting out, and subsequently hydrolysed. The action of sulphuric acid in presence of boric acid on di-, tri-, or tetra-hydroxyanthraquinones or their sulphonic acids containing hydroxyl groups in each of the benzene rings, gives rise to colouring matters of special value. Such for instance are anthrarufin, oxychrysazin anthraflavic acid and the condensation product obtained by condensing *m*-hydroxybenzoic acid by means of sulphuric acid. Anthrachryson (tetrahydroxyanthraquinone) also, when heated with sulphuric acid and boric acid is chiefly converted into hexahydroxyanthraquinone and all these colouring matters give blue shades on chromium mordants. In place of starting with the hydroxyanthraquinones the mono-, di-, and tri-hydroxy-benzoic acids may be used. A mixture of 10 kilos. of *m*-hydroxybenzoic acid, 10 kilos. of boric acid and 200 kilos. of sulphuric acid is heated at 260°—280° C. until the melt has become blue. When cool it is poured into water, the whole heated to boiling, and the colouring matter which separates, filtered off. This consists chiefly of the hexahydroxyanthraquinone of Eng. Pat. 18,729, of 1890 (this Journal, 1891, 917). The application of this method to anthrachryson is of special value, for although it had previously, by treatment with sulphuric anhydride according to Eng. Pat. 13,677 of 1891 (this Journal, 1892, 740) been converted into hexahydroxyanthraquinone, and also by oxidation in sulphuric acid solution with manganese dioxide, according to Eng. Pat. 21,717 of 1891 (this Journal, 1892, 1000) the same result had been obtained, only a very small quantity was produced by the process described in Eng. Pat. 17,712 of 1890 (this Journal, 1891, 917), by which alizarin bordeaux is oxidised to hexa-hydroxyanthraquinone. In all the methods given, the strength of the sulphuric acid employed and the temperature, may be varied within wide limits without affecting the result, and in place of boric acid, its salts or boron compounds which yield boric acid on heating with sulphuric acid, may be employed.—T. A. L.

### *The Manufacture or Production of Colouring Matters Derived from Anthraquinone.*

H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 974, January 16, 1894.

This is an extension of Eng. Pat. 14,345 of 1893 (this Journal, 1894, 723), and describes the production of colouring matters by the action of sulphuric acid in presence of boric acid at a high temperature on mono nitro-anthraquinone, mixtures of this with the di-nitro compound, nitro-amido-anthraquinones, nitrohydroxy-anthraquinones, amido-anthraquinones, amido-hydroxy-anthraquinones, or sulphonic acids of any of the foregoing substances. Ten kilos. of anthraquinone are dissolved in 200 kilos. of sulphuric acid (66° B.), mixed with 4·2 kilos. of dry sodium nitrate and heated to 60°—80° C. for 1—2 hours. The melt which then chiefly contains mono-nitro-anthraquinone is mixed with 5 kilos. of crystallised boric acid and heated for 1 to 2 hours to 190°—200° C. When cool, the dark red coloured melt is poured into water and the reddish-brown precipitate of the dye-stuff filtered off. The colouring matter thus obtained dissolves to a yellowish-red liquid in solutions of sodium carbonate, bluish-red in ammonia, and violet-red in soda lye, whilst the solution in sulphuric acid is reddish-brown with the same coloured fluorescence. The shades produced on wool are bluish-claret on alumina and reddish-violet on chromium mordants. In the case of the amido compounds the process is carried out at a somewhat higher temperature, the following proportions being given as an example. Ten kilos. of di-*o*-amido-anthraquinone are mixed with an equal weight of crystallised boric acid and 200 kilos. of sulphuric acid, and heated to 260°—270° C. Sulphur dioxide is given off and the melt becomes blue. After a short time it is cooled, poured into water and filtered. The precipitate is extracted with boiling dilute soda lye and the dye-stuff is precipitated by adding an acid to the filtrate. It gives pure blue shades on a chromium mordant on wool, and dissolves to a bluish-violet solution in soda lye whilst in concentrated sulphuric acid, the solution is red with a brownish-red fluorescence showing a very similar absorption spectrum to that of hexa-hydroxy-anthraquinone.

—T. A. L.

### *The Manufacture or Production of Hydroxyanthraquinones.*

H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 975, January 16, 1894.

This is a further extension of Eng. Pat. 14,345 of 1893 (this Journal, 1894, 723), and claims the employment of nitrous acid or its salts in the production of hydroxyanthraquinones more particularly quinizarin and purpurin, by the action of sulphuric acid in presence of boric acid on anthraquinone instead of treating the products obtained by the action of nitric acid on anthraquinone with these reagents. The process may be carried out in two ways, either gaseous nitrous acid is passed through a solution of anthraquinone and boric acid in sulphuric acid at about 225° C., until the melt becomes red and a sample after boiling with water dissolves in alkalis with a violet-red solution, or the following method is employed :—14 kilos. of sodium nitrite are dissolved in 200 litres of cooled sulphuric acid (66° B.) and subsequently 10 kilos. of anthraquinone and 10 kilos. of boric acid are stirred in. The temperature of the melt is raised as quickly as possible to 225° C. with constant agitation. The reaction is complete in 2—4 hours, and, after cooling, the melt is poured into water, boiled to decompose the boric ether, and the precipitate is filtered off. It dissolves in concentrated sulphuric acid to a yellowish-red solution showing the same spectrum as quinizarin. It sublimes at 120°—140° C. in long red needles and dissolves in alkalis with a violet-red colour.—T. A. L.

### *The Manufacture or Production of Dyestuffs.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 1062, January 17, 1894.

In Eng. Pat. 4756 of 1893 (this Journal 1894, 245) the patentees have shown that certain α-naphtholsulphonic containing the OH and $SO_3H$ groups in the meta position, combine with diazo compounds to form azo-dyestuffs fast to alkalis. They have now found that amido-naphthol sulphonic acids which contain the OH and $SO_3H$ groups in the meta position also yield azo colouring matters fast to alkalis and light. The acids specially mentioned which contain the groups in this position are the (3′.1.3)-amido-naphthol sulphonic acid and the (3′.1.3.4)-amido-naphthol disulphonic acid. The former is obtained by fusing (2.2′.4′)-naphthylamine disulphonic acid with alkalis whilst the latter is obtained by sulphonating (2.2′)- or (2.4′) naphthylamine sulphonic acid, and fusing the (2.1.2′.3′)-naphthylamine trisulphonic acid produced with alkalis. The dyestuffs more particularly claimed are obtained by combining these acids with the diazo compounds of dehydrothiotoluidine and its analogues, or the sulphonic acids thereof. This includes the thio bases containing one or more atoms of sulphur formed by heating *p*-toluidine, *m*-xylidine, or ψ-cumidine with sulphur, and the sulphonic acids therefrom. The colouring matters produced dye red to bluish-red shades, and contain an amido group which is diazotisable on the fibre, and can then be further combined with phenols, amines, and their derivatives.—T. A. L.

### *The Manufacture or Production of $\beta_1$-Naphthol $\alpha_1$ $\beta_4$ Disulpho Acid and $\beta_1$-Naphthylamine $\alpha_1$ $\beta_4$ Disulpho Acid.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 1063, January 17, 1894.

When (2.2′)-naphthol sulphonic acid is sulphonated with concentrated or fuming sulphuric acid, the first product is (2.3.2′)-naphthol disulphonic acid. If, however, sulphuric chlorhydrin be used for sulphonating, there results (2.1.2′)-naphthol disulphonic acid, and this acid, when boiled with 20 per cent. sulphuric acid, is converted into (2.2′)-naphthol sulphonic acid. By heating the disulphonic acid with ammonia under pressure, it is converted into the corresponding naphthylamine disulphonic acid. One kilo. of the sodium salt of (2.2′)-naphthol sulphonic acid is gradually stirred into 3 kilos. of 70 per cent. sulphuric chlorhydrin in the cold. Hydrochloric acid is evolved freely, and the melt is allowed to stand 24 hours, until a sample after neutralisation, refuses to combine with diazobenzene chloride, when the whole is poured into ice water, neutralised with lime, and converted into the potassium salt, which forms easily soluble compact crystals, whilst the barium salt forms groups of brilliant needles. When the potassium salt is heated with ammonia to about 190° C. for 10 hours it is converted into (2.1.2′)-naphthylamine disulphonic acid, which, after diazotisation, will combine with phenols and amines yielding azo-dyestuffs.—T. A. L.

### *Improvements in the Manufacture of $\alpha_1$ $\alpha_4$-dihydroxy-naphthalene-α-monosulpho Acid.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 1227, January 19, 1894.

The production of the acid alluded to, 1.1′.4-dihydroxy-naphthalene sulphonic acid, has already been described in Eng. Pat. 13,665 of 1889 (this Journal, 1890, 854). It has now been found that the same acid can be obtained from the 1.4′.1′-naphthylamine sulphonic acid or from the corresponding naphthol disulphonic acid by fusing with alkalis at temperatures above 200° or 170° C. respectively. The former of these two acids is obtained by nitrating and reducing the 1·4-naphthalene disulphonic acid of Eng. Pat. 11,865 of 1892 (this Journal, 1893, 595) whilst the latter is formed by diazotising the 1.4′.1′-naphthylamine disulphonic acid, boiling this derivative with water or acid when it is converted into a sultone sulphonic acid, which on fusion with alkalis gives the 1.4′.1′-naphthol disulphonic acid. The production of 1.1′.4′-dihydroxynaphthalene sulphonic acid from 1.4′.1′-naphthylamine sulphonic acid is carried out by heating 1 kilo. of the latter acid with 3 kilos. of 60 per cent. caustic soda in a pressure vessel for 24 hours to 250° C. The melt is then dissolved in sufficient 20 per cent. hydrochloric acid and allowed to cool, when the sodium salt of the dihydroxy-naphthalene sulphonic acid crystallises out. The following alternative method is also given. 20 kilos. of 1.1′.4′-naphthol disulphonic acid and 100 kilos. of 40 per cent. caustic soda lye are heated at 170°—200° C. under pressure, until a sample, freed from sulphite with sulphuric acid and mixed with sodium acetate, gives a maximum yield of dyestuff with a diazo compound when the melt is worked up as above. It is interesting to note that none of the isomeric 1.4′.1′-dihydroxynaphthalene sulphonic acid is formed in this operation, although 1.4′-naphtholsulphonic acid is more easily converted by fusion with alkalis into dihydroxynaphthalene than is the case with 1.1′-naphthol sulphonic acid.—T. A. L.

### *The Manufacture or Production of Dyestuffs by Means of Trihydroxynaphthalene mono-sulpho Acid.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfield, Germany, Eng. Pat. 1229, January 19, 1894.

By the action of alkalis at temperatures above 240° C. on the naphthalene tetrasulphonic acid obtained by sulphonating 2.3′-naphthalene disulphonic acid, a trihydroxy-naphthalene sulphonic acid is produced (Eng. Pat. 19,624 of 1893; this Journal, 1894, 1054). The patentees have now discovered that this acid is capable of combining in an acid solution more especially acetic acid, with two molecules of compounds containing a free diazo group. For instance, a colouring matter giving yellowish-brown shades on wool from an acid bath is produced by combining one molecular proportion of diazobenzene chloride with one molecular proportion of the potassium salt of the trihydroxynaphthalene sulphonic acid in an acetic acid solution, and afterwards adding one molecular proportion of diazotised *p*-sulphanilic acid. As another example of a colouring matter dyeing greyish-black to black on cotton, one molecular proportion of trihydroxynaphthalene sulphonic acid is combined with one molecular proportion of diazotised aniline and one molecular proportion of the intermediate product from equimolecular proportions of tetrazodiphenyl chloride, and 1.1′.4-amido-naphthol sulphonic acid. Tables are given in the specifications showing other combinations which may be effected.—T. A. L.

### *Manufacture of Azoxy Compounds of the Aromatic Series.* H. Loesner, Leipzig. Eng. Pat. 1555. January 24, 1894.

According to Woehler, aniline is produced by the action of arsenious acid in alkaline solution, on nitrobenzene, but hitherto the nature of this process had not been elucidated. The aniline obtained by this process is only a by-product, because under any circumstances azoxybenzene is formed as the principal product of reduction.

The azoxy-compounds may be obtained in almost theoretical quantity, by applying to the corresponding nitro-derivative the calculated quantity of the reducing agent. In the case of nitrobenzene, meta-nitrobenzoic acid, para-nitrobenzoic acid, and meta-nitrobenzenesulphonic acid the reaction runs quite smoothly, but does not succeed in the case of ortho-substitution compounds, such as ortho-nitrotoluene, ortho-nitrobenzoic acid, and ortho-nitrophenol.

Examples (1) 50 grms. of nitrobenzene are mixed with 60 grms. of arsenious acid, 75 grms. of caustic soda, and about 600 parts of water and heated to boiling from 6 to 10 hours while constantly stirring. The azoxybenze, thus obtained, is filtered and purified by recrystallisation from alcohol. (2) 30 grms. of nitrobenzoic acid are mixed with 30 grms. of arsenious acid, 44 grms. of caustic soda, and about 500 grms. of water and heated to boiling for about five hours. The azoxybenzoic acid is then precipitated from the solution by means of hydrochloric acid, filtered, and the arsenic removed by digestion with dilute hydrochloric acid. The para acid hitherto unknown forms an amorphous faintly coloured powder analogous in properties to the corresponding meta compound. (3) 27 grms. of metanitrobenzene sulphonate of sodium or potassium are mixed with 18 grms. of arsenious acid, 24 grms. of caustic soda, and 300 grms. of water and heated to boiling from 6 to 10 hours. The arsenic is then precipitated by the addition of the calculated quantity of barium or calcium chlorides, and the filtrate concentrated by evaporation to dryness. The sodium or potassium salt of the azoxybenzene sulphonic acid, thus obtained, is purified by recrystallisation.—D. B.

### *Improvements in the Manufacture and Production of New Azodyestuffs.* G. W. Johnson, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pta. 1641, January 25, 1894.

These dyestuffs are derivatives of the 1.1′.4.3′-di-hydroxy-naphthalene disulphonic acid and are obtained by combining it with the diazo compound of a monamine or of an amido-azo compound. The acid itself is produced from the 1·5 naphthalene disulphonic acid. This, when sulphonated at a low temperature with fuming sulphuric acid yields naphthalene trisulphonic acid, which on subsequent nitration and reduction gives 1 4.3′.1′ naphthylamine trisulphonic acid. On converting this into the diazo compound and boiling it with dilute acids it yields 1.1′.4.3′-naphthsultone disulphonic acid which on fusion with caustic alkalis gives 1.1′.4.3′ dihydroxy-naphthalene disulphonic acid. The sodium salt of this acid crystallises in white prismatic needles and is easily soluble in water. The solution has a faint bluish-violet tinge and gives a deep bluish-green coloration on the addition of ferric chloride, which disappears on heating. It is stated that the acid will combine with one or two diazo groups but only the combination of equimolecular proportions of a diazo compound and the acid is claimed. The combination takes place in an alkaline or faintly acid solution, the colours obtained tend more towards the blue end of the spectrum than those from the corresponding chromotropes. They differ from the colouring matters from 1·8 dihydroxy-naphthalene disulphonic acid S in that like the chromotropes they form valuable lakes on the fibres which differ considerably from the original shades.—T. A. L.

### *The Production of Perchlornaphtholdisulpho Acid, and Diazo Dyestuffs therefrom.* S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 1920, January 29, 1894.

By the action of cuprous chloride on the diazo compound of 1.1′.3.3′-amido naphthol disulphonic acid (acid H of Eng. Pat. 1742 of 1891; this Journal, 1891, 918) it yields 1.1′.3.3′-chloro-naphthol disulphonic acid which gives valuable azo-dyestuffs faster to washing and bluer in shade than those from the unchlorinated α-naphthol disulphonic acid. 50 kilos. of the acid H are converted into the sparingly soluble yellow diazo compound. After filtering off, this is mixed with 10 per cent. hydrochloric acid and a solution of 5 kilos. of cuprous chloride is added at 10° C. The whole is then kept at this temperature until the yellow colour has disappeared. After precipitating the copper with sulphuretted hydrogen the filtered solution is saturated at the boiling point with salt when the acid sodium salt of the chloro-naphthol disulphonic acid separates out on cooling. The acid salts crystallise well whilst the neutral salts are very easily soluble; the solutions do not fluoresce and give a dark-green coloration with ferric chloride. The acid combines with diazo- or tetrazo-compounds and in the case of the latter, symmetrical or mixed diazo dyestuffs can be produced, the chloro-naphthol disulphonic acid being used as first or second component. Greenish blue to blue and violet shades are thus obtained.—T. A. L.

### *Process for Obtaining certain Toluene Derivatives from the Mixed Nitrotoluenes obtained by Nitrating Toluene.* H. Loesner, Leipzig. Eng. Pat. 2206, February 1, 1894.

"If aromatic nitro-compounds are reduced by means of salts of arsenious acid (arseniates) [*sic*], amido-bodies are produced in addition to azoxy-compounds." Ortho substitution compounds of nitro-bodies, however, are not or scarcely at all affected by reducing agents. This property may be utilised for separating the individual nitro-compounds from a mixture of ortho-, meta-, and para-compounds. If a mixture of ortho-, meta-, and para-nitrotoluene with arsenious acid be digested in alkaline solution only, the meta- and para-compounds are reduced, while ortho-nitrotoluene remains perfectly unaltered. The latter may be easily separated from the azoxy-amido compounds by known methods. It is advantageous to operate with the use of pressure, in order to facilitate and simplify the reaction.—D. B.

### *The Manufacture and Production of New Mordant Dyeing Colouring Matters.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 3474, February 17, 1894.

The colouring matters are produced by condensing gallic acid with dimethyl- or diethyl-aniline by means of phosphorus oxychloride with or without the addition of zinc chloride or similar substances. About 10 kilos. of gallic acid and 40 kilos. of dimethylaniline are mixed in an enamelled pan provided with an agitator, and 40 kilos. of phosphorus oxychloride are run in. A reaction sets in spontaneously, and when it has somewhat moderated, about 40 kilos. of zinc chloride are slowly added, and the whole is continually stirred until the frothing ceases. The melt is then carefully diluted with 200 litres of water, and the whole is poured into 1,000 litres of water. After adding sodium acetate, the dye-stuff is filtered off and kept in paste form. It gives bright blue shades on chrome mordanted wool, fast to light. The addition of the zinc chloride given in the example is not essential.—T. A. L.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

### PATENTS.

### *Improvements in Size Boiling and Feeding Apparatus for Taping or Slashing Machines employed for Sizing Textile Yarns for Weaving.* M. Bury and W. T. Bury, Darwen, Lancaster. Eng. Pat. 10,207, May 28, 1894.

A contrivance for continually supplying heated and liquefied size to taping machines, &c., consisting of a vertical metallic cylinder, provided at its lower end with separate inlets for steam and size. The latter is pumped into the cylinder—or drawn from a raised reservoir—and during its passage through the apparatus, boiled and disintegrated by the admission of steam, the action being assisted by one or more perforated partitions. From the top of the cylinder the size flows through a pipe directly into the "sow" or "starch-box" of the machine.—H. T. P.

*Improvements in the Treatment of Vegetable Fibrous Matters to obtain Fibres therefrom.* J. Smith and P. W. Nicolle, London. Eng. Pat. 1089, January 18, 1894.

By boiling and subsequently crystallising a solution containing sodium sulphate (2 mols.) and sodium bicarbonate (1 mol), a double salt is obtained of the composition:—$SO_3$, 21·27 per cent.; $CO_2$, 5·15 per cent.; $Na_2O$, 31·50 per cent.; $H_2O$, 42·08 per cent.; and which may be called "a basic carbonated sulphate of soda." The salt is to be used for the purpose of obtaining fibre from such plants as flax, hemp, &c. by the process described in a previous patent (this Journal, 1891, 922), the ½ per cent. solution of carbolate of soda therein named being replaced by a 2½ per cent. solution of the above compound. It is claimed that owing to the feeble alkalinity of the salt, its use involves no injury whatever to the fibre. When the fibre is to be treated with boiling solutions, it is unnecessary to prepare the double salt separately—a mixture of bicarbonate and sulphate of soda may be employed instead.

—H. T. P.

*Improvements in the Manufacture of Artificial Silk.* H. de Chardonnet, Paris, France. Eng. Pat. 24,638, December 21, 1893.

An improvement on the process described in previous patents (this Journal, 1887, 139; 1891, 359 and 566; 1892, 939: compare 1890, 286) consisting essentially in the use of collodion made from hydrated "pyroxil." The latter is obtained by only partially drying nitrated and washed cellulose. The product, containing 25—30 per cent. of water, is said to be a definite hydrate, which cannot be regenerated by soaking completely dried pyroxil in water, and is far more soluble than the dry variety. Moreover its solubility, as also the fluidity of the collodion may be increased by the addition of small proportions of certain ethers, metallic chlorides, acids, &c. The collodion thus prepared, in virtue of the water of hydration it contains, has the property of setting very rapidly, so that the operation of thread-drawing (*ibid.*) need not be conducted under water, the thread being simply discharged into the air, or along a moist surface. Moreover, the threads do not tend to stick together, and, in the case of multiple threads, remain more open and supple. The subsequent denitration of the thread is effected in a bath containing an alkaline sulphide.

—H. T. P.

*Improvements in Machines or Apparatus for Spreading India-rubber and like Materials upon Fabrics.* R. D. Kay, T. Rowley, Manchester, and G. O. Hunstone, Salford. Eng. Pat. 21,667, November 14, 1893.

The improved machine is constructed vertically. Commencing at the bottom, there are, arranged on opposite sides of the apparatus a letting-out and a taking-up roller; above these a spreading and finally a drawing roller, the whole being connected by suitable gearing. The fabric to be coated is drawn over a guide-roller, and from thence over the spreading cylinder. At this point the india-rubber mass or "dough," is pressed into close contact with the fabric and spread over the latter in a thin layer by means of a horizontal knife or gauge fixed close to the cylinder. Subsequently the material passes over the drawing-roller (hollow, and heated by steam) at the top of the apparatus, and down again to the taking-up roller. During its passage over the upper portion of the machine, the coated fabric is dried by means of a steam-chest, or system of steam-pipes arranged between the rollers. By reversing the machine, the cloth may be made to travel in an opposite direction, and coated a second time. For this purpose, two spreading knives are provided on opposite sides of the cylinder, either the one or the other being in operation, according to the direction of the motion. Doubled fabric may be produced by passing coated fabric and lining-cloth together through the machine, the adherence of the two materials being ensured by means of a weighted roller pressing on the spreading cylinder.—H. T. P.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*The Fixation of Lead Dioxide on Fibres, and its Applications.* Bonnet. Bull. Soc. Ind. Mulhouse. Trans. 1894, 69.

By means of plumbite of soda, lead dioxide may be fixed as follows:—(1) Mordant cold for 15 minutes in plumbite of soda, (1 litre = 135 grms. of PbO) diluted with 19 vols. of water: (2) pass directly, without washing, into bleaching powder at 2°—3° B., work ½ hour: (3) wash. Repeat the series of operations. The fibre is very little injured. The repetition of the operations may be omitted if, after washing, the fibre is worked in water acidified with nitric acid.

Fibres thus mordanted acquire a fairly deep black in a bath of aniline salt. The $PbO_3$ may also be utilised to precipitate other oxides; *e.g.*, if the mordanted fibres are worked in a bath of chromium chloride, or of chrome alum made faintly alkaline, chromium oxide is precipitated on the fibre. Lead is then removed by a passage through a weak bath containing soda and glucose.—R. B. B.

*Detection of Artificial and Natural Colouring Matters on the Fibre.* A. Lehne and A. Rusterholz. Färber Zeitung, 1891, *et seq.*

*See under* XXIII., *page* 72.

### PATENTS.

*Improvements in or Appertaining to the Bleaching of Fibrous or Textile Materials.* M. Williams, Liverpool. Eng. Pat. 23,750, December 9, 1893.

Alkaline and oxidising agents which hitherto have been used separately in the usual bleaching processes are by this patent applied simultaneously. For instance, a mixture is made of chloride of lime or a hypochlorite, a carbonated or silicated alkali, and hot water; in this the goods are placed, and preferably the vat is kept heated and agitated by the passage through it of a current of hot air.

—W. E. K.

*Improvements in Preparing for Bleaching and Dyeing and in Bleaching, Dyeing, and Washing Vegetable Textile Material, and in Apparatus therefor.* J. C. Mewburn, London. From La Société Leblois, Piceni and Co., Paris. Eng. Pat. 1656, January 25, 1894.

This process is especially applicable to the bleaching and dyeing of cotton slivers or rovings without subjecting them to matting or deterioration. The slivers or rovings are first threaded or strung on to cords or tapes by a method described. They are then subjected to the action of the washing, bleaching, or dyeing liquor in a vacuum vessel having a movable internal lid, which acts as a weight and presses down the contents of the vessel as they become impregnated with liquid, so preventing matting or entanglement. The manipulation consists in first forming a vacuum within the vessel and then opening a cock at the bottom to admit the liquor. Then the vacuum is reformed and after that air is admitted at the bottom of the vessel, these two last-named operations being repeated eight or nine times. This treatment produces a tumultuous movement of the bath, which effects a thorough impregnation of the material. The material after withdrawal from the vacuum vessel is placed in another apparatus consisting of an immersing wheel, provided with containing drawers arranged around its periphery, and in this it is submitted, if required, to the last operations of bleaching, dyeing, or washing. It is claimed that in the vacuum vessel, cotton in bales (without the removal of the containing hoops or cloths) can be effectively treated.—W. E. K.

*Improvements in Apparatus for Washing and Cleansing Printers' Blanketing.* W Hadfield, J. J. Sumner, and H. Hadfield, Furness Vale. Eng. Pat. 12,772, July 2, 1894.

Whilst passing over a drum or other curved surface the blanket is subjected to the action of scrubbing brushes mounted on vibrating levers or frames and oscillating in the direction of the traverse of the blanket. Simultaneously water or other cleansing liquid is discharged on to the face of the blanket by means of spurt pipes. It is claimed that by reason of the unyielding backing afforded by the drum the cleansing action of the brushes is very effective, and at the same time the back of the blanket is kept almost dry. After leaving the drum the blanket passes over a revolving dry brush, which removes a large proportion of the moisture left upon it.—W. E. K.

*An Improved Machine for Printing on Textile Fabrics and the Like.* J. Bolet, Barcelona. Eng. Pat. 18,218, September 25, 1894.

This invention relates to a rotary machine adapted to operate by continuous movement for printing on textile fabrics and the like by the aid of relief-engraved rollers, and employing fatty inks. The arrangements generally resemble those of the printing machines used in calico print works. There is a bowl, against which the engraved roller is pressed, and a back-grey is used. A special train of nine rollers for inking the engraved roller is employed. —W. E. K.

*Improvements in Machinery for Mordanting, Dyeing, Washing, and Scouring Hanks of Yarn.* W. H. Thorpe, Halifax. Eng. Pat. 19,226, October 10, 1894.

The hanks of yarn are carried on rollers supported in a longitudinal frame, which latter, by means described, is reciprocated backward and forward in the liquor contained in the receiving cistern, and at the same time the rollers have imparted to them a partial forward and backward rotation. The hanks are kept distended by rollers at the bottom of the cistern, held by notched bars running along each side, and kept rigid by means of a pawl taking into notches in the vertical rods running to the upper framework of the machine. Several cisterns are provided, and the whole framework and hanks thereon can be transferred from one to another by means of pulley blocks.—W. E. K.

*Improvements in Dyeing Mixed, Woven or Knitted Fabrics.* T. Ingham, Manchester. Eng. Pat. 19,235, October 10, 1894.

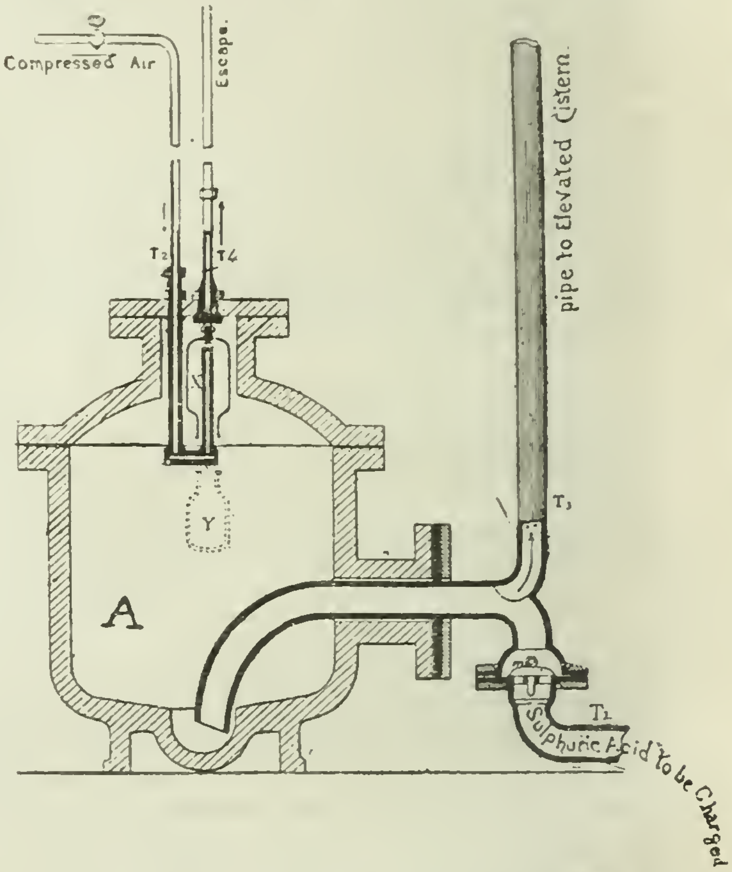
A modification of Pat. 2984, 1889; the colouring matter is applied at boiling heat, and the oxidising bath at double strength, the intermediate process of drying being consequently dispensed with.—W. E. K.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Kestner's Compressed Air Elevator for Liquids.* Biver. Bull. Soc. d'Encouragement, 1894, 336—342.

An automatic elevator for acids and other liquids, working by compressed air. The action is brought about by a float, which, when it rises, opens a valve admitting compressed air into the acid-vessel of the apparatus, and closes an air escape valve; when the float falls, this process is reversed.

In the drawing, which represents the simplest form of the apparatus, A represents a cast-iron vessel of about 50 litres capacity. Through openings in the top are passed the air escape-pipe $T_4$ and the compressed air supply-pipe $T_2$, which is recurved so that its exit is in the same vertical line with $T_4$. Through the side opening of A passes the acid pipe, the lower branch $T_1$ of which communicates with the reservoir of acid at a slightly higher level than A, and is provided with a valve *m*; whilst the upper branch $T_3$ leads to the receptacle into which the acid is to be pumped. X, the float, is a stoneware bottle of about 400 cc. capacity, provided at the top with the valves for closing $T_2$ and $T_4$ and having a vertical motion of about 2 mm. between the two.



The apparatus being empty and the float down, the acid from the reservoir lifts the valve *m* and flows into A until it raises the float, when the air exit closes and the compressed air enters. The pressure of the compressed air closes *m* and raises the acid by $T_3$ until the end of $T_3$ is unsealed. The air then escapes by $T_3$, the pressure is relieved, the float falls, and the whole action begins again. A weight Y can be hung on to X in the case of high pressures where the liquid is to be raised to a considerable height.

Details of the working parts are given in the paper, and drawings of another form of the apparatus, in which a rod attached to X works the valve arrangements in a small glass-faced box placed above the lid of A and communicating with it by a tube in which the rod moves. The working parts can thus be seen and got at for repairs, &c. When the apparatus is used for hydrochloric acid it is covered internally with caoutchouc.—J. T. D.

### *The Freezing Points of Sulphuric Acid of Different Degrees of Concentration.* R. Pictet. Comptes rend. 1894, **119**, 642—645.

The author's results are shown in the following table :—

| Formula. | Percentage $H_2SO_4$ | Densities. | Freezing Points. |
|---|---|---|---|
| | | | ° C. |
| $H_2SO_4$ pure ........... | 100·00 | 1·842 | + 10·5 |
| $H_2SO_4 + H_2O$......... | 84·48 | 1·777 | + 3·5 |
| $H_2SO_4 + 2H_2O$ ....... | 73·08 | 1·650 | − 70 |
| $H_2SO_4 + 4H_2O$ ....... | 57·65 | 1·476 | − 40 |
| $H_2SO_4 + 6H_2O$ ....... | 47·57 | 1·376 | − 50 |
| $H_2SO_4 + 8H_2O$ ....... | 40·50 | 1·311 | − 65 |
| $H_2SO_4 + 10H_2O$ ...... | 35·25 | 1·268 | − 88 |
| $H_2SO_4 + 11H_2O$ ...... | 33·11 | 1·249 | − 75 |
| $H_2SO_4 + 12H_2O$ . ... | 31·21 | 1·233 | − 55 |
| $H_2SO_4 + 13H_2O$ ...... | 29·52 | 1·219 | − 45 |
| $H_2SO_4 + 14H_2O$ ...... | 28·00 | 1·207 | − 40 |
| $H_2SO_4 + 15H_2O$ ...... | 26·63 | 1·196 | − 34 |
| $H_2SO_4 + 16H_2O$ ...... | 25·39 | 1·187 | − 26·5 |
| $H_2SO_4 + 18H_2O$ ...... | 23·22 | 1 170 | − 19 |
| $H_2SO_4 + 20H_2O$ ...... | 21·40 | 1·157 | − 17 |
| $H_2SO_4 + 25H_2O$ ...... | 17·88 | 1·129 | − 8·5 |
| $H_2SO_4 + 50H_2O$ ...... | 9·82 | 1·067 | − 3·5 |
| $H_2SO_4 + 75H_2O$ ...... | 6·77 | 1·045 | 0·0 |
| $H_2SO_4 + 100H_2O$ ..... | 5·16 | 1·032 | + 2·5 |
| $H_2SO_4 + 300H_2O$ ..... | 1·78 | 1·007 | + 4·5 |
| $H_2SO_4 + 1,000H_2O$ ... | 0·54 | 1·001 | + 0·5 |

—A. R. L.

### *The Decomposition of Nitric Acid by Ammonium Sulphate in the Concentration of Sulphuric Acid.* G. Lunge and W. Abenius. Zeits. angew. Chem. 1894, 608—610.

The nitrogen acids exist in sulphuric acid either as nitrosylsulphuric acid (in weak acid also partly as nitrous acid) or as nitric acid. They are, as is known, destroyed by boiling with ammonium sulphate, although it is difficult to remove the last traces by this means. The authors in the present investigations neglect such traces of the nitrogen acids as are only indicated by such reagents as diphenylamine, brucine, &c., and by "complete decomposition" they understand that the nitrogen acids have been so far removed that no gas can be collected in the nitrometer.

On boiling with ammonium sulphate, nitrous acid (that is to say, in this connection, nitrosylsulphuric acid) and nitric acid act differently. In the case of nitrous acid the reaction is expressed by the equation—

$$NOOH + NH_3 = 2H_2O + 2N.$$

From a number of experiments it was proved that even in sulphuric acid of 1·71 sp. gr. the whole of the nitrous acid was destroyed by boiling for 5 minutes with the amount of ammonium sulphate required by this equation.

On the other hand, nitric acid is not readily destroyed. Three reactions are *primâ facie* possible in this instance :—

$$1.\ 3HNO_3 + 5NH_3 = 9H_2O + 8N,$$

$$2.\ HNO_3 + NH_3 = 2H_2O + N_2O,$$

and 3, the nitric acid may give off oxygen, thus being reduced to nitrous acid, which then reacts with ammonia in the way already indicated.

The authors have made a number of investigations with concentrated acid of 1·84 sp. gr. and with acid of 1·71 sp. gr., but have not yet been able to decide which of these reactions represents what takes place. Their researches however show definitely that even in the most concentrated acid it is necessary to boil for half an hour with 1 mol. of $NH_3$ to 1 mol. of $HNO_3$ in order to decompose all the nitric acid, but that in the case of acid of 1·71 sp. gr., such as is obtained from lead pans, the nitric acid can only be removed by boiling for many hours with a large excess of ammonium sulphate. Their results show the importance in sulphuric acid manufacture, of guarding against all contamination of the acid with nitric acid, whilst contamination with nitrous acid is not of such serious consequence.

—H. S. P.

### *The Action of Nitric Oxide on Certain Metals at a High Temperature.* F. Emich. Monatsh. Chem. **15**, 375—390.

Sabatier and Senderens have previously studied the action of nitric oxide upon certain metals and their lower oxides, and concluded that the resulting oxides are different from those formed when the metals are heated in the air (Comptes rend. **114**, 1429—1432). The author's experiments show that, on the contrary, in the majority of cases the same oxides are formed as final products, but that their formation is much slower when nitric oxide is the oxidising agent. In view of the fact that nitric oxide is itself partially decomposed at 500°—600° C., the experiments in most cases were performed at or below this temperature. The metal was employed in a finely-divided state, generally prepared by the reduction of the oxide in a current of hydrogen. At the start, the action of the nitric oxide is incomplete, and it is necessary to pulverise and reheat the metal in nitric oxide repeatedly, before the final action can be achieved. This point was overlooked by Sabatier and Senderens, and hence in all probability arises the differences in the results obtained.

The action of nitric oxide upon the following 14 metals (copper, zinc, cadmium, mercury, tin, lead, chromium, molybdenum, tungsten, uranium, manganese, iron, nickel, cobalt) was tried, with the result that the same products are obtained as when they are heated in air, except in the cases of copper and lead, which form cuprous oxide and lead monoxide respectively, instead of cupric oxide and red lead ($Pb_3O_4$). Mercury is without action on nitric oxide at its boiling point.—C. A. K.

### *The Occurrence of Perchlorate in Saltpetre.* C. Haeussermann. Chem. Zeit. 1894, **18**, 1206—1207.

The author confirms Hellich's observation that commercial potassium nitrate is frequently contaminated by perchlorate. Various samples of "pure" potassium nitrate, intended to be used in the manufacture of gunpowder, were all found to contain perchlorate, although in every case chlorate was absent and chloride practically so. According to the author the impurity is derived in the first place from the Chili saltpetre, from which by double decomposition potassium nitrate is largely prepared, and originally probably from the natural nitre deposits which form the source of Chili saltpetre. The possible risk of explosions arising from the use of such saltpetre for gunpowder manufacture is pointed out. At the same time there is no evidence to show that such risk exists; and, as a matter of fact, similar brands of nitre have been employed during past years without accident. As a means of getting rid of the perchlorate, the author suggests that the impure saltpetre be fused in a cast-iron vessel until all perchlorate is destroyed, and afterwards recrystallised.—H. T. P.

### *Detection and Estimation of Minute Quantities of the Nitrogen Acids.* G. Lunge and A. Zwoff. Zeits. angew. Chem. 1894, 345.

*See under* XXIII., *page* 67.

*The Electrolytic Preparation of Potassium Zincate.* Ph. Schoop. Zeits. f. Elektrotech. u. Elektrochem. 1894, **6**, 205 and 247.

*See under XI., page 41.*

### PATENTS.

*Improvements in or Appertaining to Apparatus for Drying Bicarbonate of Soda.* G. Jármay, Winnington. Eng. Pat. 23,889, December 12, 1893.

Moist sodium bicarbonate is fed through a valved hopper into a long, covered trough, having a valved outlet at the farther end, towards which the salt is taken by the action of a revolving shaft carrying paddles. Air, previously heated to about 95° C., is drawn in through a pipe at the entrance end of the apparatus by a fan connected to a vertical pipe immediately above the outlet valve. The dust bicarbonate carried forward by the draught collects in a dust-settling box surmounted by a dust bag or hose. Both the mechanical feeder and the discharging door or screws are so constructed as to form a hermetic seal in each. The air passed through is preferably mixed with carbonic acid, and then a higher temperature than that stated may be used. The air, or mixture of air and carbonic acid, may be conveniently heated by steam in a multitubular apparatus. —E. S.

*Improvements in the Manufacture of Refined Bicarbonate of Soda.* G. Jármay, Winnington, Chester. Eng. Pat. 23,890, December 12, 1893.

Reference is made to previous inventions for purifying the crude sodium bicarbonate obtained in the ammonia-soda process, one by the present patentee and Ludwig Mond (Eng. Pat. 2996, 1884; this Journal, 1885, 282), and the other by Solvay (Eng. Pat. 173, 1888; this Journal, 1889, 45). The improvements on these processes now described consist in dissolving the crude bicarbonate in a close vessel having a hopper with valve for admission of the salt, and a mechanical agitator, at from 85° to 95° C., this temperature being obtained, not by blowing steam in, but by a steam coil. Besides ammonia, some carbonic acid is given off, and these gases, with steam, pass into a multitubular chamber, the coil in which is surrounded by the mother-liquor from a previous operation. Exit is provided for the cooled carbonic acid gas. The solution in the dissolving vessel now contains bicarbonate and sesquicarbonate; it is filter-pressed and pumped to the upper part of an iron tower having numerous compartments with internal cooling pipes through which water is passed, so as to reduce the temperature of the solution to about 40° C. Dilute carbonic acid gas, such as that from limekilns, is passed in near the bottom of the tower, so as to bubble upwards and keep the liquor agitated. The carbonated liquor, with bicarbonate in suspension, passes by a pipe from the bottom of the tower into an elevated filtering vessel, in which the sodium bicarbonate collects, and the filtered mother-liquor flows thence into the heater, or multitubular chamber, and then into the "dissolver." The crust of bicarbonate that collects in the towers is dissolved by the mothor-liquor heated to about 80° C., and the solution thus obtained is run into the dissolving vessel, to be saturated with crude bicarbonate. —E. S.

*Improvements in Treating the Residual Products of certain Manufactures and in Treating certain Metallic Ores for the Manufacture of Chlorine.* E. J. Hunt, Stafford. Eng. Pat. 24,175, December 15, 1893.

*See under XI., page 42.*

*Improvements in Obtaining Cyanides and Ferrocyanides.* J. B. Readman, Edinburgh. Eng. Pat. 6621, April 3, 1894.

Carbonaceous matter and barium carbonate are heated by electricity in a carbon-lined furnace, one carbon electrode being introduced through a stuffing-box in the close-fitting cover, and the other through the bottom of the vessel, so that the arc is formed between them through the body of the mixture, while nitrogen, or air deprived of oxygen, is passed in. For barium carbonate, other alkaline earths or alkalis may be substituted, oxides of sodium, potassium, calcium, strontium, barium, "or their carbonates or other suitable salts, or the said metals" being specified. The furnace is built externally of fire-bricks; the iron cover is insulated by asbestos, which is also used in the stuffing-boxes for the electrodes; a tapping outlet is provided through which the fused cyanide flows into a receptacle protected from the air by a casing; and a pair of valved hoppers, both communicating with a pipe for admission of the nitrogen, is fitted to the cover. The charge, which may consist of 5 parts barium carbonate to 1 part of oil-, coke-, or wood-charcoal, both in powder and well mixed, is passed in through the hoppers, which have close-fitting lids. An exit pipe is provided for waste gases, opposite to the tapping outlet. Should any of the cyanide formed be volatilised, the escaping vapours are passed through collecting, condensing, or absorbing apparatus. When a ferrocyanide is required, iron, or one of its suitable salts, is added to the charge; or it may be obtained from the cyanide formed as described by known means.—E. S.

*Process for the Manufacture of Neutral Sodium Carbonate, Neutral Sodium Sulphite, and Sodium Borates.* E. Dresel and J. Lennhoff, Berlin. Eng. Pat. 14,905, August 3, 1894.

To prepare sodium carbonate "one equivalent" of carbonic acid is passed into an ammoniacal solution of sodium chloride, and then dry ammonia-gas under a stated pressure, the temperature of the liquid being kept at or below 8° C. The sodium carbonate is precipitated with one atom of water of crystallisation, which may be expelled by heating to above 100° C. Sodium sulphite is prepared in like manner, sulphur dioxide being substituted for carbonic acid, the temperature in this case being not higher than 15° C. The neutral sodium sulphite precipitated is anhydrous. Or a solution of sodium chloride, with an equivalent of ammonium carbonate or sulphite, is subjected to the action of ammonia "under cooling or pressure or both," to obtain respectively the carbonate or sulphite. In like manner sodium borate is obtained by reacting on sodium chloride solution with ammonium borate and ammonia; but in this case sodium sulphate may replace the chloride. The preferred process consists in adding, for the neutral borate, one equivalent, or, if a biborate (borax) is wanted, two equivalents of boric acid, to solution of sodium chloride or sulphate, and then passing dry ammonia into the solution; the boric acid dissolves as the temperature rises, forming ammonium borate, which reacts on the sodium salt, and, on cooling, the borate crystallises out. "It is advisable to use ammonia in excess, until the solution possesses the same alkalinity as the borate to be produced."—E. S.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### PATENT.

*An Apparatus for applying Glazes or Enamels to Tiles or other like Goods.* A. Maw, G. H. Maw, and B. Suart, Jackfield. Eng. Pat. 23,753, December 9, 1893.

The apparatus consists of a horizontal frame to which another horizontal frame is hinged, along which travels an endless band conveying the tiles to which the glaze is to be applied. The glaze is contained in a reservoir placed above the main frame, in which revolves a roller distributing the glaze upon a band of india-rubber covered with some textile absorbent material, which passes over the surface of each tile in turn

as it is presented by the travelling band. The pressure of the tiles against the rubber band is regulated by means of the hinged portion of the frame, which is controlled by a graduated lever carrying a jockey weight. The reservoir of glaze can be lowered bodily out of contact with the distributing roller when it is desired to cut off the supply.
—B. B.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*The Co-efficient of Dilatation of Cement and Cement Mortars.* Keller. Thonind. Zeit. 1894, **18**, 469

The author has determined the expansion of various cement mixtures, both under the influence of temperature and under that of the addition of moisture. Commercial Portland cement was used neat, and mixed with sand and gravel from the Rhine. The stones in the gravel were about 20 mm. in their longest diameter. The following mixtures were used. (1) Neat cement, (2) One part of cement to one of aggregate, (3) 1 : 2, (4) 1 : 4, (5) 1 : 6, (6) 1 : 8. Prisms 300 mm. long and 70 by 70 mm. in section were prepared and kept under water until the time of testing. The range of temperature through which the tests were performed was from – 16° to 72° C. Twenty-four hours' exposure was necessary to make sure that the test pieces attained a uniform temperature throughout their mass. The following mean co-efficients, referred to a rise of temperature of 1° C. and in presence of an equal amount of moisture in the test pieces, were determined. (1) 0·0000126, (2) 0·0000110, (3) 0·0000101, (4) 0·0000104, (5) 0·0000092, (6) 0·0000095. These figures appear to be regularly related to the composition of the test pieces, the small fluctuations observed being errors of observation.

A second series of tests was made to ascertain the influence of moisture in the test pieces, with the result that the expansion due to the addition of 1 per cent. of moisture was found to be as follows for the six mixtures examined. (1) 0·000090, (2) 0·000073, (3) 0·000072, (4) 0·000042, (5) 0·000033, (6) 0·000027. The author proceeds to calculate the total expansion of a bar of concrete 20 m. in length, formed of a mixture of 1 part of cement to 2 of gravel, arising from a difference of temperature of 40° C. and from an increase of water of 2 per cent. Taking the figures previously given, the expansion due to rise of temperature is 0·000404. That due to increase of moisture is 0·000142, so that the total expansion is represented by the sum of these numbers multiplied by the length of the bar, this being equal to 0·01096 m. or in round numbers 11 mm.
—B. B.

*The Valuation of Marl for Hydraulic Cements.* G. Lunge and M. Schochor-Tscherny. Zeits. f. angew. Chem. 1894, **16**, 481—495.

The authors have endeavoured to ascertain whether it is practicable to supplement the information afforded by the analysis of a marl intended for the manufacture of a hydraulic cement, by a direct test indicating its behaviour when exposed to a temperature approaching, but not reaching, that at which hydraulic cements are prepared. They give numerous analyses of marls used in the manufacture of cement, and elaborate details of the extent to which the acid and basic constituents of these marls react upon each other at a full red heat. After comparing the data which they have obtained in this manner, with those given by burning the marls in a small trial kiln on a small scale, the authors state that they have established a sufficient concordance between the results to justify the use of the proposed process, which is thus summarised. The sample to be examined is exposed in a platinum crucible for two hours to a strong red heat, and the ignited material is powdered and successively extracted with dilute hydrochloric acid (1 : 3) and with 5 per cent. sodium carbonate solution. The insoluble residue is dried, ignited, and weighed, when its quantity forms a measure of the degree of ease with which the material is burnt to a hydraulic cement. In an appendix to the paper, the authors give 1,127° C. as the approximate temperature at which their experiments were conducted, this figure being obtained by the air pyrometer of Meyer and Riddle, and lying about 100° above the temperature indicated by the incipient fusion of an alloy of silver and gold containing 60 per cent. of the latter, which was also used in determining the temperature. They endorse the statement of M. Meyer that the clinkering point of most cements lies at or near 1,450° C., and dismiss the statement hitherto current that it is greatly higher, *e.g.* 2,000° C.—B. B.

*The Hardening of Mortar.* J. A. Macpherson. J. Amer. Chem. Soc., November 1894.

In order to ascertain whether the common belief among builders that mortar is improved by being allowed to lie in a heap for some days before being used, is founded on fact, tests were made on mortars that had been thus exposed for known periods, briquettes being prepared and their tensile strength determined after the lapse of six or seven weeks. A slight increase of strength, amounting to about 10 per cent. when the time of exposure was increased from three to seven days, was observed. This result does not appear to be due to the formation of calcium silicate, as an insignificant amount of this substance was found in the mortar. This is borne out by the examination of a mortar 130 years old, which was found to contain 0·34 per cent. of calcium silicate. The influence of sugar upon mortar was investigated and found to be slightly favourable when the briquettes were kept in air, and almost without influence when they were kept under water. The substitution of bullock's blood diluted with one-third its volume of water, for pure water, increased the strength of the briquettes by about 10 per cent.—B. B.

### PATENTS.

*Improvements in the Manufacture of Portland Cement.* A. McAra, Glasgow. Eng. Pat. 1427, January 23, 1894.

Argillaceous or siliceous limestone is ground and mixed with argillaceous or calcareous materials such as "soft limey blaes or shale," or with fat lime or chalk, in order to bring the composition of the resulting slurry to that usual in the preparation of Portland cement. The use of the main constituent in the form of a dry powder and that of the material added to correct the composition of the mixture in the form of a slurry, are claimed.—B. B.

*A New or Improved Method or Process for the Manufacture of Artificial Wood.* C. Geige, Broich, Germany. Eng. Pat. 10,585, May 31, 1894.

Six to eight parts by volume of peat are washed until the fibres are separated, and mixed with two parts of plaster of Paris and 10 to 12 parts of water. The mass is moulded and subjected to hydraulic pressure, and dried by means of a current of cold air. The product when dry may be oiled or coated with a solution of resin in alcohol. In order to prevent the rapid setting of the plaster, glue may be added, together with chromate of potash, or other agglutinants may be substituted for the plaster. The composition is said to be readily worked in the same manner as wood.—B. B.

*Improvements relating to the Treatment of Terra-Cotta, Wood, Clay, Gypsum, Limestone, and other Materials for Preserving and other Purposes.* E. Tortora, Naples, Italy. Eng. Pat. 19,437, October 12, 1894.

The invention consists in placing such materials as terra-cotta, wood, gypsum, &c., in a bath of paraffin or ozokerite at a temperature above the boiling point of water, but below that of the preservative wax. Moisture and gases are expelled from the pores of the materials treated, and absorption of the preservative takes place. It is stated that "soft and cracked stones are transformed into a very good material by this process." Mixtures of "sand and gum lac, sand and gypsum," and like compositions, may also be treated in a similar manner.—B. B.

*Improvements in and relating to the Vulcanisation of Timber.* W. E. Heys, Manchester. From F. M. Grumbacher, Berlin, Germany. Eng. Pat. 20,574, October 27, 1894.

The process patented consists in drying timber at a moderate temperature, *e.g.*, not exceeding 120° C., and subsequently "vulcanising" it by exposing it to a temperature as high as 250° C. The apparatus used consists of a horizontal cylindrical chamber within which are placed rails upon which a truck runs in the manner adopted in creosoting plant, provided with a steam coil, and the usual fittings, such as a manometer and pyrometer. Both stages of the operation are carried out in this vessel, the end of the first stage being recognised by the cessation of condensation of water in a small condenser attached to one end of the cylindrical chamber. When the drying is completed air is pumped in to a pressure of about 10 atmospheres, and the temperature of the chamber is raised by means of the steam coil to about 250° C. It is claimed that by the preliminary drying at a comparatively low temperature, "vulcanisation" under pressure and at a higher temperature can be effected without injuring the wood.—B. B.

*New or Improved Material for Building Purposes.* F. Wittmann, Berlin, Germany. Eng. Pat. 20,535, October 26, 1894.

The material patented consists of a mixture of 1,000 grms. of slag or coal ashes, 100 grms. of cream of lime, 100 grms. of cement, and 120 grms. of water. The composition thus prepared is moulded into slabs or arches, with or without stiffening insertions of iron. Slabs prepared in this way are suitable for partition walls where it is desired to hinder the transmission of sound.—B. B.

## X.—METALLURGY.

*The Practical Operation of the Cyanide Process on the Witwatersrand (Transvaal) Gold Fields.* M. Eissler. Institute of Mining and Metallurgy, November 21, 1894.

The reason that the cyanide process, although unsuccessful in America and elsewhere, is so successful in the Witwatersrand Fields, is believed by the author to be that the ores in this locality carry the gold in a pure, metallic, and extremely fine state of division, and that the gold in the pyrites is in a free state and not in chemical combination. That gold is soluble in cyanide of potassium was known in the Middle Ages, and ancient documents are promised to prove this statement. Its application to the treatment of ores was patented in the United States in 1867, but no satisfactory practical results were obtained. In 1894, about one-third of the gold produced at the Witwatersrand fields was obtained by the cyanide process.

The author describes the working details of the process as carried out in the district for the treatment of tailings, and does not enter into the chemistry of the subject. The conglomerates, after stamping, contain a very large percentage of slimes, by which is understood the very fine particles of talcose and clayey materials, together with fine quartz, iron oxides, and sulphides. At least 30 per cent. of the ores pass away into the slime pits, which on the quantity treated, is calculated to represent 20,000 ounces of gold per month. Up to the present no method has been devised for profitably dealing with these slimes. It is a mechanical problem, as there is no chemical difficulty in the way. The gold is easily soluble in cyanide, and the author believes that the difficulty may be overcome by agitating with very weak solutions, settling, decanting, and recovering the gold by the Siemens and Halske electrical process, which is equally effective with very weak or strong solutions. The slimes are in an extremely fine state of division, and in one case it is shown that they do not completely settle in 24 hours, and the final settlings after this contain 6 dwt. of gold per ton, and are richer than the first. The following results show the physical condition of these tailings :—

| Size of Sieve. | Result. | Gold Assay. |
|---|---|---|
| Meshes per Sq. In. | | Dwt. per Ton. |
| 900 | All passed through. | .. |
| 1,600 | 1·85 per cent. remained on sieve ... | 3·03 |
| 3,600 | 27·93 " " " ... | 4·00 |
| 7,225 | 20·74 " " " ... | 4·40 |
| 14,400 | 7·70 " " " ... | 4·65 |
| | 41·78 " passed through. | .. |
| This 41·78 per cent. was panned, and— | | |
| | 11·80 per cent. remained in the dish........ | 6·30 |
| | 22·34 " fine sand passed away....... | 2·85 |
| | 7·64 " slimes in the panning water | 2·85 |

The author discusses the methods and advantages of "intermediate filling" and "direct filling," in respect to which there is considerable controversy, and he proceeds to describe in detail the leaching and stock tanks and the zinc boxes, and to give a synopsis of the process. From this it appears that the tailings, from the plate amalgamation treatment, are first treated with an alkaline wash containing 0·15 per cent. of $KCy$ and four ounces of caustic soda per ton of solution. After this the strong solution of $KCy$ (0·3 to 0·5 per cent.) is run on to the tailings to the extent of one-third the weight of the latter. When this solution is leached out the tailings are drained for an extra four hours, by which means they become exposed to the air, which, with the cyanide left behind, effectually attacks the remaining gold. The weak solution of $KCy$ (0·15 per cent.) is then used to wash out the gold, with a final washing with water. Fifty hours is the time taken for the whole of the operations. When the tailings are acid from the decomposition products of iron pyrites, caustic lime is sometimes added to them previous to leaching. The important question of whether it pays to concentrate the tailings before sending them to the cyanide works has not yet been definitely settled in these fields.

The presence of copper in the ore acts prejudicially to the cyanide treatment. It is important therefore to remember the fact of the selective solvent action of weak solutions of cyanide on gold in preference to other metals, and also that gold will dissolve in the weakest solutions in which copper and other metals might remain unaffected. In the case of complex ores the tendency is to increase the strength of the cyanide to overcome the disturbing influence of the baser metals, very often the result ending in failure. To employ very weak solutions would be likewise commercially ineffectual if the ordinary zinc precipitation method were adopted, since the dissolved gold is not thereby precipitated from very weak solutions. The new process, by Siemens and Halske, of electrically precipitating gold on thin lead plates, which works with solutions of any strength even in the presence of caustic soda, renders the employment of very weak solutions, in accordance with the selective solvent action before mentioned, practically successful.

In this process the conditions which the metal cathode must fulfil, are :—(1) The precipitated gold must adhere to it; (2) it must be capable of being rolled out into very thin sheets to avoid unnecessary expense; (3) it must be easy to recover the gold from it; and (4) it must not be more electro positive than the anode, in order to prevent return currents being generated when the depositing current is stopped. The most suitable metal is therefore lead, rolled into very thin sheets, and it is found to be important that a very large surface of electrode should be employed, a better effect being obtained by doubling the number of plates than by increasing the current tenfold. No less important is the question of the anode. Carbon could be used for this, but it will not withstand the action of the current and soon crumbles into a fine powder, which decomposes the cyanide. Zinc used as an anode forms a white precipitate of ferrocyanide of zinc by the reaction of zinc oxide upon the ferrocyanide formed during the leaching. Similarly iron anodes form Prussian blue. The latter can be decomposed with caustic soda, and the cyanide recovered by evaporating the solution and smelting with potassium carbonate. Iron plates are therefore used for the anode. Only a very weak current is required to precipitate the gold, the advantages gained by such a weak current being (1) that the gold is deposited hard on the plates; (2) that the iron anodes are preserved for a long time, as their waste is in proportion to the current strength; and (3) that little horse-power is required. In this process there are none of the complications arising from the formation of lime and alumina and hydrate of iron, which under similar circumstances sometimes occasion so much trouble in the zinc process. Practically, experience shows that if an ore containing copper be treated with a strong solution of cyanide, say 2 to 3 per cent., the potassium cyanide may be all decomposed, but if a weaker solution, say 0·5 per cent. be applied, although the cyanide will be also decomposed, the same extraction of gold will be effected. So that though in the former case the treatment may appear commercially impracticable, the proper carrying out of the process by leaching with weak solutions may prove to be both effective and economical.

The vats hold 135 tons, and it takes five hours to fill them. The tailings first get an alkaline wash of 10 tons. After this 70 tons of strong solution of cyanide (0·05 to 0·08 per cent.) are pumped on, and then 20 tons of a weak solution of 0·01 per cent. strength, each vat taking five days to thus leach, filter, and discharge. The actual extraction of fine gold by these solutions has averaged 70 per cent., whilst the consumption of cyanide has been a quarter of a pound per ton of tailings treated. The iron anodes are plates 7 ft. long, 3 ft. wide, and one-eighth of an inch thick. They are kept in a vertical position by wooden strips, and are so placed in the vat that the solution in passing through is made to circulate alternately over and under them. The lead sheets are stretched between two iron wires fixed in a light wooden frame, which is then suspended between the iron plates. They are covered with canvas to prevent short-circuiting. Once a month these frames are taken out one at a time, the lead removed and replaced by fresh sheets, and the frame returned without any interruption of the working. The lead, which contains from 2 to 12 per cent. of gold deposited as a thin bright, yellow, adherent film, is then smelted into bars and cupelled. The consumption of lead is 750 lb. per month at the works, treating 3,000 tons per month, and the consumption of iron is 1,080 lb. for the same period, and the whole cost of treatment works out to 3*s.* per ton. A month's working showed that whereas the balance between the tailings and the final residue showed a theoretical output of 71·6 per cent., the actual gold recovered amounted to 74·1 per cent. The tailings assayed 6 to 8 dwt., and the final residues, after treatment, 1 to 2 dwt. per ton. The solutions which leave the precipitation boxes still contain traces of gold, analysis showing that the strong solutions carry away between 4 and 5 dwt. per ton of solution, and the weak from 0 to 1 dwt., but the solution, after the addition of cyanide, is used over again to leach fresh tailings.—A. W.

### *Loss of Gold and Silver during Scorification Assay.* W. P. Mason and J. W. Bowman. J. Amer. Chem. Soc. 1894, **16**, 313—314.

Two tables are given recording the total loss incurred in the cupellation, and in the scorification *plus* cupellation, of various weights of gold and silver under conditions such as would obtain in careful practical work. The following is a summary of the results:—

| Weight before Cupellation or Cupellation *plus* Scorification. | Number of Experiments. | Percentage of Loss. | | |
|---|---|---|---|---|
| | | Highest. | Lowest. | Average. |
| Silver: | | | | |
| 150—250 cupelled ... | 7 | 2·92 | 1·79 | 2·18 |
| 400—450 „ ... | 5 | 2·27 | 0·95 | 1·85 |
| 500—550 „ ... | 4 | 2·29 | 1·38 | 1·85 |
| Mean........... | 16 | .. | .. | 1·99 |
| 200—360 scorified and cupelled. | 6 | 3·95 | 1·68 | 2·78 |
| 400—500 „ | 7 | 4·53 | 2·06 | 2·76 |
| 550—652 „ | 7 | 2·51 | 1·66 | 2·10 |
| Mean........... | 20 | .. | .. | 2·54 |
| Gold: | | | | |
| 200—350 cupelled ... | 16 | 0·888 | 0·165 | 0·30 |
| Mean........... | 16 | .. | .. | 0·30 |
| 221—350 scorified and cupelled. | 8 | 1·07 | 0·44 | 0·65 |
| 350—480 „ | 12 | 2·10 | 0·48 | 1·02 |
| Mean........... | 20 | .. | .. | 0·87 |

—W. G. M.

### *Fusing-points of Re-melted Lead-Tin Alloys.* B. Wiesengrund. Wied. Ann. 1894, **52**, 777.

THE author prepared the following alloys of lead and tin:—$PbSn_{12}$, $PbSn_5$, $PbSn_4$, $PbSn_3$, $PbSn_2$, $PbSn$, $Pb_2Sn$, $Pb_3Sn$, $Pb_4Sn$, $Pb_5Sn$, $Pb_{12}Sn$, and investigated their melting-points. In agreement with the results of Rudberg, E. Wiedemann, and Pillichody, he found that on cooling the melted alloy there were two stationary or slowly-altering temperatures. One of these, especially in the case of alloys rich in tin, occurred at about 180° C., whilst the other, in the case of alloys rich in lead, lay between 200°– 300° C. The results are given in tables and curves, and are explained on Rudberg's and Wiedemann's hypothesis, namely, that one of the points (187°) is the melting-point of a "chemical alloy" having the composition $PbSn_3$, whilst the higher point represents the melting-point of a solution of the excess of metal in the above "chemical alloy."—J. S.

### *Experiments on a Ferro-Tungsten.* J. S. de Benneville. J. Amer. Chem. Soc. 1894, **16**, 297—304.

A RICH ferro-tungsten gave abnormal results on analysis, and this led to a more detailed examination. The alloy, as described by Howe in his "Metallurgy of Steel," was "platinum-grey, hard, and brittle," and many fragments exhibited cleavage planes of a pyritous appearance; but it was visibly heterogeneous. The average proportion of tungsten exceeded 40 per cent., but varied so much that it is probable that several alloys were present. Two-thirds of the total iron could be removed by strong hydrochloric or nitric acid; sulphuric acid had but little effect, whilst fused potassium bisulphate decomposed the alloy completely; aqua regia attacked it slowly, provided that the tungstic acid was removed from the particles as it was formed. It is noteworthy that while from 36 to 38 per cent. of iron was dissolved by hydrochloric acid (sp. gr. = 1·2), only from 2 to 3 per cent. of tungsten was extracted with it, yet the amount of "free" iron was usually small, and could for the most part be accounted for by the presence of particles from the steel mortar in which it was necessary to crush the samples. Small portions of the alloy were then digested for 30 hours with neutral silver nitrate solution, which would dissolve free iron or convert free tungsten into tungstic acid, in either case depositing an equivalent amount of metallic silver. In this way the free or soluble iron was found to range from 0·7 to 5·6 per cent., except in two cases where segregation had occurred in cooling, and in these it averaged 33 per cent., whilst the free or soluble tungsten ranged from 4 to 7 per cent. The residue from this operation was washed and digested for from 36 hours to a week with excess of ammoniacal silver nitrate solution, and in this manner the previously unattacked iron and tungsten were determined. An alloy which has the approximate empirical formula $Fe_3W_4$, has been described by Howe, and in this iron acts as an octovalent element; hence, the alloy here spoken of is not saturated with the tungsten. The combining power of iron and tungsten in alloys must be very considerable, as the iron is not affected by the neutral solution of the very electro-negative elements, silver (as nitrate) or copper as copper ammonium chloride.—W. G. M.

## PATENTS.

*Improvements in Apparatus for Coating with Tin, Lead, or other Metals or Alloys of same.* H. F. Taylor, Neath. Eng. Pat. 21,530, November 11, 1893.

The plates on entering the bath are caught by nippers, which may be preliminarily adjusted to the thickness of the plates, and are automatically gripped by them as they pass downwards through the bath and upwards to the rolls, the rate of translation being varied by cam mechanism, so that the descent is slightly accelerated as soon as the plate has passed through the flux, and the ascent is much more rapid until the first pair of rolls is almost reached, when it is slowed, so that the rolls themselves may grip and carry the plate through to the end. The rolls are arranged as in Morewood's specifications (Eng. Pat. 1873, 3125 and 3126), except that the troughs under the upper two pairs have a triangular rib underneath, so placed towards the rear that the overflow drip falls on the descending side (not into the nip) of the pair of rolls next below; and thus excess tin is returned to the bath without unduly coating the plate.—W. G. M.

*Improvements in the Manufacture of Steel.* B. Talbot, Pencoyd, Pa., U.S.A. Eng. Pat. 18,919, March 23, 1894.

In order to economise time and labour in charging the open-hearth steel furnace, the fragments of scrap are cemented together by pouring the pig-iron in a melted condition over and around them in open ingot moulds, and charging the resulting ingots hot. The four sides of the mould are preferably clamped together, and the clamps should be loosened directly the outer edge of the iron has set, to prevent the jamming which would arise from the expansion of the scrap. The ingots are tapered, the base being widest, and ordinarily weigh from 3,500 lb. to 4,000 lb. each.—W. G. M.

*Improved Method of and Apparatus for Extracting Moisture from Air for Blast Furnaces and Converters.* J. Johnson, Liverpool. From J. Gayley, Braddock, Pa., U.S.A. Eng. Pat. 20,207, October 23, 1894.

To avoid the irregularities introduced by variations in hygrometric conditions, the air for the furnaces is cooled to 0° C. This is effected by passing it from the pumps first through a water-jacketed condenser-tube, then through an expanded chamber fitted with transverse water-cooled pipes and a second chamber containing iron pipes cooled by means of anhydrous ammonia furnished by an ice-making machine, and finally over a series of iron grids intended to catch the moisture condensed into mist, which would otherwise be carried over mechanically. Other means of cooling may be used, and the refrigeration may precede the compression in the blowing engine.—W. G. M.

*Improvements in the Manufacture of Steel, Steely-iron, or Homogeneous Metal.* W. P. Thompson, Liverpool. From E. Bertrand and O. Thiel, Kladno, Bohemia. Eng. Pat. 20,122, October 25, 1894.

This specification refers to a modification of Eng. Pat. 1894, 10,923 (this Journal, 1894, 816), by which, instead of running the metal through troughs from one open-hearth furnace to another, it is tapped into a ladle suspended from a revolving crane, and thus conveyed to the next furnace, into which it is poured through a movable channel. The furnaces in which the different stages of the refining are carried on are placed tangentially to the circular path of the suspended ladle, with the tap-hole outwards.—W. G. M.

*Improvements in Processes for Reducing Aluminium.* J. C. Fell, London. From F. A. Gooch and L. Waldo, Connecticut, U.S.A. Eng. Pat. 20,615, October 27, 1894.

This invention consists in electrolysing a fused mixture, preferably of the chloride and fluoride of aluminium, in any suitable vessel, and in simultaneously injecting steam or water on or near the surface for the purpose of absorbing the escaping halogens, suitable means being provided for their removal. The baths preferred are composed as followed :—

| | Parts. |
|---|---|
| The double chloride of aluminium and sodium . | 15 |
| Cryolite | 55 |
| Sodium chloride | 30 |

or—

| | |
|---|---|
| Cryolite | 55 |
| Chloride of aluminium | 12 |
| Chloride of sodium | 19 |
| Chloride of potassium | 14 |

But these proportions are variable within wide limits. It is stated that the product at the anode is almost wholly composed of hydrochloric acid, and that, therefore, by the addition of chloride of aluminium to the bath from time to time, the process may be maintained almost continuously.
—G. H. R.

*Improvements in Processes for Reducing Aluminium.* J. C. Fell, London. From F. A. Gooch and L. Waldo, Connecticut, U.S.A. Eng. Pat. 20,616, October 27, 1894.

The process and the baths are the same as those given in the foregoing specification (Eng. Pat. 20,615), but instead of water the addition of a solid containing hydrogen in combination with hydrous salts, or salts containing combined water, either as water of crystallisation, or as water of constitution, or both, is recommended. The salt preferred is the hydrous crystalline chloride of aluminium ($Al_2Cl_6 12H_2O$), as it contains a large proportion of water in its combination, and also has the advantage that the chloride of aluminium contained in it replenishes the bath.
—G. H. R.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*The Capillary-Electrolytic Sluice in the Extraction of Gold.* J. H. Jory. Eng. and Mining J. **58**, 1894, 440.

In the manipulation of gold-bearing rock considerable loss has resulted from the fact that if the ore is crushed very fine a large quantity remains suspended in the water in a very fine state of division and so flows away, while if only coarsely crushed a quantity of the gold is never reached in the amalgamation process and is thus lost in the tailings. It is to get over this that the electro-capillary sluice is employed. It consists of a large number of amalgamated copper plates set in an inclined position so closely together that the passages between them are very narrow, about $\frac{1}{50}$ inch. The rock having been very finely crushed a considerable quantity of gold remains suspended in the washing water. This, however, in passing through the narrow passages is brought very intimately in contact with the amalgamated surfaces, to which the greater part of the gold adheres. The action is helped by the passage of an electric current, which is said to carry the gold particles with it and also to decompose any films of oxides and sulphides that would hinder amalgamation. It is considered better to use an alternating current.—E. T.

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*Electrolytic Preparation of Potassium Zincate.* P. Schoop. Zeits. f. Electrotech. u. Elektrochem. 1894, **6**, 205—208 and 247—249.

The attention which has been directed of late to the use of the zinc copper accumulator, has caused the author to study the preparation of alkaline solutions of zinc hydroxide such as have been used in the well-known Lalande-Chaperon element which is capable of being used both as a primary and a secondary cell. In its original form as made in Paris in 1888, it consisted of an anode made from an alloy of 95 per cent. of zinc and 5 per cent. of mercury, and a cathode of iron, the depolarizer consisting of cupric oxide and the electrolyte of a strong solution of caustic potash. Caustic soda could not be satisfactorily substituted for the dearer alkali, as the resistance was higher and the solution of the zinc took place more slowly.

In its form as a secondary cell, the zinc used for this element was electrolytically precipitated from the solution, which in this case consisted of potassium zincate. According to the author, in the preparation of alkaline zincates, direct chemical processes are not readily applicable even when aided by conducting them with a metal such as iron in contact with the zinc to be dissolved, as a transference of the zinc to the iron is apt to occur, and only comparatively weak solutions are obtained. This inconvenience is avoided by making the zinc the anode in a cell containing caustic potash as the electrolyte, and having the cathode (of iron) separated by a porous cell. An alternative plan consisted in abandoning the use of a porous cell and suppressing the hydrogen, which would otherwise have appeared at the cathode, by the use of cupric oxide, as in the Lalande cell itself. When using this arrangement, it is desirable to connect the electrodes with the source of current before pouring in the electrolyte, as otherwise traces of cupric oxide might be dissolved, and it is also well to cease passing the current before any turbidity appears in the solution, as the disappearance of such turbidity is slow. The preparation of the corresponding solution with caustic soda presents no difficulty, but the resulting liquid is not a good electrolyte for a secondary cell, on account of its high resistance.

Working on the principles thus enunciated, the author has proposed the following method for the technical preparation of potassium zincate:—The apparatus consists of a copper vessel, within which fits a cylinder of spongy copper. Interior to this is a zinc cylinder resting on a bed of magnesia to keep it from contact with the copper vessel. A steel screw serving as an agitator and driven by an electric motor, occupies the centre of the zinc cylinder and ensures circulation of the electrolyte, which is a solution of caustic potash.

The whole apparatus rests upon a clay cylinder round which is wrapped a nickel spiral heated by a current, the temperature being thus easily maintained at about 60° C. The process is started by making the copper vessel the anode, and thus oxidising the spongy copper. The direction is then reversed and the zinc dissolved, while the copper oxide serves to suppress the equivalent of hydrogen resulting. The author makes a suggestion that it may be practicable to free the electrolyte obtained in this apparatus from most of its impurities, by subjecting it to a supplementary electrolysis in a separate vessel with zinc electrodes and a porous diaphragm of magnesia. The ions of negative impurities, *e.g.*, chlorine, collect on that side of the septum containing the anode, while on the cathode side metallic impurities are precipitated on the zinc plate.—B. B.

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*Electrolytic Determination of Nickel and Cobalt in an Ammoniacal Solution of their Chlorides.* F. Oettel. Zeits. f. Elektrotech. u. Elektrochem. 1894, **8**, 192.

*See under* XXIII., *page* 69.

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*Electrolytic Determination of the Halogens.* G. Vortmann. Monatsh. für Chem. 1894, **15**, 280.

*See under* XXIII., *page* 69.

### PATENTS.

*Improvements in Primary Batteries.* W. H. Longsdorf, London. From G. Hewett, New York, U.S.A. Eng. Pat. 21,420, November 10, 1893.

The cell described is of the zinc carbon type, the exciting liquid being a solution of bisulphate of soda or of potash, or of common salt in sulphuric acid, while depolarisation is effected by means of powdered chromic acid, or of crystals of bichromate of potash or of soda. The battery is constructed with an outer vessel, preferably of cylindrical form, and with a cover of non-conducting material which supports the electrodes. The carbon electrode which is cylindrical and cup-shaped with perforations at the lower end, is about three-fourths of the height of the outer vessel so as to leave a considerable space between them at the bottom. The zinc element is a cylinder surrounding and concentric with the carbon cup, and the arrangement of the parts is such that while the zinc does not reach down to the depolarising solution formed at the bottom of the cell, the carbon above this level is protected by paraffin wax.—G. H. R.

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*Improvements in or Relating to Electric Regenerative Batteries or Accumulators, and in Porous Cells therefor.* R. Haddan, London. From R. Riguelle, St. Josse ten Noode, Belgium. Eng. Pat. 22,674, November 25, 1893.

These improvements consist in the material used for the electrodes, and in the substance employed for the porous cell. This latter is composed of asbestos cloth which has been treated with kaolin, moulded to the shape required, and afterwards fired. The joints are not sewn but overlap, which is claimed as an improvement. The outer containing vessel, which also serves as the negative electrode, is formed of a metal unattacked by the liquid used, such as brass covered with lead, and in it is placed either a mixture of oxide of tin and oxide of lead, or an alloy of tin and lead of the formula $Pb_3Sn$, both being in a powder. The porous cell stands in this mixture, and contains a suitable positive pole, preferably of carbon, or metalized carbon, surrounded with powdered peroxide of lead. If the alloy of lead and tin has been employed the battery is now ready for action, but if not, a preliminary charge is necessary. The voltage claimed is 2·25.—G. H. R.

*Improvements in Treating the Residual Products of Certain Manufactures and in Treating Certain Metallic Ores for the Manufacture of Chlorine.* E. J. Hunt, Stafford. Eng. Pat. 24,175, December 15, 1893.

The improvement consists essentially in treating the residual products of certain manufactures with chloride of sodium so as to obtain sulphate of soda, which may be crystallised out, leaving a solution of the chloride of the metal sufficiently pure to be treated by electrolysis, when the metal is recovered, and chlorine evolved, which latter can be utilised in any suitable manner, such as the production of bleaching powder. For instance, in the sulphuric acid process of cleaning iron for galvanising or tinning, the spent acid consists essentially of a solution of sulphate of iron, which, on treatment with common salt, yields a solution of chloride of iron and sulphate of soda, which can be treated by crystallisation and electrolysis as already described. In the treatment of zinc ores the sulphate of zinc obtained by roasting and lixiviation may be treated with common salt, whereby a mixed solution of chloride of zinc and sulphate of soda is obtained, and the sulphate of soda being crystallised out, the remaining solution of chloride of zinc is resolved into chlorine and metallic zinc. The skimmings of the galvanising bath which consists essentially of chloride of zinc, salammoniac and oxide of zinc, may be similarly treated.—G. H. R.

*Improvements in Forges or Furnaces for Heating or Working Metals Electrically.* W. P. Thompson, London. From C. L. Coffin, Detroit, U.S.A. Eng. Pat. 494, January 9, 1894.

The electric forge to which this improvement relates, consists essentially of a table with a bed of refractory non-conducting material, in which may be a coil of pipe, whose inner end comes up through the centre of the bed through a stop of refractory material, while its lower end leads downwards through the table for the purpose of being connected to any suitable source of supply of air, gas, or vapour. Suitable mechanism for maintaining the arc is supplied by means of springs which feed the carbons forward, while the latter are prevented from meeting by the before-mentioned stop. A magnet is provided by means of which the arc may be deflected, and there is a resistance switch in the arc-producing mechanism, the whole being covered with a jacket of refractory material.—G. H. R.

*Improvements in or relating to Secondary Batteries.* C. J. Hall, Leeds, England. Eng. Pat. 2487, February 5, 1894.

According to this invention the plates, which are cast or formed in any suitable manner, are pierced through with numerous holes, into which are inserted coils made of lead ribbon. For traction work the edges of the holes may be burred after the coils are in place, to assist in retaining them. The coils may be pasted with oxide of lead if desired. It is claimed that this construction allows of freedom of expansion and contraction in working.—G. H. R.

*Improvements relating to Electrolysis, and to Apparatus therefor.* H. H. Lake, London. From I. L. Roberts, Brooklyn, U.S.A. Eng. Pat. 13,358, July 10, 1894.

This invention relates to the manufacture of chlorine and caustic soda by the electrolysis of a solution of common salt, and is an improvement on Eng. Pat. 20,111 (this Journal; 1893, 697). The electrolysing apparatus consists of a tank, preferably of iron, which serves as the cathode. The anode, which is composed of carbon, stands in a porous earthenware jar which is packed with crystals of sodium chloride. This vessel is provided with a cover containing three holes, one for the passage of the anode, another for a gas vent, and a third for a long tube through which a supply of salt crystals is introduced into the anode compartment. Outside this vessel comes the improved gelatinous diaphragm, composed of a mixture of finely-powdered coal and a solution of silicate of soda or potash of a strength of about 25° or 30° B., and about 2 or 3 per cent. of caustic soda or potash, the latter being employed to prevent the coagulation of the silicic acid by any impurities in the powdered coal which would tend to impair the homogeneity of the diaphragm and weaken it. This gelatinous diaphragm is maintained in place by a bag of wire netting and cloth or asbestos fabric.
—G. H. R.

*Improvements in and relating to Vessels for Electrolytical Purposes.* P. Jensen, London. From H. Cappelen and D. Cappelen, Norway. Eng. Pat. 18,910, October 5, 1894.

The object of this invention is to provide a varnish which shall render wood durable and non-conducting when used for the construction of electrolytic vessels. It is claimed that this may be obtained by a mixture of 1 part water-glass and 9 parts of black japan or other suitable asphalt composition.—G. H. R.

*A New and Improved Process for the Production of Ozone.* J. T. Donovan and H. L. Gardner, Massachusetts, U.S.A. Eng. Pat. 19,127, October 9, 1894.

This improvement consists in the production of ozone by the electrolysis of a solution of a permanganate of a solid metallic base in water. Preferably the electrolyte employed is a saturated solution of permanganate of potassium, in a 5 or 10 per cent. solution of sulphuric acid, saturation being maintained by the addition of crystals of the salt. It is claimed that with suitable apparatus 38½ per cent. ozone may be obtained.—G. H. R.

*Improved Means for Securing the Conducting Wire to the Carbon Electrode in Elements of Galvanic Batteries.* F. A. von Alimonda and N. von Alimonda, Austria. Eng. Pat. 19,191, October 9, 1894.

According to this invention connection with the carbon plate is made as follows:—The lower end of the wire is bent at right angles, and projects either into the carbon or into the lug affixed to the latter, and the vertical portion of the wire is embedded in a groove cut in the carbon or in the lug, or partially in both.—G. H. R.

*Improvements in Processes for Reducing Aluminium.* J. C. Fell, London. From F. A. Gooch and L. Waldo, Conn., U.S.A. Eng. Pat. 20,615; also Eng. Pat. 20,616, October 27, 1894.

*See under X., page 40.*

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Investigation of Fats and Fatty Acids.* W. Thörner. Chem. Zeit. **18**, 1154—1155.

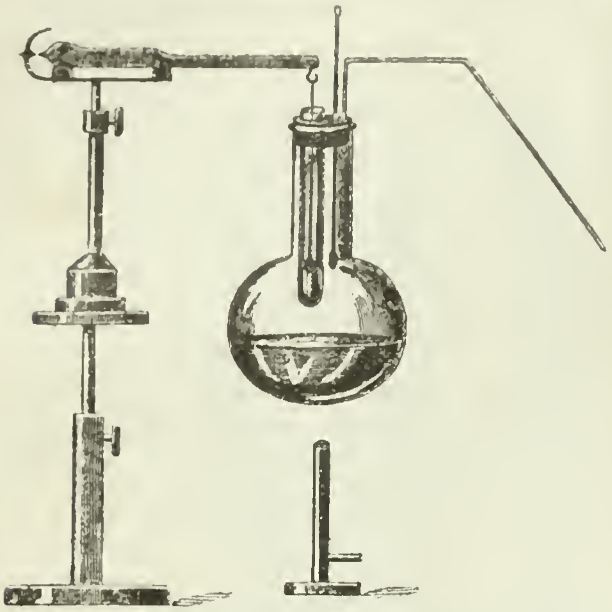
The analyst is frequently called upon to decide as to the particular fat or oil that has been used in the manufacture of a given soap or similar material. It is, however, to be remembered that, in the analysis of such substances, it is the fatty acid and not the original fat which is isolated. Now, although the necessary constants for deciding the question, given experimental data, are at hand in the case of the fats themselves, these constants are wanting in the case of the the fatty acids. The author's results are shown in the table on next page. The values in column I. were obtained by

TABLE FOR THE PHYSICAL AND CHEMICAL INVESTIGATION OF FATS AND FATTY ACIDS.

| — | Kind of Fat. | I. | II. | III. | | IV. | | V. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Amount of Fatty Acids in the Fat at 100° C. | Specific Gravity of Fat at 100° C., determined with König's Butter Spindle. | Specific Gravity at 100° C., determined with Reimann's Apparatus in Conjunction with the Westphal Balance. | | Refractive Index at 60° C. | | Polarisation at 50°—60° C. | |
| | | | | Fat. | Fatty Acids. | Fat. | Fatty Acids. | Fat. | Fatty Acids. |
| | | Per Cent. | | | | | | | |
| 1 | Butter | 89—91 | 0·865—0·867 | 0·899—0·900 | 0·876—0·888 | 1·445—1·448 | 1·437—1·439 | 0 | 0 |
| 2 | Cotton-seed oil | 96·0 | 0·8735 | 0·9038 | 0·8805 | 1·457 | 1·446 | 0 | 0 |
| 3 | Cacao butter | 97·0 | 0·8580 | 0·8910 | 0·8780 | 1·4496 | 1·4420 | 0 | 0 |
| 4 | Cocoa-nut oil | 97·0 | 0·8700 | 0·9060 | 0·8885 | 1·4410 | 1·4295 | 0 | 0 |
| 5 | Earth-nut oil | 98·0 | 0·8640 | 0·8976 | 0·8830 | 1·4545 | 1·4461 | 0 | 0 |
| 6 | Mutton tallow | 97·0 | 0·8590 | 0·8946 | 0·8673 | 1·4501 | 1·4374 | 0 | 0 |
| 7 | Cod-liver oil (medicinal) | 98·0 | 0·8715 | 0·9075 | 0·8858 | 1·4621 | 1·4521 | 0 | 0 |
| 8 | Linseed oil | 98·0 | .. | 0·9170 | 0·8890 | 1·4660 | 1·4546 | 0 | 0 |
| 9 | Almond oil | 98·0 | 0·8675 | 0·9015 | 0·8750 | 1·4555 | 1·4461 | 0 | 0 |
| 10 | Margarin | 95—96 | 0·8590 | 0·897—0·899 | 0·876—0·879 | 1·433—1·453 | 1·443—1·444 | 0 | 0 |
| 11 | Poppy-seed oil | 96·0 | 0·8725 | 0·9075 | 0·8830 | 1·4586 | 1·4506 | 0 | 0 |
| 12 | Olive oil | 96·0 | 0·8640 | 0·8997 | 0·8683 | 1·4548 | 1·4410 | 0 | 0 |
| 13 | Palm oil | 98·0 | 0·8600 | 0·8930 | 0·8790 | 1·4510 | 1·4441 | 0 | 0 |
| 14 | Palm-nut oil | 97·0 | 0·8670 | 0·9005 | 0·8760 | 1·4431 | 1·4310 | 0 | 0 |
| 15 | Castor oil | 92·0 | .. | 0·9465 | 0·9290 | 1·4636 | 1·4546 | +6·4° | +7·8° |
| 16 | Beef tallow | 96—97 | 0·8600 | 0·8945 | 0·8660 | 1·4510 | 1·4375 | 0 | 0 |
| 17 | Rape-seed oil (crude) | 96·0 | 0·8635 | 0·8990 | 0·8715 | 1·4667 | 1·4491 | 0 | 0 |
| 18 | Lard | 96—97 | 0·8610 | 0·8955 | 0·8700 | 1·4539 | 1·4395 | 0 | 0 |
| 19 | Sesamé oil | 96·0 | 0·8705 | 0·9043 | 0·8786 | 1·4561 | 1·4461 | +1·0° | +1·3° |
| 20 | Sunflower oil | 97·0 | .. | 0·9070 | 0·8880 | 1·4611 | 1·4531 | 0 | 0 |

| — | Kind of Fat. | VI. | | VII. | | VIII. | | IX. | | X. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Melting Point. | | Solidifying Point. | | Saponification Value. | | Iodine Value. | | Volatile Fatty Acids. | |
| | | Fat. | Fatty Acids. | Fat. | Fatty Acids. | Fat. | Fatty Acids. | Fat. | Fatty Acids. | Fat. | Fatty Acids. |
| | | ° C. | ° C. | ° C. | ° C. | | | | | | |
| 1 | Butter | 28—33 | 38—40 | 20—23 | 33—35 | 225—230 | 210—220 | 28—32 | 28—31 | 22—32 | 8—13 |
| 2 | Cotton-seed oil | .. | 35—40 | .. | 32—35 | 194—195 | 201·6 | 106—107 | 112—115 | 0·95 | 0·3 |
| 3 | Cacao butter | 32—33 | 49—50 | 23·0 | 46—47 | 198—200 | 190 | 34 | 32·6 | 0·8 | 0·35 |
| 4 | Cocoa-nut oil | 23—24 | 24—25 | 22—23 | 20·0 | 255—260 | 258 | 9·0—9·5 | 8·5—9·0 | 7·5 | 7·0 |
| 5 | Earth-nut oil | .. | 30—32 | .. | 29—30 | 194—196 | 201·6 | 91—96 | 96—97 | 0·4 | 0·3 |
| 6 | Mutton tallow | 44—55 | 46—47 | 40—41 | 39·0 | 192—195 | 210·0 | 43—44 | 34·8 | 1·2 | 0·4 |
| 7 | Cod-liver oil (medicinal) | .. | 50—52 | .. | .. | 175—185 | 207·0 | 128—130 | 130·5 | 0·4 | 0·6 |
| 8 | Linseed oil | .. | 17·0 | .. | 13·5 | 190—192 | 196·0 | 177—178 | 155·0 | 0·9 | 0·4 |
| 9 | Almond oil | .. | 14·0 | .. | 5·0 | 190—192 | 204·0 | 82—83 | 87—90 | 0·55 | 0·5 |
| 10 | Margarin | 32—35 | 42·0 | 20—22 | 39·0 | 192—200 | ca. 188·0 | 48—64 | .. | 0·3—0·9 | 0·7 |
| 11 | Poppy-seed oil | .. | 20·5 | .. | 16·5 | 193—194 | 199·0 | 134—135 | 116·3 | 0·6 | 0·4 |
| 12 | Olive oil | .. | 26—28 | .. | 21—22 | 191—193 | 193·0 | 82—83 | 87—88 | 1·5 | 6·25 |
| 13 | Palm oil | 36—37 | 47—48 | .. | 42—43 | 201—202 | 204·0 | 51·5 | 53·3 | 0·6 | 1·1 |
| 14 | Palm-nut oil | 25—26 | 20·7 | .. | .. | 216—250 | 264·0 | 13—14 | 12·0 | 3·4—5·0 | 4·8 |
| 15 | Castor oil | .. | 13·0 | .. | 3·0 | 201—203 | 182·0 | 93—94 | 87—88 | 4·0 | 3·0 |
| 16 | Beef tallow | 43—49 | 45·0 | 37·0 | 43—45 | 193—195 | 201·6 | 38—40 | 26—30 | 1·0 | 0·5 |
| 17 | Rape-seed oil (crude) | .. | 20·0 | .. | 16·0 | 177—179 | 185·0 | 98—100 | 97—99 | 0·9 | 0·6 |
| 18 | Lard | 26—32 | 37—38 | 26·0 | 35·0 | 195—196 | 204—207 | 59—60 | 47·6 | 1·1 | 0·4 |
| 19 | Sesamé oil | .. | 25—32 | .. | 23·5 | 192—193 | 201·6 | 103—105 | 110—111 | 1·2 | 0·4 |
| 20 | Sunflower oil | .. | 23·0 | .. | 17·0 | 193—194 | 201·6 | 129 | 133—134 | 0·5 | 0·3 |

the method described (Chem. Zeit. **15**, 1201; this Journal, 1892, 62). The values for the specific gravities in column II. were obtained with a König's spindle, and those in column III. were obtained with a Westphal balance and a Reimann's plummet, with a thermometer of range 95°—100° C. The adoption of the last-mentioned method is to be preferred; it was carried out with the aid of the apparatus shown in the figure, which sufficiently explains itself.—A. R. L.



*Alimental Fats.* F. Wallenstein and H. Finck. Chem. Zeit. **18**, 1189.

*See under* XXIII., *page* 78.

### PATENTS.

*A Process for the Purification of Oils, Fats, and the like.* F. Burton, London. Eng. Pat. 963, January 16, 1894.

In this process, oils, fats, &c. are treated with sodium peroxide. In order to prevent too violent an action, the material is previously acidulated with sulphuric or other acid; also, to retard the rapid evolution of oxygen from the peroxide, a solution in sulphuric acid of sodium phosphate or other salt of an alkaline earth to the extent of 5 per cent. on the sodium peroxide, is then added. The mixture is well agitated, and sodium peroxide added slowly over a period of 2 to 3 hours, and the whole allowed to stand for 24 hours, after which the oil is washed with water. —J. J. K.

*Improvements in the Manufacture of Soap, and Washing Compounds.* A. Warwick, J. Smith, and P. W. Nicolle, London. Eng. Pat. 1088, January 18, 1894.

Two molecules of sodium sulphate and one molecule of sodium bicarbonate are dissolved in water. The solution is boiled and allowed to crystallise, when a new body, termed "a basic carbonated sulphate of soda" is formed, the crystals of which salt possess the following composition:—

| | |
|---|---|
| Sulphuric anhydride | 21·27 |
| Carbonic acid | 5·15 |
| Soda | 31·50 |
| Water of crystallisation | 42·08 |
| | 100·00 |

It is feebly alkaline, and is said to possess great detergent power.

In using this product for the manufacture of soap, six parts of fatty acids are heated to 120°—130° C.; then five parts of the "basic carbonated sulphate of soda" (melted in its water of crystallisation) are gradually added, and the whole boiled until the fatty acid is saponified. A washing powder may also be prepared by grinding together the sodium sulphate and bicarbonate in the dry state. It is said to be less hurtful to the skin and to fabrics than ordinary soap is.—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A*.)—PIGMENTS, PAINTS.

*Examination of White Lead in Oil.* R. Hefelmann. Pharm. Centralh. N.F., 1894, **15**, 314.

*See under* XXIII., *page* 70.

### PATENTS.

*Improvements relating to Rust-preventive Paints.* A. Bücher, Heidelberg, Germany. Eng. Pat. 22,730, November 27, 1893.

The pigment in this composition consists of a mixture of two parts of finely-divided zinc and one of calcium or magnesium carbonate, to which is added one half per cent. of a "polishing substance," such as tripoli, colcothar, or vegetable charcoal. This is stirred with a brush immediately before use into a mixture of 2 parts of olive oil soap, and 1 part of lard soap solution prepared respectively as follows:—10 parts of olive oil, 5 of potassium carbonate, 7 of alcohol, and 10 of water are heated until saponified, and the mass is diluted with 23 parts of alcohol and 10 of water. After filtering, the liquid has a sp. gr. of 0·9193. The lard soap is prepared by grinding and "boiling" together 15 parts of olive oil, 5 of lard, 10 of litharge, and 3 of water. 160 parts of this product are melted, ground with 30 of potassium carbonate, and thoroughly extracted with alcohol. The two alcoholic solutions are mixed and as much benzene added as possible without causing a turbidity. Before the painted article is taken into use it is polished by brushing with a dry brush. For permanent structures, the pigment is mixed with an alkaline glue solution instead of the soap, which is prepared by boiling together a solution of 60 parts of borax and 4 of potassium carbonate with 80 parts of glue previously dissolved in 2,000 parts of water.—F. H. L.

*A New or Improved Apparatus for Drying White Lead or other Material.* O. Hamilton, Northfleet, Kent. Eng. Pat. 1866, January 29, 1894.

An air-tight chamber is fitted with a number of superposed shelves on which endless chains carrying stirrers and scrapers work with alternative motion, so arranged as to break up the damp material and move it about, at the same time gradually propelling it along the shelves from the top of the apparatus to the bottom. An automatic feed arrangement is provided at the top (Eng. Pat. 1057, 1894) which regularly admits a definite amount of wet material into the chamber. The whole apparatus may be worked under slightly diminished pressure to avoid leakage of poisonous dust.—F. H. L.

*An Improved Composition Paint for Ships' Bottoms.* J. and A. Tennant, Aberdeen. Eng. Pat. 15,676, August 17, 1894.

The paint consists of 8 lb. of resin, $1\frac{1}{2}$ of "Cologne brown dry colour," 15 oz. of shellac, 25 gills of spirits of wine, 6 gills of benzene, $\frac{1}{4}$ gill of toluene and 10 drops of pyridine. As a finishing coat a mixture of paraffin wax and white lead "boiled together" is applied hot.—F. H. L.

### (*B.*)—RESINS, VARNISHES.

*Excrescent and Exuding Resins.* M. Bamberger. Monatsh. für Chem. **15**, 1894, 505.

The resinous coating of *Pinus Laricio Poir.*, in a former paper by the author, was shown to contain about 4 per cent. of dihydroxycinnamic and about 1 per cent. of ferulic acid, besides small quantities of vanillin. This resin, on treatment with ether, yields about 20 per cent. of a soluble and 80 per cent. of an insoluble resin. The latter, pinoresinol, possesses the formula $C_{10}H_{18}O_6$, and contains two methoxyl groups, which were determined in Benedikt's apparatus according to Zeisel's method. Pinoresinol is a phenol containing two free hydroxyl groups. The mother-liquors resulting in the preparation of potassium-pinoresinol, on treatment with hydrochloric acid, yield a brown resin possessing the properties of a tannin. The dihydroxycinnamic and ferulic acid contained in the crude resin exist there in the free state and not in the form of pinoresolic ethers.—C. O. W.

*The Examination of Linseed Oil Varnish and of Oil Colours.* F. Filsinger. Chem. Zeit. 1894, **18**, 1867—1868.

In continuance of a previous paper (this Journal, 1894, 892), the author has found that the optical method of examination of linseed oils is available also for varnish and for oil paints. By solution of one volume of linseed varnish in a mixture of two volumes of chloroform and one of absolute alcohol, the rotatory power of the substance may be determined in Schmidt and Hänsch's apparatus in a 50 mm. tube; the results being afterwards calculated to the normal length of 200 mm. Oil paints may be rubbed down thin, and then extracted with the same solvent, any remaining colour being removed by filtration through blood charcoal, all turpentine having been previously evaporated off. Samples containing rosin oil give a rotatory effect of +25° to 30°. During the process of varnish making the iodine number of the oil falls "as low as" 160, while the saponification number remains at 180—190. Varnishes are sometimes met with, with these same constants, but with a rotation of +24°—26°, such must contain besides rosin oil some other adulterant, about which nothing is at present known.—F. H. L.

*The Analysis of Varnishes.* P. C. McIlhiney. J. Amer. Chem. Soc. **16**, 344.

*See under* XXIII., *page* 78.

### (*C.*)—INDIA-RUBBER, &c.

PATENT.

*Improvements in the Manufacture of Seamless Articles from Rubber.* S. E. Statham, Manchester. Eng. Pat. 23,342, December 5, 1893.

This invention relates to the use of hollow moulds of metal or earthenware of any shape or size, arranged so as to be heated from the inside, which are coated by dipping with rubber solution to any desired thickness. The film is vulcanised *in situ* and finally stripped off. Stress is laid on the necessity of keeping the moulds hot and of performing the whole operation in a dry atmosphere to avoid the deleterious influence of moisture between the different layers of rubber composing the finished article.—F. H. L.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

PATENT.

*Improvements in Tanning Skins and Hides.* T. H. L. Bake and H. A. Leverett, London. Eng. Pat. 13,195, July 7, 1894.

A current of hydrogen gas, or of any suitable gaseous compound of hydrogen, containing arsenic, is caused to pass at intervals through the liquor in which the hides are suspended. The hydrogen is made from commercial sulphuric acid and zinc or iron, or from iron and steam; it is stated that "in these cases it will be found that arsenic will be present with the hydrogen gas in quantities sufficient for the purpose."

The hydrogen is stored in a gas-holder, whence it passes into a smaller gas-holder from which it is forced through a pipe leading to the bottom of the tan-pit and delivering the gas through a number of holes. The gas which has bubbled through the liquor is conveyed back into the large gas-holder by a pipe opening out of the cover of the pit. By regulating the pressure in the small gas-holder the flow of gas may be made intermittent. Larger pits than those customary are used, and the handling of the hides is dispensed with. The duration of the tanning is said to be much abbreviated, and the quality of the leather to be equal to that of the best that is tanned by the more lengthy processes.—A. G. B.

## XV.—MANURES, Etc.

*Can Sparingly Soluble Basic Slag be made Readily Soluble?* P. Wagner. Chem. Zeit. **18**, 1511—1512.

The solubility and efficiency as manure of basic slag does not depend, as was supposed, on the amount of lime present, but on the richness in silica. Hoyermann (Beitr. zur Frage d. Citratlösl. d. Phosphorsäure in Thomasschlackmehl. Hannover, 1894), showed that by fusing a mixture of sand and basic slag, the citrate-solubility of the slag was raised from 58 to 84 per cent.; he nevertheless considers that the more sparingly soluble slag is the more valuable as manure, owing to the greater amount of free lime it contains.

The basic slags of commerce vary in their citrate-solubility from 100 down to 40 per cent. One of the chief conditions for high solubility is a certain percentage of silica. If it does not prove too difficult to raise the percentage of silica in slags, it remains to be ascertained in what degree the value of the manure is raised, if at all, with the increased solubility.

The question is one of importance. In Germany, in 1893, 13,000,000 cwt. of slag were used as manure, and about the same quantity of superphosphate; the superphosphate cost about 1,000,000*l*. more than the slag.

—N. H. J. M.

*Chemical Constitution of Basic Slag and the Determination of its relative Manurial Value.* P. Wagner. Chem. Zeit. **18**, 1933.

*See under* XXIII., *page* 70.

*Direct Estimation of Citrate Soluble Phosphoric Acid.* B. B. Ross. J. Amer. Chem. Soc. **16**, 304.

*See under* XXIII., *page* 70.

*Estimation of Phosphoric Acid soluble in Citrate Solution in Thomas' Slag and Mineral Phosphates.* P. Wagner. Chem. Zeit. 1894, **18**, 1153.

*See under XXIII., page 69.*

### PATENT.

*Improvements in the Treatment of Sewage Sludge to Obtain a Useful Manurial Product therefrom.* J. T. Dinsdale, London. Eng. Pat. 21,931, November 15, 1893.

Sewage sludge, "which has been separated from sewage by simple filtration or draining without the use of precipitants," is mixed with a mineral acid or an acid salt, preferably nitre cake, in order to fix the ammonia. The nitre cake is previously ground with an equal weight of coke. The mixture is allowed to commence fermenting, and is then passed through a mixing and drying machine in which it is mixed with a proportion of Kieselguhr and some powdered kelp salt. The dry powdered product is ready for use in agriculture. For every ton of dry material in the sludge, the inventor uses nitre cake $\frac{1}{4}$ cwt., coke, $\frac{1}{4}$ cwt., kieselguhr $5\frac{3}{4}$ cwts., kelp salt, $2\frac{3}{4}$ cwts.—L. A.

## XVI.—SUGAR, STARCH, GUM, Etc.

*International Congress for Applied Chemistry at Brussels and Antwerp.* August 4—11, 1894. Chem. Zeit. 1894, **18**, 1279—1280. *Section for Sugar Chemistry.*

*Graduation and Calibration of Chemical Instruments:*—Communications were submitted on this subject by F. Dupont, Paris; F. Sachs, Brussels, and Schmidt, Cologne. The following were the resolutions:—The metric litre and its sub-divisions are to be adopted; and the centigrade thermometric scale. A special commission was appointed to inquire into the best means of graduating flasks, burettes, pipettes, and areometers. The standard temperature at which to graduate these instruments is to be decided upon, and tables are to be drawn up for the comparison of degrees, Beaumé, Brix, Balling, Vivien, &c., as well as tables for correcting these degrees for temperature.

*Estimation of the Commercial Value of Molasses:*—A communication was read by A. Aulard, Marseilles. The following resolutions were adopted:—The sale of beetroot molasses on the specific gravity is to be discontinued. The analysis of molasses for distillery purposes shall be thus conducted:—In the case of normal molasses, by direct polarisation; but in that of molasses obtained from after-products and the like, special methods shall be used for the estimation of the saccharose and raffinose. From the point of view of the production of alcohol, it may be taken that 1 kilo. of raffinose is equivalent to $\frac{2}{3}$ kilo. of saccharose. The analysis of cane sugar molasses is to be accomplished by the well known inversion methods which serve for the estimation of saccharose and invert sugar. The specific gravity of molasses when required is to be taken with the pyknometer or other special instrument, but not with the areometer. If however it is required to know the degree Beaumé, this may be calculated with the aid of the tables of Berthelot, Caulier, and d'Almeida.

*Best Means of Purifying the Refuse Water of a Sugar Factory, with regard to the Cost of carrying out the same in Practice.*—On this question communications were presented by Battut, Arleux du Nord, and Stift, Vienna. The following resolutions were adopted. It has never been proved that the refuse water of sugar factories has been the cause of infectious disease. The running off of condensation water (warm or cold) into the rivers or canals is attended with no ill consequences, and the same is true of the wash water containing carbonic acid. The water from the rinsing of the roots and the washing machines shall be run into reservoirs to allow the settlement of solid matter, whence it may subsequently be run off into the culverts without fear of stopping them up. Irrigation is the best means of effecting the purification of the refuse water from the beetroot slice presses, the diffusion process, and the washing of the animal charcoal. Irrigation cannot be carried out in all factories, and, when this is so, special means must be devised, the latter, of course, only when complaints have been made. Factories situated on the banks of a river can run off their refuse water into the river if its flow of water amounts at least to 50 times the quantity of the refuse water introduced.

*Standard Methods of Testing Beetroot Sugar and Cane Sugar.*—With certain modifications, F. Strohmer's suggestions were adopted. After opening the sample bottle, the upper layer is rejected. The sugar is then turned out into a porcelain dish and the lumps lightly broken up with a spoon. The solution of the sugar for the polarisation is brought about without application of heat. Clarification is effected by basic lead acetate (3 parts of lead acetate, 1 part of lead oxide, and 10 parts of water), alum or alumina being also used. Sugars polarising above 99 per cent. may be clarified with alumina alone. These remarks also apply to products of cane sugar manufacture; but in these cases, reducing sugar invariably present, is to be estimated by alkaline copper solution. After making up to the mark, the solution is filtered, but the first few drops are rejected. The half-shadow polarimeter only to be employed. The tubes and glasses shall be tested frequently. Readings of the polarimeter to be reported to 0·1 per cent. The moisture is determined by heating at least 5 grms. of the sample for two hours at 100°—105° C. If the sample contains above 4 per cent. of water, it should be heated for at least four hours. The ash is to be estimated on at least 3 grms. of the sample; it is incinerated with pure concentrated sulphuric acid and one-tenth subtracted from the weight obtained. Invert sugar shall be estimated by a copper-potash solution (Fehling's or otherwise); in doubtful cases by Herzfeld's method. If no more than 0·05 per cent. be found, the invert sugar is reported *nil.* The alkalinity of raw sugars is estimated, using litmus as indicator.

*Estimation of Losses of Sugar in all Stages of the Manufacturing Process.*—The resolutions adopted were as follows:—Since no means are known of estimating exactly and expeditiously the actual saccharose present in the products at various stages of the manufacturing process, it is desirable to report the losses as "polarisation losses." To estimate the losses, it is absolutely necessary that the factory shall possess means of measuring the quantity of the products coming in and going out at the various stages. In factories having the necessary apparatus, it is advisable that the total loss (in polarisation) from the diffusion liquor to the massecuite, II. Product inclusive, shall be estimated according to the following directions:—1. Estimation of the exact volume (or weight) of the diffusion liquor, having regard when necessary, to the temperature. 2. The mean polarisation of this liquor. 3. The exact weight of the sugar obtained (I. Product). 4. Polarisation of this sugar. 5. Volume of the massecuite, II. Product. 6. Specific gravity of this massecuite at a determinate temperature. 7. Polarisation of this massecuite. This method is already carried out in Belgium and Holland by F. Sachs. In cases where the losses of sugar, as indicated by the polarimeter, between the diffusion liquor and the massecuite II. Product are considerable, attention should be directed to the evaporating and boiling processes. The presence or otherwise of invert sugar must be established. The estimation of the total losses during the diffusion offers greater difficulties. The necessary information may perhaps be attained by carrying out the following instructions:—1. Exact weighing of the well cleansed beetroots. 2. Estimation of the sugar contained in the freshly-cut beetroot slices by means of hot digestion and polarisation. 3. Estimation by the polarimeter of the sugar contained in the diffusion liquor. Means must of course be at hand for accurately measuring the total volume of the diffusion liquor.—A. R. L.

### *Incrustations in the Evaporating Apparatus.* Pellet. Bull. de l'assoc. Chim. 1894, **12**, 319.

The author discusses the question which he has repeatedly dealt with, viz., the incrustations which form in the evaporating apparatus during the manufacture of beetroot sugar. The composition of these incrustations varies according to the mode of working—whether or not sulphurous acid has been used. Their origin is now proved from the roots themselves, the defecating lime, the coke, &c. Incrustations are met with containing 73 per cent. of calcium sulphite, 54 per cent. of calcium carbonate, 89 per cent. of calcium oxalate, and 56 per cent. of silica; they often contain also considerable quantities of copper, iron, alkalis, magnesia, sulphates, organic matters, fats, and fatty acids.—A. R. L.

### *Investigation of Beetroots in the Second Year of their Growth.* Claassen. Zeits. für Rübenzuckerind. 1894, **44**, 835.

The extensive investigations of the author show that single seed-roots exhibit a very different behaviour as regards the amount of saccharose which they contain. In many roots, after the ripening of the seed, fresh sugar is formed through the agency of the new green leaves. This sugar accumulates in the roots, the growing portions of the plant, and the seed-stalks. Probably by allowing such roots to remain over the winter they would commence fresh growth in the following spring.—A. R. L.

### *Organisms which produce Sugar and Alcohol.* Went and Prinsen-Geerligs. Deutsch. Zuckerind. 1894, **19**, 1043.

The authors have isolated the following new micro-organisms in the course of their studies on the rational manufacture of rum:—1. *Chlamydomucor oryzæ*, a mould, similar to that described by Calmette, from the so-called Chinese yeast. It contains a saccharifying non-dialysable enzyme, and this on access of air converts starch into glucose; dextrin and amylodextrin are likewise converted into glucose. Saccharose serves as a nutrient for the organism, but is not inverted. The glucose which is formed is non-fermentable. Closely related to the organism just mentioned, and perhaps only a sporangium-bearing form of the same, is *Rhizopus oryzæ*, which occurs on rice-straw and behaves in a manner analogous to the organisms first described. 2. *Monilia javanica* in access of air ferments glucose, fructose (levulose), maltose, raffinose, and saccharose (which it first inverts), but not milk-sugar; fermentation proceeds but slowly, and when the concentration of the sugar solution is above 9 per cent. it is not complete. 3. *Saccharomyces Vordermanii.* This yeast ferments the same sugars as the one just mentioned, but fermentation proceeds readily and is complete when the concentration of the solution is as high as 18—19 per cent. The products of the fermentation are carbonic anhydride, traces of succinic acid, glycerol, ethyl acetate, and aldehyde; the alcohol produced is very pure, free from fusel oil and acids, and has an excellent flavour and aroma. The authors have obtained pure cultures of this yeast, which appears to have an important practical value.—A. R. L.

### *Sugar-Cane Disease in Mauritius.* Boname. Sucr. indigène, 1894, **44**, 392.

According to the author this disease is not of a specific nature, and is caused by micro-organisms, among which may be mentioned *Bacillus vascularum* (Cobb), *Trichosphæria sacchari* (Went); other micro-organisms which have not as yet been characterised are also concerned in the disease. To combat the disease the canes should be fortified as much as possible by improving the conditions of vegetation; moreover, by careful selection and disinfection of the cuttings, which easily overcomes infection. Finally, the plantations should be carefully inspected and all suspicious matter burned.—A. R. L.

### *Sugar-Cane Disease in Pernambuco.* Palmires. Sugar Cane, 1894, **26**, 555.

The plants attacked by this disease, which is of a contagious nature, are principally those which are naturally weak and have been planted in bad soil, or have not been properly cultivated. A feature of the disease is that the fibro-vascular threads of the canes become filled with a viscous, gummy mass, whereby the plants soon die.

—A. R. L.

### *Phoma Betæ.* Frank. Zeits. Zuckerind. 1894, **44**, 833.

This widely disseminated organism develops, as a rule, only saprophytically on the old or even dead under-leaves of the beetroots, and in that case it is harmless. Under the influence of dry weather, however, it assumes the harmful parasitic character. In such cases the disinfection of the plants or of the soil is unavailing; it therefore seems advisable to cut off the beetroot tops together with the dead stalks and under-leaves, on which are millions of phoma spores, which, after falling on to the soil, would remain there for a long time, and on coming into contact with parts of plants or their sap, would infect them. Beetroots known to be infected with phoma should therefore be harvested early, their tops collected and used as food or burned.

—A. R. L.

### *Cause of the Loss of Sugar.* Jesser. Zeits. Zuckerind. in Böhm. 1894, **19**, 1.

The decomposition of sugar when its solutions are boiled, appears to be due to the action of water, in fact to be a hydrolytic action, the product of which is invert sugar. If the solutions are strongly alkaline this invert sugar is decomposed with the production of acids which partially neutralise the alkali; when, however, the solutions are only slightly alkaline the alkali is entirely neutralised, and there remain unoxidised decomposition products which frequently exhibit cupric reducing power. Caustic alkalis act quicker and more energetically than carbonates do, which in equivalent quantity do not oxidise the decomposition products of the sugar, and when present in larger quantity take a longer time to effect the oxidation. The estimation of the losses presents in practice great difficulties in consequence of the alterations in polarisation of the non-sugar constituents, and also of our lack of knowledge of the behaviour of these substances towards various indicators. The loss from evaporating and boiling appears, in the author's experiments, to have been not more than 0·074 per cent. of the sugar. By using high temperatures and keeping the liquor a protracted period in the various apparatus, it is possible to bring about the neutralisation of the alkalinity of the liquor and produce a deleterious effect as regards colour. In normal work the loss is probably not more than 0·1 per cent. of the sugar. In order to reduce the losses to a minimum and obtain the best results, conditions should be observed such that the final products manifest an alkaline reaction towards phenolphthaleïn.

—A. R. L.

### *Purification of Cane-Sugar Juice with Baryta.* Du Beauffret. Bull. de l'Assoc. Chim. 1894, **12**, 242.

The author's experiments show that the cupric reducing substances of the sugar cane do not consist of invert sugar, but of optically inactive acids belonging to the oxalic and succinic series; after the extraction of the alkaloids by the ordinary methods, these acids may be isolated; they give insoluble barium salts in the cold, generally of the formula $C_6H_{10}BaO_6$. Supported by these observations, the author has made use of baryta instead of lime in all stages of the manufacturing process. The chief advantage of this is the increased yield of first product, 95 per cent. of the total sugar contained in the crude juice being obtained in the form of first product of polarisation 96.—A. R. L.

*Application of Baryta in the Manufacture of Cane Sugar.* Gravier. Bull. de l'Assoc. Chim. 1894, **12**, 350.

Advantageous results are obtained by purifying molasses by Manoury's process with baryta, and subsequently leading it through the cycle of manufacturing operations. By leading back 1 per cent. of molasses thus purified with baryta, together with the raw juice, the yield of first product is increased by 0·5 per cent.—A. R. L.

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*Estimation of the Strength of Various Gums.* G. Dalen. Mitt. königl. tech. Versuchsanstalten, 1894, 149—155.

Four samples of artificial gum were examined for the purpose of comparing their adhesive power with that of *gum arabic*. With the various methods adopted for making these tests, sufficiently satisfactory results have not been hitherto obtained, and the literature relating to the testing of this material is of little assistance and the methods unreliable. According to Karmarsch the side surfaces of two blocks of wood are united by means of the glue to be tested, and, after drying, the power necessary to separate them is ascertained. This method is adopted in the artillery workshops at Spandau, except that the blocks are glued upon their face-surfaces instead of upon the sides. To prevent the glue being absorbed by the wood the ends are first soaked in the glue.

According to Weidenbusch's method, bars of gypsum are soaked in a 10 per cent. solution of the glue to be tested, and, after drying, the hardness or compactness ascertained; the difference between which and the orignal gypsum is a measure of the strength of the glue. The above two methods do not, however, give reliable results, which largely depend upon the nature and condition of the wood, and upon the degree of concentration of the glue solution. These methods are generally used, and, being performed under similar conditions, give a relative value of the binding powers of the samples tested. In judging the binding power of a material, its own tenacity has not alone to be considered, as a great deal depends upon the adhesion of the bodies, and in making the tests it was considered preferable to adopt a method corresponding to the use to which the gum is put.

A solution of each of the four samples, as well as gum arabic, was made, containing 5, 10, 20, 30, and 40 per cent. of gum. Strips of three qualities of unsized paper were taken, of which the thickness, the percentage of ash, and the fibres were known. These strips were soaked in the solutions of gum and the excess removed by pressing between blotting paper. After drying at an ordinary room temperature and in an atmospheric moisture of 65 per cent., the strips were tested under similar conditions for strength. Table I. gives the results obtained, the numbers being the mean of five separate tests, and, with the exception of the incomplete test with the 40 per cent. solution, the numbers are remarkably consistent. For calculating the tearing length, and of the gum taken up by the strips, the weight of the strips dried at 100° C. is taken as a basis. From Table I. it is seen that the different qualities of paper take up different quantities of the same gum solution, and the same paper takes up different quantities of gum from the several solutions of the same degree of concentration. On this account the results cannot be directly compared, but must be calculated upon equal quantities of absorbed gum. The diagrams, Figs. 4 and 5, graphically show the breaking power and tearing length. The results of the three gums A, C, and D, are almost the same, and are shown as one line. In the column for 25 and 30 per cent. the breaking weight for paper I. is omitted, because the thickness of the paper differed somewhat from the rest and is therefore not comparable with the others. Table II. shows, in addition to the values indicated in the diagrams, Figs. 4 and 5, the increase of breaking weight and tearing length (columns *d* and *g*), and also the ratio numbers for gum arabic (columns *e* and *h*). Taking the breaking weight or tearing length as a measure of the binding power, then the ratio numbers in columns *e* and *h* represent the strength of the gums as compared with gum arabic. Although it is impossible to obtain a definite measurement of the strength, the results obtained are interesting as regards the behaviour and value of different gums. From the above tests one sees that:—1. With weak solutions, gum arabic has a much greater binding power than artificial gums. This may be of special interest in cases where it is employed as a "dressing"; the numbers found will form a basis for estimating the relative value of various gums. 2. With an increase in the quantity of gum the difference in the binding power of gum arabic and others gradually decreases. 3. That gum B, in comparison with the other samples, approaches gum arabic.

Fig. 4.

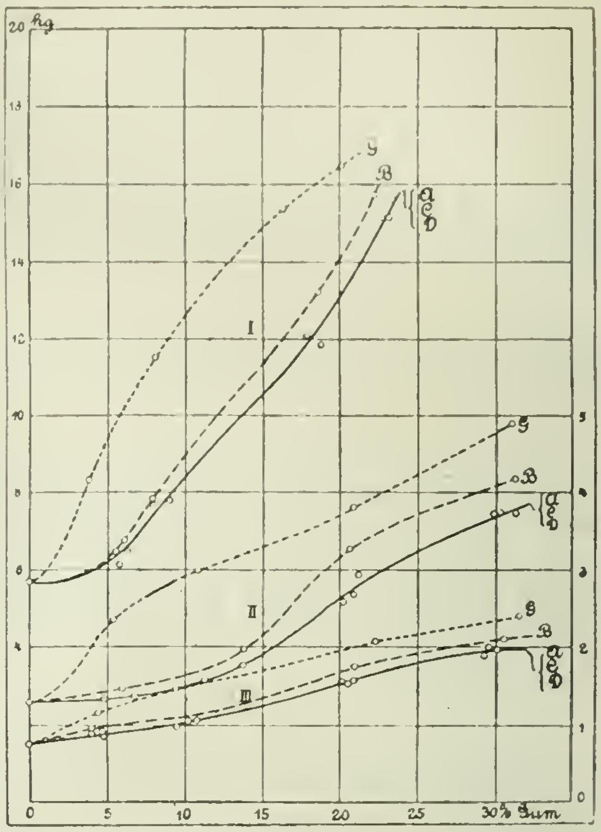

Fig. 5.

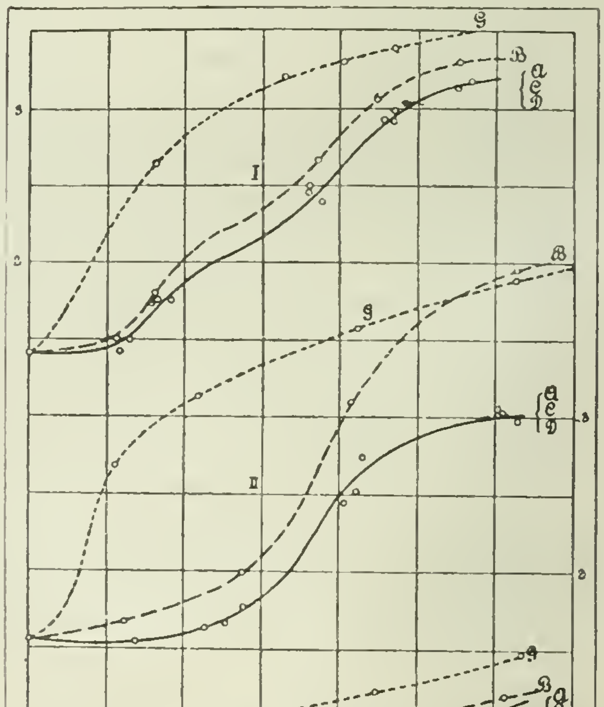

TABLE I.—SHOWING RESULTS OF TESTS.

| Composition of the Gum Solution. | | 5 per Cent. | | | | 10 per Cent. | | | | 20 per Cent. | | | | 30 per Cent. | | | | 40 per Cent. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Qualities of Paper used. | Gum. | Gum contained in the Strips dried at 100° C. | Breaking Weight in Kilos. | Tearing Length. | Increase by Stretching. | Gum contained in the Strips dried at 100° C. | Breaking Weight in Kilos. | Tearing Length. | Increase by Stretching. | Gum contained in the Strips dried at 100° C. | Breaking Weight in Kilos. | Tearing Length. | Increase by Stretching. | Gum contained in the Strips dried at 100° C. | Breaking Weight in Kilos. | Tearing Length. | Increase by Stretching. | Gum contained in the Strips dried at 100° C. | Breaking Weight in Kilos. | Tearing Length. | Increase by Stretching. |
| I.<br>Thickness, 0·47 mm.<br>Weight per sq. m., 2 grms.<br>Ash, 23·0<br>Fibres composing the paper—Cotton and small quantity of linen. | A | % 5·9 | 6·11 | 1·44 | % 1·3 | % 8·2 | 7·67 | 1·75 | % 1·2 | % 18·0 | 12·19 | 2·49 | % 1·1 | % 22·8 | 15·16 | 2·93 | % 0·9 | % 28·4 | 13·90 | 3·18 | % 1·3 |
| | B | 6·2 | 6·72 | 1·57 | 1·6 | 8·2 | 7·88 | 1·80 | 1·3 | 18·6 | 13·20 | 2·67 | 1·3 | 22·3 | 15·74 | 3·06 | 1·1 | 27·6 | 14·2 | 3·29 | 1·4 |
| | C | 6·4 | 6·41 | 1·51 | 1·3 | 8·0 | 7·61 | 1·74 | 1·1 | 18·8 | 11·8 | 2·38 | 1·2 | 23·3 | 15·14 | 2·91 | 1·0 | 27·5 | 13·5 | 3·13 | 1·2 |
| | D | 5·7 | 6·42 | 1·51 | 1·4 | 9·1 | 7·77 | 1·76 | 1·2 | 18·0 | 12·05 | 2·46 | 1·1 | 23·5 | 15·61 | 2·99 | 1·0 | 28·4 | 13·82 | 3·16 | 1·2 |
| | Gum arabic | 3·8 | 8·31 | 2·00 | 1·6 | 8·2 | 11·48 | 2·63 | 1·8 | 16·4 | 15·36 | 3·19 | 1·7 | 20·2 | 16·46 | 3·29 | 2·0 | 23·5 | 13·8 | 3·38 | 2·0 |
| | Soaked in water | 0·0 | 5·27 | 1·31 | 1·5 | 0·0 | 5·02 | 1·24 | 1·4 | 0·0 | 4·95 | 1·23 | 1·3 | 0·0 | 5·05 | 1·25 | 1·3 | 0·0 | 4·10 | 1·31 | 1·6 |
| | Paper untreated | 0·0 | 5·75 | 1·44 | 1·1 | 0·9 | 5·55 | 1·38 | 1·3 | 0·0 | 5·67 | 1·41 | 1·2 | 0·0 | 5·62 | 1·41 | 1·2 | 0·0 | 4·71 | 1·51 | 1·3 |
| II.<br>Thickness, 0·15 mm.<br>Weight per sq. m., 66 grms.<br>Ash, 0·2 %<br>Fibres composing paper—Cotton. | A | 6·8 | 1·36 | 1·54 | 1·9 | 13·9 | 1·73 | 1·76 | 1·6 | 21·4 | 2·91 | 2·73 | 1·5 | 31·3 | 3·72 | 2·98 | 1·4 | .. | .. | .. | .. |
| | B | 6·2 | 1·46 | 1·66 | 2·0 | 13·9 | 1·97 | 1·99 | 1·8 | 20·6 | 3·26 | 3·09 | 1·8 | 31·3 | 4·19 | 3·95 | 1·8 | .. | .. | .. | .. |
| | C | 4·9 | 1·34 | 1·55 | 1·9 | 12·7 | 1·61 | 1·66 | 1·6 | 20·3 | 2·56 | 2·44 | 1·3 | 30·3 | 3·73 | 3·02 | 1·3 | .. | .. | .. | .. |
| | D | 4·9 | 1·31 | 1·51 | 1·9 | 11·3 | 1·57 | 1·64 | 1·4 | 21·0 | 2·66 | 2·51 | 1·3 | 30·1 | 3·73 | 3·04 | 1·2 | .. | .. | .. | .. |
| | Gum arabic | 5·5 | 2·35 | 2·69 | 2·9 | 10·9 | 2·98 | 3·12 | 2·7 | 21·0 | 3·79 | 3·57 | 2·6 | 31·1 | 4·88 | 3·89 | 2·7 | .. | .. | .. | .. |
| | Soaked in water | 0·0 | 1·03 | 1·24 | 1·7 | 0·0 | 1·14 | 1·34 | 1·8 | 0·0 | 1·09 | 1·30 | 1·6 | 0·0 | 1·19 | 1·39 | 1·6 | .. | .. | .. | .. |
| | Paper untreated | 0·0 | 1·24 | 1·51 | 1·9 | 0·0 | 1·32 | 1·55 | 1·8 | 0·0 | 1·28 | 1·53 | 1·6 | 0·0 | 1·33 | 1·61 | 1·6 | .. | .. | .. | .. |
| III.<br>Thickness, 0·12 mm.<br>Weight per sq. m., 49 grms.<br>Ash, 3·0 %<br>Fibres composing paper—<br>Ground wood, 10 %<br>Cotton and linen, 50 %<br>Wood and straw cellulose, 10 % | A | 4·9 | 0·90 | 1·25 | 1·8 | 9·6 | 0·97 | 1·31 | 1·4 | 20·3 | 1·56 | 1·73 | 1·0 | 30·1 | 1·96 | 2·08 | 1·1 | .. | .. | .. | .. |
| | B | 4·0 | 0·94 | 1·32 | 1·9 | 10·1 | 1·10 | 1·48 | 1·7 | 21·1 | 1·71 | 1·92 | 1·2 | 30·6 | 2·09 | 2·20 | 1·2 | .. | .. | .. | .. |
| | C | 4·8 | 0·84 | 1·17 | 1·6 | 10·8 | 1·05 | 1·40 | 1·5 | 20·6 | 1·52 | 1·69 | 1·0 | 29·4 | 1·90 | 2·02 | 1·1 | .. | .. | .. | .. |
| | D | 4·0 | 0·87 | 1·22 | 1·9 | 10·3 | 1·03 | 1·38 | 1·4 | 21·0 | 1·53 | 1·69 | 1·0 | 29·6 | 1·99 | 2·12 | 1·1 | .. | .. | .. | .. |
| | Gum arabic | 4·5 | 1·15 | 1·60 | 2·0 | 9·6 | 1·44 | 1·95 | 1·9 | 22·4 | 2·06 | 2·23 | 1·5 | 31·6 | 2·38 | 2·46 | 1·6 | .. | .. | .. | .. |
| | Soaked in water | 0·0 | 0·78 | ·14 | 2·1 | 0·0 | 0·77 | 1·16 | 1·9 | 0·0 | 0·76 | 1·06 | 1·5 | 0·0 | 0·76 | 1·15 | 1·8 | .. | .. | .. | .. |
| | Paper untreated | 0·0 | 0·73 | 1·07 | 2·1 | 0·0 | 0·74 | 1·10 | 2·2 | 0·0 | 0·76 | 1·06 | 1·7 | 0·0 | 0·77 | 1·16 | 1·9 | .. | .. | .. | .. |

TABLE II.

| Quantity of Gum in Paper. | | 0 per Cent. | | 5 per Cent. | | | | | | 10 per Cent. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Breaking Weight. | | | Tearing Length. | | | Breaking Weight. | | | Tearing Length. | | |
| | | a | b | c | d | e | f | g | h | c | d | e | f | g | h |
| Paper used. | Gum used. | Breakage Weight in Kilos. | Tearing Length. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. |
| I. | A C D | 5·65 | 1·51 | 6·1 | 0·45 | 12 | 1·45 | 0·04 | 5 | 8·35 | 2·7 | 39 | 1·87 | 0·46 | 33 |
| | B | 5·65 | 1·51 | 6·2 | 0·55 | 15 | 1·5 | 0·09 | 11 | 8·9 | 3·25 | 47 | 2·05 | 0·64 | 46 |
| | Gum arabic | 5·65 | 1·51 | 9·3 | 3·65 | 100 | 2·2 | 0·79 | 100 | 12·5 | 6·85 | 100 | 2·8 | 1·39 | 100 |
| | Paper untreated | .. | .. | 5·65 | .. | .. | 1·41 | .. | .. | 5·65 | .. | .. | 1·41 | .. | .. |
| II. | A C D | 1·28 | 1·55 | 1·32 | 0·04 | 4 | 1·55 | 0·00 | 0 | 1·47 | 0·19 | 12 | 1·6 | 0·03 | 3 |
| | B | 1·28 | 1·55 | 1·41 | 0·13 | 13 | 1·63 | 0·08 | 8 | 1·62 | 0·34 | 21 | 1·78 | 0·23 | 15 |
| | Gum arabic | 1·28 | 1·55 | 2·25 | 0·97 | 100 | 2·6 | 1·05 | 100 | 2·9 | 1·62 | 100 | 3·07 | 1·52 | 100 |
| | Paper untreated | .. | .. | 1·28 | .. | .. | 1·55 | .. | .. | 1·28 | .. | .. | 1·55 | .. | .. |
| III. | A C D | 0·75 | 1·1 | 0·86 | 0·11 | 24 | 1·23 | 0·13 | 24 | 1·02 | 0·27 | 37 | 1·35 | 0·25 | 28 |
| | B | 0·75 | 1·1 | 1·0 | 0·25 | 56 | 1·35 | 0·25 | 45 | 1·1 | 0·35 | 48 | 1·48 | 0·38 | 44 |
| | Gum arabic | 0·75 | 1·1 | 1·2 | 0·45 | 100 | 1·65 | 0·55 | 100 | 1·48 | 0·73 | 100 | 1·97 | 0·87 | 100 |
| | Paper untreated | .. | .. | 0·75 | .. | .. | 1·1 | .. | .. | 0·75 | .. | .. | 1·1 | .. | .. |

| Quantity of Gum in Paper. | | 15 per Cent. | | | | | | 20 per Cent. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Breaking Weight. | | | Tearing Length. | | | Breaking Weight. | | | Tearing Length. | | |
| | | c | d | e | f | g | h | c | d | e | f | g | h |
| Paper used. | Gum used. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. |
| I. | A C D | 10·5 | 4·85 | 52 | 2·17 | 0·76 | 44 | 12·95 | 7·3 | 68 | 2·61 | 1·2 | 64 |
| | B | 11·3 | 5·65 | 61 | 2·36 | 0·95 | 56 | 14·0 | 8·35 | 78 | 2·85 | 1·44 | 77 |
| | Gum arabic | 14·95 | 9·3 | 100 | 3·12 | 1·71 | 100 | 16·4 | 10·75 | 100 | 3·28 | 1·87 | 100 |
| | Paper untreated | 5·65 | .. | .. | 1·41 | .. | .. | 5·65 | .. | .. | 1·41 | .. | .. |
| II. | A C D | 1·9 | 0·62 | 31 | 1·83 | 0·28 | 16 | 2·6 | 1·32 | 55 | 2·5 | 0·95 | 48 |
| | B | 2·17 | 0·89 | 45 | 2·08 | 0·53 | 30 | 3·15 | 1·87 | 78 | 2·97 | 1·42 | 71 |
| | Gum arabic | 3·28 | 2·0 | 100 | 3·33 | 1·78 | 100 | 3·69 | 2·41 | 106 | 3·54 | 1·99 | 100 |
| | Paper untreated | 1·28 | .. | .. | 1·55 | .. | .. | 1·28 | .. | .. | 1·55 | .. | .. |
| III. | A C D | 1·22 | 0·47 | 49 | 1·5 | 0·4 | 41 | 1·51 | 0·76 | 64 | 1·68 | 0·58 | 54 |
| | B | 1·33 | 0·58 | 61 | 1·65 | 0·55 | 57 | 1·68 | 0·93 | 78 | 1·87 | 0·77 | |
| | Gum arabic | 1·70 | 0·95 | 100 | 2·07 | 0·97 | 100 | 1·94 | 1·19 | 100 | 2·17 | 1·07 | 100 |
| | Paper untreated | 0·75 | .. | .. | 1·1 | .. | .. | 0·75 | .. | .. | 1·1 | .. | .. |

TABLE II.—*continued.*

| Quantity of Gum in Paper. | | 25 per Cent. | | | | | | 30 per Cent. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Breaking Weight. | | | Tearing Length. | | | Breaking Weight. | | | Tearing Length. | | |
| | | *c* | *d* | *e* | *f* | *g* | *h* | *c* | *d* | *e* | *f* | *g* | *h* |
| Paper used. | Gum used. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. | In Kilos. | Increase in Kilos. | Ratio Number. | In Km. | Increase in Km. | Ratio Number. |
| I. | A<br>C<br>D | .. | .. | .. | 3·04 | 1·63 | 81 | .. | .. | .. | 3·2 | 1·69 | 85 |
| | B | .. | .. | .. | 3·22 | 1·81 | 90 | .. | .. | .. | 3·35 | 1·84 | 92 |
| | Gum arabic | .. | .. | .. | 3·43 | 2·02 | 100 | .. | .. | .. | 3·52 | 2·01 | 100 |
| | Paper untreated | .. | .. | .. | 1·41 | .. | .. | .. | .. | .. | 1·51 | .. | .. |
| II. | A<br>C<br>D | 3·42 | 2·14 | 73 | 2·85 | 1·3 | 60 | 3·67 | 2·39 | 69 | 3·0 | 1·45 | 63 |
| | B | 3·7 | 2·42 | 82 | 3·58 | 2·03 | 94 | 4·07 | 2·79 | 80 | 3·9 | 2·35 | 102 |
| | Gum arabic | 4·22 | 2·94 | 100 | 3·71 | 2·16 | 100 | 4·75 | 3·47 | 100 | 3·85 | 2·3 | 100 |
| | Paper untreated | 1·28 | .. | .. | 1·55 | .. | .. | 1·28 | .. | .. | 1·55 | .. | .. |
| III. | A<br>C<br>D | 1·79 | 1·04 | 73 | 1·88 | 1·78 | 66 | 1·95 | 1·2 | 75 | 2·08 | 0·98 | 74 |
| | B | 1·93 | 1·18 | 83 | 2·05 | 0·95 | 81 | 2·09 | 1·34 | 84 | 2·18 | 1·08 | 82 |
| | Gum arabic | 2·18 | 1·43 | 100 | 2·28 | 1·18 | 100 | 2·34 | 1·59 | 100 | 2·42 | 1·32 | 100 |
| | Paper untreated | 0·75 | .. | .. | 1·1 | .. | .. | 0·75 | .. | .. | 1·1 | .. | .. |

—S. P. E.

*Purification of Sugar Liquor by Electrolysis.* Javaux, Gallois, and Dupont. Oesterr. Zeits. Zuckerind. 1894, **23**, 613.

THE beetroot or cane-juice, after being neutralised with lime and purified, is rendered slightly alkaline; it is then electrolysed twice, diaphragms being made use of. The two treatments follow one another. The cathodes generally consist of iron or carbon; the anodes, which dip into the liquor, may be, for the first treatment, of aluminium, and for the second treatment, of lead. By the first treatment the acids form completely insoluble compounds with the metals of the anodes, and the production of large quantities of soluble lead salts is therefore excluded; traces of the insoluble salts are decomposed by phosphoric acid. It is said that the whole of the product is obtained as refined sugar, neither after-products nor molasses being produced.—A. R. L.

*Inversion of Sugar and Raffinose Solutions.* Besemfelder. Deutsch. Zuckerind. 1894, **19**, 1282.

SOLUTIONS of about 70° Brix are treated with 0·3—0·5 per cent. of aluminium sulphate and inverted to the desired limit at 85°. Pure sugar solutions require, with an addition of 1·5 per cent. of acid, three hours' heating. Neutralisation is effected by addition of barium or strontium aluminate. The liquor is then warmed and carbonic anhydride passed through; it is then filtered at 100° C. and concentrated in a vacuum. The precipitate consists of barium or strontium sulphate and alumina.—A. R. L.

*Amount of Citric Acid in Sugar-Cane Juice.* Shorey. Deutsch. Zuckerind. 1894, **19**, 1043.

THE amount of citric acid in cane juice is sometimes considerable, and when the purification of the juice and the evaporation of the same have been conducted carelessly, calcium citrate may accumulate in the sugars to such an extent that 3—4 per cent. of this compound may sometimes be found in the after-products.—A. R. L.

*Estimation of Crude Fibre in Sugar Cane.* J. L. Beeson. J. Amer. Chem. Soc. **16**, 308.

*See under* XXIII., *page* 80.

*The Variety of Sugar in Indican.* C. J. van Lookeren. Landw. Ver.-Stat. **45**, 198.

*See under* Analyt. and Scient. Notes, *page* 81.

## PATENTS.

*Improvements in the Manufacture of Lævulose.* S. Pitt, Sutton, Surrey. From the Chemische Fabrik auf Actien vormals E. Schering, Berlin, Germany. Eng. Pat. 24,459, December 19, 1893.

PURE levulose is said to be a food material which can be administered to a person suffering from diabetes. The method described is founded on the basis of Dubrunfaut's lime process for the separation of dextrose from levulose dextrose forming a lime compound which is soluble in water, whereas the lime compound of levulose is insoluble. The essential features of the present invention are:—(1.) The decomposition of the lime compound of levulose after washing with water by carbonic acid ($CO_2$) under high pressure and at a low temperature. (2.) The treatment of the lime compound of levulose with a highly concentrated solution of levulose so as to form a liquid mixture, and decomposing the lime compound by carbonic acid, with or without pressure. (3.) The addition to solutions of levulose, prior to their evaporation, of acids, especially organic acids, phosphoric acid or boric acid, in such quantity that the evaporated solution will have an acid reaction; this prevents the decomposition of the sugar.—A. R. L.

*Improvements in Centrifugal Apparatus for Drying and Purifying Sugar or other Crystalline or Granular Matters.* D. Stewart, Glasgow. Eng. Pat. 1790, January 27, 1894.

*See under* I., *page* 14.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Extract relating to the Chemistry of Brewing, &c., from the International Congress of Applied Chemistry, Brussels and Antwerp.* August 4—11, 1894. Chem. Zeit. **18**, 1894, 1482—1483.

In the biological section, the following subjects were brought under discussion:—

I.—*Fermentation with Pure Yeast and the Treatment of Yeast with Hydrofluoric Acid.* Dr. Cluss (Halle).

It was resolved that the methods of Delbrück and Effront, used conjointly, are to be recommended.

II. and III.—*The Use of Pure Yeast in Top Fermentations.* H. van Laer.

The author of the paper maintained, in spite of the assertions of the Copenhagen school to the contrary, that satisfactory results are obtained by the use of pure "compounded" yeasts.

A variety of opinions was expressed regarding the use of single-race cultures in practice, since it appears desirable to adopt this method with caution.

Communications concerning yeast were also received from Lindner (Berlin) and Martinand (Poisieu-sur-Champagne).

IV.—*The Use of Molasses in Distilleries.* A. Aulard (Marseilles).

Attention was drawn to the enormous progress which the Belgian distillers have made in the fermentation of molasses. In order to get the maximum lawful yield, it is necessary to use an enormous quantity of yeast. The wort is rendered acid, boiled, and filtered. Filtration ensures a more complete fermentation and a better yield. It was also pointed out by Effront (Brussels) and Van de Vijvere that filtration removes a number of ferments which cannot otherwise be separated. These are anaërobic organisms, which neither antiseptics nor boiling will remove, and which revivify even in an atmosphere of carbonic acid.

V.—*The Morphology and Physiology of the Deposit of Vinegar.* Van der Bossche (Chassart).

Although causing no change in the vinegar, and also perfectly innocuous, it is necessary to remove vinegar deposits, because such vinegar is looked upon unfavourably by purchasers.

VI.—*Analyses of Barley for Brewers, Distillers, and Glucose Manufacturers.* J. Vuylsteke.

Methods of analysing barleys should vary according to the use for which they are intended. Effront holds that a fermentation should be included in the analysis. Dr. Delbrück proposed for this purpose a single-race yeast, Berlin No. 2.—T. A. G.

*Mould Fungi occurring upon Barley and Hops.* P. Lindner. Wochenschr. f. Brauerei, **11**, 1321—1323.

The author describes four such growths, with special reference to their appearance in drop-cultures and in ordinary solid media.

*Oïdium lactis* (oval lactic mould) frequently develops upon green malt, covering the grains with a white web or felt, an appearance easily produced in the laboratory by sowing spores of the fungus upon steeped barley contained in a loosely-covered glass vessel. Also it occurs upon the walls of vessels and pipes, in the porous parts of vats and barrels, &c., as slimy, yellowish fungoid masses, whilst upon pressed yeast it is often seen as a dry white deposit. When sown in wort it develops large colonies or clusters, the upper surface of which is a pure white, woolly web, beneath which accumulate bubbles, chiefly containing carbon dioxide; Hansen has shown that in wort it produces a trace of alcohol.

Within tubes coated with a thin film of wort-gelatin, it grows as a beautiful radiating mycelium of silk-like lustre; upon thicker films it forms enormous colonies, having a radiating substructure with a dry, floury surface, then as development proceeds an active evolution of gas produces a swelling within the mass, which increases till the bubble is distended to walnut size, and with shining translucent walls; rupture of the bubble has never been observed, the contents only being liberated when the gelatin liquefies; it is worthy of note that the mycelium also is so firmly rooted that it does not yield to the gas pressure.

Especially interesting is it to watch the budding of an oïdium spore in a drop culture. The young spore-cell grows at an extraordinary rate and ramifies abundantly, then numerous transverse divisions or septa appear, followed by the usual subdivision of the filaments into a chain of cells, the disruption being accompanied by frequent strong convulsive movements of the filaments—a behaviour that may be repeatedly produced by tapping the microscope or the object-stage.

The name is given because of its frequent occurrence in milk (though it does not cause acidification of milk, as hitherto often assumed), also from the form of its cells, although the term oval is somewhat inaccurate, the spores being formed by the breaking up of the mycelial sheaths into separate segments, and are consequently more cylindrical than oval, the latter form being produced by a swelling of the spores.

*Oïdium lupuli*, so named by Matthews and Lott, resembles Oïdium lactis in its spore formation, and appears, among other things, upon damply-stored hops as a reddish-coloured powder. In contrast to the former variety it forms a very luxuriant ærobic mycelium, growing extremely rapidly and almost entirely filling the culture vessel; at the ends of the hyphæ, delicate branches appear which by segmentation give oïdium-like cells; frequently these branched ends resemble small tree shoots, the cells being swollen to oval form and frequently forked. The spores are faintly reddish in colour, appearing a fine orange or salmon tint in mass. The dimensions vary greatly, cylindrical cells occurring 31 $\mu$ long and 14 $\mu$ broad; spherical cells are also known. The spores are smooth, absorb water readily, and after much soaking become rounded off almost to globular form.

*Fusisporium moschatum* (Kitasato), Fusarium hordei (Matthews). The red colour often noticed upon grains of malt is regarded by Matthews as a form of Fusarium, barley so attacked exhibiting but a feeble growth, or remaining almost ungerminated. It is well characterised, not only by the colour of the spores, but also by their curved crescent-like form, and further by producing an intense odour of musk when growing in wort and wort-gelatin, and which gradually disappears from old cultures. It is evidently identical with the *Fusisporium moschatum* described by Kitasato. If spores be scraped from a growth and sown in drops of wort, almost all of them will be found on the following day to have germinated; the tapering end cells remain principally sterile, while the intermediate spores swell up and form germ sacs, which, it is interesting to note, coalesce with their neighbours to form a single mycelium. A scattering of spores in drop cultures is but seldom seen, the procedure being that short papillary side branches appear, and from them proceed the crescent-shaped spores, which fall off at maturity and accumulate to a more or less large heap of crescents. Singularly enough this form cannot produce a web of spores in wort-gelatin; the filaments only grow together to more or less thick cords, projecting into the air to a height of 1 cm. (one centimetre), and filled with minute oily drops.

*Penicillium cladosporioïdes* (Cladosporium herbarum Link) is often seen upon malt, hop leaves, damp walls, doors, and window panes, and, according to Zoebl, is the cause of the terminal brown discoloration upon barley corns. Upon the wort-gelatin film lining the detection tube, its presence is shown by the olive-green colour of the spore clusters and by the dark-green colour of the mycelial layer attached to the glass. In wort drop-cultures, it forms a somewhat branched mycelium, yellowish-brown at an early period and enclosing numerous oily drops; after two days small conidia bearers project upwards and at the tips sprout into delicate branches; if such a filament comes in contact with the cover glass it readily scatters into the several constituent cells, which vary entirely in form and number, being mainly elongated and having sharp corners, and with a cell wall greenish to brown in colour; upon many mycelial threads may be found ragged excrescences (absorption organs), which attach themselves to the walls and thus strengthen the mycelium.—G. W. A. T.

### *The Specific Character of the Fermentative Functions of Yeast Cells.* A. J. Brown. J. Chem. Soc. **65** and **66**, 1894, 911—923.

The author's experiments have not only shown that, in his opinion, aëration does not prevent or hinder the exhibition of the fermentative functions of non-increasing yeast-cells (J. Chem. Soc. **61**, 1892, 369), but in the present paper they appear to demonstrate that if, in the place of M. Pasteur's theory that fermentation is "life without air," is substituted the consideration that yeast cells can use oxygen in the manner of ordinary aërobic fungi, and probably require it for the full completion of their life history, none of Pasteur's results receive contradiction thereby. Moreover, it will be found in the statement that the exhibition of the fermentative functions of yeast cells *is independent* of their environment with regard to free oxygen, there is also nothing of a contradictory nature in such hypothesis as regards any of the results of M. Pasteur's experiments.

—W. S.

### *Faulty Hops the Cause of Blister- or Bladdery-Fermentation.* L. R. Wochenschr. f. Brauerei, **11**, 1323—1324.

Hitherto the causes of this undesirable phenomenon have been regarded as due to: (1) Impure yeast; (2) Uncleanliness of the brewery plant; and (3) Unwholesome cellar atmosphere, although the prevention of the latter by constant ventilation-currents must check the formation of the bubbles.

From the following observations, the author concludes that a "bladdery head" is a purely mechanical phenomenon, due to the employment of faulty hops. In an instance where hops which were originally good, but having become damp and much deteriorated, had been used alone, a number of blisters appeared, some of them of hand size, while at the same time a neighbouring vat pitched with the same yeast, but hopped with perfectly sound cones, showed not a single blister throughout the whole of the fermentation.

When such a bladdery surface is examined, the greater part of the hop resin is seen to be distributed as minute particles over the entire surface, which seems to be thus covered with a thin, light, sticky, barely-porous layer favouring the blistery appearance by offering resistance to the escaping carbon dioxide, the gas being caught in the sticky scum, rises in bubbles that suddenly burst, but only to be formed anew. No separation of hop resin occurs at the beginning of fermentation, consequently the phenomenon does not appear then, but only towards the end of the process. The appearance of "curly heads" is also distinctly accompanied by the separation of hop resin, but their constant change of form and position destroys the bubbles that may then tend to form, and only as soon as a stable surface has been formed does the resinous layer rise in blisters, which continue to be formed to the end of fermentation, and when squeezed between the fingers leave thereon a sticky, bitter-tasting mass. By the use of sound hops, on the contrary, the resin remains on the surface in larger, heavier particles, which the carbon dioxide is unable to raise and swell.

The author hopes the discussion of this cause of the phenomenon may help to determine a more certain and much needed proof regarding the soundness of hops, for the sulphuring operation easily conceals faults of colour as well as other unsound qualities of the cones.—G. W. A. T.

### *The So-called High- and Low-Attenuating Yeasts.* Windisch. Wochenschr. f. Brauerei, **11**, 1565—1566.

Two types of yeast have been scientifically established—Saaz and Frohberg—which differ essentially as regards the degree of attenuation they can effect in beer worts, the Frohberg yeast carrying it to a further degree than the Saaz species. In practice, yeasts are frequently spoken of as of high and low attenuating power, a difference due, in the minority of cases, to the fact that they belong to both the Saaz and Frohberg types; more often are they of the Frohberg type, a feebly-attenuating variety which, under conditions of favourable fermentation in the laboratory, easily attains to the furthest degree of attenuative power. The author has repeatedly demonstrated (Wochenschr. f. Brauerei, **11**, 1564—1565) that the feeble attenuating capacity of an essentially top-fermentation yeast often becomes reduced so that the organism prematurely agglomerates and becomes deposited. On the other hand, the highly-attenuating yeasts seldom break well in the vat. If it is assumed that breaking capacity depends upon some characteristic peculiarity of the yeast, then a yeast so characterised should always comport itself so, and attenuate but feebly, while a yeast lacking that capacity should always give a turbid fermentation, with considerable attenuation. Yet such is by no means the case, for often, where a change of pitching-yeast is introduced with the intention of producing feeble attenuation attended with breaking capacity, there results instead much attenuation, together with a turbid fermentation; and no less often is the reverse behaviour manifested.

The author has already communicated (Wochenschr. f. Brauerei, **11**, No. 42) results upon the employment of the extremely attenuating yeast of a Rhenish brewery in the brewery at Jaroschau, in Hradisch, Moravia, which comported itself quite satisfactorily, but after two reproductions the attenuative power became so much reduced as to be of no further use. Concerning the yeast peculiar to the Jaroschau brewery, according to Dr. Wichmann, of the Vienna Research Station, it exhibits properties differing from those of other varieties; it finishes fermenting at a high degree of attenuation, quickly clarifies in storage vessel, and leaves the beer with a full-bodied flavour, so much so that a sample produced from a 1050·5 sp. gr. wort when compared with a German beer from a 1057 sp. gr. wort was declared by the brewer of the latter to indicate considerably more body than the German beer. A further advantage conferred is, that it enables the beer to be sold while still very new, and so, without diminishing the demand for the full round-flavoured beverage, reduces the stock and time of storage. Also clarification speedily takes place, so that shavings are not required—a great advantage, seeing that their employment causes waste of beer, is a source of beer infection, and in no case favourably influencing the beer palate. In other breweries without shavings or other mechanical means, only prolonged storage can effect the requisite clarification.

The question then arises, will this particular yeast retain its preferable properties in other establishments? Why such fundamental differences of behaviour should exist in the various breweries is still an unsolved problem. For instance, how do we explain why a yeast attenuating in one brewery up to 70 per cent, only proceeds to 55 per cent. in another? The bodies that limit the attenuation in the first reproduction—that is, the sugars—are neither quantitatively nor qualitatively so essentially different as to explain such a variance; and the same may be said of the other yeast-foods, the albuminoids, and the salts present in the worts.

Notwithstanding the great activity that has been already displayed in investigating the life-work of yeast, still more remains to be accomplished and established, and the field for work is even immeasurable.—G. W. A. T.

### *Raffinose (Melitriose) and its Non-occurrence in Beers.* A. Bau. Woch. f. Brauerei, 1894, **11**, 1439—1443. (See Chem. Zeit. 1894, **18**, 1794—1798; see this Journal, 1895, 80.)

In the year 1889 Scheibler and Mittelmeier stated that they had detected the presence of melitriose (raffinose) or melibiose, one of its products of hydrolysis, in beer, and a little later these chemists asserted that melitriose is a constant constituent of beer.

The author enters upon an historical sketch of the literature of melitriose. He then describes experiments made with the object of verifying O'Sullivan's observation as to the presence of melitriose in barley. In the first few experiments positive evidence was not obtained, but ultimately the carbohydrate was isolated in small quantity by Scheibler's strontia method from a sample of barley. The author considers it not unlikely that melitriose is a constant constituent of barley; in certain varieties, however, its amount is so small that its recognition is extremely difficult, if not impossible.

The barley used for the manufacture of malt has generally been stored, and the question arises whether during this storage the melitriose is destroyed, as, according to Scheibler, it is in the case of beetroots. During the steeping process the soluble constituents of the grain are extracted, and melitriose being soluble in water would of course be removed. The sugar formed during germination is, on the evidence of numerous observers, saccharose, which naturally undergoes partial inversion. Brown and Morris have shown that the germ requires sugar for its growth, and that it can derive its nourishment from melitriose among numerous other compounds. Hence, it is easy to understand that the melitriose originally present in the barley will, during the malting, either be reduced to a minimum or entirely vanish. According to Scheibler, melitriose is readily decomposed in the moist condition at a high temperature, and any of this carbohydrate which might be present in green malt would probably be destroyed during the kilning. In a word, none of the numerous chemists who have investigated the pre-existing sugars in malt have detected melitriose—not even O'Sullivan, the discoverer of its presence in barley. The author isolated the sugars from a sample of Pilsener malt. A solution of these was mixed with nutritive matter, and pitched with a high-fermentation yeast of the Frohberg type; after complete fermentation the solution was optically inactive, and no sugar could be recognised by the osazone test. This was done with a like result in the case of three samples of malt, so that neither melitriose nor melibiose were present. The author concludes from these observations that melitriose is not a constituent of high dried (kilned) malt; its presence in green malt must, however, be left an open question.

Although the question of the action of diastase on melitriose has never been investigated, it appears probable that this sugar would remain unaltered during the mashing and boiling processes. As to its behaviour during the fermentation stage of the brewing process, the author finds that the sugar is completely fermentable by low fermentation yeasts of the Frohberg and Saaz type. Fermentation does not set in briskly, however, with pure solutions of melitriose until several days after they have been pitched with yeast, a fact which seems to indicate that hydrolysis precedes fermentation. The yeasts just mentioned also effect the complete fermentation of melitriose when it is present, together with other sugars, as, for example, when it is added to beer wort. High fermentation yeasts of the Frohberg and Saaz type hydrolyse melitriose into levulose, which then ferments, and melibiose, which remains unattacked. The author has utilised these facts as the basis of a method for the quantitative estimation of melitriose (this Journal, 1895, 80). *Saccharomyces Ellipsoideus* II. (Hansen) behaves towards melitriose exactly as the two high fermentation yeasts above mentioned; but *Monilii Candida* (Hansen) is without action on both melitriose and melibiose. From the evidence brought forward up to this point, therefore, the presence of melitriose in beer, which is generally (in Germany) fermented by a high yeast, is extremely doubtful; by the aid of the new analytical methods, however, the author has proved conclusively its absence in beer as well as that of melibiose. Scheibler's observations respecting the action of invertase on melitriose require confirmation, since the kind of yeast from which the invertase was derived was not stated. Scheibler and Mittelmeier base their statement that melibiose is present in beer on the fact that they separated an osazone having a melting point 177°—178° C. Lintner and Düll obtained an osazone of this melting point from Munich beer, but found it to be a mixture of maltosazone and isomaltosazone.—A. R. L.

### *Estimation of Saccharose in Malt.* E. Jalowetz. Chem. Zeit. 1894, **18**, Rep. 294.

Meissl's inversion method cannot be employed for estimating saccharose in malt worts and cold water malt extracts, for the results obtained by it are too low. By using the proportions of extract and hydrochloric acid recommended by Jais (this Journal, 1894, 1101), the percentages of saccharose found are considerably above the truth. In the case of alcoholic extracts, Meissl's method may be employed without modification, but care must be taken here not to exceed the proportion of hydrochloric acid. The modified Clerget* inversion method gives correct values for the percentage of saccharose with worts, cold water extracts, and alcoholic extracts. The test is preferably carried out in an aqueous extract, 50 grms. of malt being digested with 400 cc. of water for 1 hour. The percentage of saccharose in malt varies greatly according to the kind of barley, the germination, and the kilning. In the case of malts from Moravian barley, the percentage of saccharose increases as the temperature of kilning. Pilsener malts contain, on an average, 3·5 per cent., and Bavarian malt 4 per cent. and more, of saccharose.

—A. R. L.

### *Action of Diastase on Isomaltose.* C. J. Lintner. Zeits. f. ges. Brauw. 1894, 378.

Whereas in the author's former experiments (this Journal, 1892, 766), in which isomaltose was prepared by the action of malt extract on starch, it was found that the isomaltose so obtained was completely converted into maltose by diastase; in the more recent experiments this conversion is found to be incomplete. Isomaltose prepared by the action of oxalic acid on starch, remains quite unaltered when treated with diastase. Isomaltose, but no maltose, is formed by the action of oxalic acid on starch. It is suggested by the author that the isomaltose produced by diastase and that produced by acid are stereo-isomeric modifications. This may also be connected with a difference in configuration and behaviour towards diastase and yeast of the Saaz type.

—A. R. L.

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* Probably Herzfeld's modification of Clerget's method is here meant.

*Raffinose (Melitriose) and its Quantitative Estimation.* A. Bau. Chem. Zeit. 1894, **18**, 1794.

*See under* XXIII., *page* 80.

*The Analysis of Malt.* J. A. Miller. J. Amer. Chem. Soc. **16**, 353.

*See under* XXIII., *page* 80.

## PATENTS.

*Improvements in Machines for Drying Brewers' Refuse and other Substances or Materials.* R. Cunliffe, Weaste, Lancashire. Eng. Pat. 23,069, December 1, 1893.

This invention consists in modifications of the machines for drying brewers' refuse, spent grain, &c., in which a rotary cylindrical retort inside a casing is employed in connection with a furnace for producing the necessary heat. The improvements consist mainly (*a*) in arrangements to enable the retort to be operated either by hand or by power, (*b*) to provide means for the better utilisation of the hot gases from the furnace, so as to render the drying more rapid, and (*c*) the use of hollow fire-bars.—L. T. T.

*Improvements in the Manufacture from Starch or Starchy Substances of a Material Suitable for Use in Brewing and for other Purposes.* C. H. Meyer, Shepton Mallet. Eng. Pat. 1146, January 18, 1894.

The inventor submits the starchy substance to the action of chlorine, or of chloride of lime in solution, to render the starch readily soluble. The chlorine or chloride of lime is removed by washing, and the starch is then mixed with water and boiled, preferably under slight pressure, to gelatinise it and render it soluble. Malt extract or other diastase is added to invert the starch, and the dextrinous solution is concentrated or evaporated to dryness, for use in brewing.—L. T. T.

*Improvements in the Manufacture of Beer and in Apparatus therefor.* L. Wagner and J. Marr, Baltimore, Maryland. Eng. Pat. 15,919, August 21, 1894.

The inventors propose to "first filter, and subject to the action of an electrical current, the water for the mash, then make the mash and boil the wort, filter the wort under air or gas pressure and cool it, then ferment the same under a vacuum, abstract the carbonic acid and admit a limited amount of air, the beer being stirred and the yeast lifted and mixed therein during the first part of the period of fermentation, and afterwards purify the fermented beer under carbonic acid gas pressure by filtration and the action of an electrical current, and charge it with carbonic acid." Elaborate apparatus is described to carry this out.
—L. T. T.

*Improvements in, and in the Production of Diastatic and Alcoholic Ferments, and the Utilisation of Bye-Products.* J. Takamine, Peoria, Ill. Eng. Pat. 17,277, September 11, 1894.

The inventor finds that certain fungi, during their growth upon proper media, become possessed of diastatic and fermenting properties. The best results have been obtained with the microscopic fungus *eurotium oryzæ*, but other mould fungi belonging to the genera *aspergillus*, *mucor*, and *pencilium* may also be used. The inventor prefers to use, as the raw material upon which to grow the fungus, comminuted or broken grains of the cereals, such as wheat, oats, barley, &c., and preferably such grains from which the greater part of the starchy matter has been removed, leaving the comminuted parts in the form of bran, shorts, middlings, &c., and particularly wheat-bran. Many other substances (such as oil-cake, grain from brewing, &c.) may, however, be so employed. The bran part of the grain is the best for the purpose, as it is of a loose and coarse nature, thus affording a large surface for the growth of the fungus and a ready access of air, besides being rich in albuminoids and nitrogenous matter, and so forming a nutritious soil. Bran contains, besides, a large percentage of woody fibre, which, acting as a filter, makes its use beneficial in the process of extraction, being cheap and abundant at all seasons of the year.

The fungus is sown and developed on the medium chosen in the way described in the inventor's former Eng. Pat. 17,374, 1891 (this Journal, 1892, 1022). To the whole mass upon and through which the fungus has been thus developed the author applies the name "Taka-Koji." During the growth of this fungus an abundant supply of enzyme is formed. Taka-Koji possesses two distinct properties, namely, diastatic and fermenting property.

The diastatic enzyme may be extracted by percolating water, or water mixed with alcohol, through the Taka-Koji, or by steeping the latter in the liquid. By repeatedly treating fresh quantities of Taka-Koji with the same liquid, the strength of the liquid may be increased. The enyzme may be precipitated from the solution by adding to the latter 1·5 to 3 times its volume of 90 per cent. alcohol. The precipitate consists mainly of enzyme with traces of mineral matter. It may be separated by decantation or filtration, washed with 85 per cent. alcohol, and dried at a low heat or dehydrated by means of absolute alcohol. It is an amorphous, almost white or light yellowish-brown powder, readily soluble in water, and possesses the power of converting gelatinised starch into sugar. The solution may, if it be preferred, be concentrated to a syrup at a temperature not exceeding 50° C. and preserved in that form. The pure enzyme does not give the blue coloration given by malt-diastase when the latter is treated with tincture of guiacum mixed with hydrogen peroxide.

The ferment portion—which consists of the bloom of the fungus, and possesses remarkably high fermentative power—may be directly separated from the dried Taka-Koji in the form of a fine powder by sifting the Taka-Koji. The residue contains the enzyme, and may be used as a diastatic agent, or the enzyme may be extracted with water. The ferment forms a fine powder, composed of young immature spores of the mycelial ferment, and differs in colour according to the fungus employed. It consists of microscopical spherical cells capable of exciting alcoholic fermentation under suitable conditions.

The enzyme and ferment may be extracted together by steeping the Taka-Koji in water, thoroughly stirring, and then pressing the mass. The enzyme becomes dissolved in the water, and the ferment, which is insoluble in water, becomes detached by attrition and remains suspended in the liquid. If the extract is then allowed to stand, the ferment subsides and the enzyme solution may be removed by decantation, or they may be separated by filtration.

The residue of Taka-Koji, after the ferment and enzyme have been removed, may be used to grow a fresh supply of fungus. Wheat-bran may be so used five times, and 10 times if 10 per cent. of fresh bran is added after each operation.

Various modifications of manufacture and treatment are described.

The ferment cells are more active than ordinary yeast cells, and can live in stronger alcoholic solutions. When used as a substitute for ordinary yeast in brewing the ferment produced may be pressed and used for bread-making with very satisfactory results.—L. T. T.

*Mechanism for Ageing Liquors.* T. R. Timby, Washington, D.C. Eng. Pat. 19,662, October 16, 1894.

"It is known that the agitation of liquor, especially distilled liquor, in barrels, has the effect of giving it the quality otherwise imparted by age." The present invention consists of platforms on rockers which are worked by mechanical means, and rest or move on uneven surfaces, so as to jar or jolt the platforms. The barrels being placed on these, they and the liquor contained therein are subjected to a more irregular and thorough jolting and agitation than with the ordinary cradle, and the ageing effect is said to be thereby much increased.—L. T. T.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (*A.*) CHEMISTRY OF FOODS.

*Alimental Fats.* F. Wallenstein and H. Finck. Chem. Zeit. 18, 1189.

*See under* XXIII., *page* 78.

### PATENTS.

*An Improvement in the Preparation of Rape-Seed for Use as Food for Cattle and other Animals.* A. W. MacIlwaine and L. E. Common, both of Hull. Eng. Pat. 1670, January 25, 1894.

The inventors claim the preparing of an improved cattle food by removing the bitter principle of rape-seed.

The crushed seed or finely-divided cake is first deprived of oil by means of volatile solvents, and then exhausted with boiling alcohol until the bitter taste has practically disappeared. The alcohol is subsequently evaporated from the seed, cake, or meal, and also from the extract, by means of dry steam, condensed and used again.—L. de K.

*New or Improved Machinery or Apparatus for Testing Milk and Drying Butter.* S. Cheeld, Chesham. Eng. Pat. 2143, January 31, 1894.

The inventor combines the well-known centrifugal milk-machine with a butter-drying apparatus by means of a spindle so arranged that the butter-chamber and the frame for holding the milk-tubes are interchangeable. The revolving part is surrounded by an outer chamber. The spindle is driven in the ordinary manner.—L. de K.

*Improvements in the Production of a Peptonised Beverage from Milk.* A. Bernstein, Berlin, Germany. Eng. Pat. 10,106, May 25, 1894.

The inventor's claim is the production of peptonised milk by means of a specially-prepared bacterium.

The milk, butter-milk, or whey is first completely sterilised and a small quantity of the peptone bacteria, grown on agar, is added. After a few days the milk, if kept at about 20°, becomes more transparent and liquid. More milk may now be added, and the action of the bacteria continued for about a week. The milk is now boiled, which will cause the unaltered caseine to curdle, because a small amount of free acid has formed. The liquid is then filtered, heated for some time in an open vessel, and then kept for use in bottles.

The bacteria may be obtained from milk by Koch's process. They exist as very short rods, two being generally connected together, and exhibit rapid whirling motions; their colonies cultivated on plates of meat-peptone-gelatin are of a liquid cloudy appearance, and soon liquefy gelatin completely.—L. de K.

## (*B.*)—SANITARY CHEMISTRY.

*The Determination of Nitrates in Potable Water by the Phenolsulphonic Acid Process.* A. H. Gill. Tech. Quarterly 7, 1894, 55.

*See under* XXIII., *page* 71.

### PATENTS.

*Improvements in the Purification of Sewage and Water, and Apparatus for Use therein.* F. P. Candy, Balham, Surrey. Eng. Pat. 17,335, September 15, 1893.

A device is described for maintaining in their relative positions the layers of filtering material, in filters which are composed of two or more layers of different kinds or sizes of filtering material.

An arrangement for introducing a fluid precipitant into water flowing under pressure through a pipe or pipes on its way to a precipitation-tank or a filter-bed is next described.

The third alleged improvement consists in adding freshly precipitated sludge to the sewage or water flowing into the precipitation-tank, which "assists in carrying down the coagulum which is produced in the precipitation-tank by the action of the precipitants, and thus accelerates precipitation" (see also this Journal, 1890, 406, Eng. Pat. 1791; and 1893, 856, Eng. Pat. 19,829).—L. A.

*Improvements in Precipitation Tanks, and in connection with the Precipitation of Sewage and Polluted Waters.* F. P. Candy, Balham, Surrey. Eng. Pat. 23,155, December 2, 1893.

"Quiescent" precipitation tanks, that is, tanks in which the sewage is allowed a certain time for settling, and the settled sewage then run off, are constructed with the bottom of each tank sloping away from the sewage inlet towards a broad V-shaped trench at an opposite end of the tank, the inlet being so designed as to direct the current of water along the bottom of the tank with the object of sweeping the mud which has settled out of the previous tankful of sewage into the trench, from which it can be drawn off by means of a perforated or slotted pipe lying in the angle of the trench.

Another arrangement, suitable either for quiescent or continuous flow tanks, is to have the whole bottom of the tank composed of a series of parallel narrower V-shaped trenches, with a perforated or slotted pipe lying in each.

Means are next described for admitting sewage into continuous flow tanks in an improved manner. Various alternative methods are described.—L. A.

*Improvements in or relating to the Disinfection or Purification of Water.* C. Salzberger, Bürgsteinfurt, Germany. Eng. Pat. 1762, January 26, 1894.

The water of lakes and rivers, intended for the supply of towns, is first of all saturated with lime, and is then subjected to a current of carbon dioxide until the lime has been converted into bicarbonate. It is next passed upwards through a filtering vessel containing sloping shelves, and thence into another closed vessel, in which it is agitated and at the same time subjected to an electric current, by means of electrodes formed of aluminium and carbon connected by leads to a dynamo. The carbonate of lime is thus precipitated by the expulsion of the carbon dioxide which held it in solution, and after the water has again passed through a filter, it is fit for use. The object of agitating the water during the passage of the current, is to prevent the precipitated carbonate of lime from forming an incrustation on the electrodes, and to facilitate the expulsion of the carbon dioxide. The aluminium electrode is a cylindrical plate perforated with numerous slots; the carbon electrode consists of two frames, holding plates arranged like louvre-boards, suspended from a revolving arm, one just within, and the other close outside of the aluminium cylinder; the agitation of the water is produced by the revolution of the arm carrying the carbon plates.—L. A.

*Improvements in the Process of and Apparatus for Softening Waters and Purifying Waste Liquors.* H. L. Doulton and A. W. Manger, London. Eng. Pat. 18,992, October 6, 1894.

This specification relates to improvements in the apparatus described in No. 15,169 of 1893 (this Journal, 1894, 832). The saturated lime-water flowing from the vessel in which it is prepared is now caused to pass upwards through a second "quiescent" vessel, which may or may not contain a filter, in order to more perfectly clarify it. Regulating valves are provided on the pipes which convey the water to be purified, and the reagents, to the precipitation-tank, in order to more perfectly control the flow. The baffles or partitions have been removed from the settling-tank,

because experience has shown "that deposits of lime are carried forward and are apt to choke the water-ways and clog the filter." The manganous carbon filter is provided with a screw by which the filtering material can be subjected to any required degree of compression; also a flushing arrangement is added for cleansing the filter.
—L. A.

*Improvement in Means and Apparatus for Treating Smoke and Fumes.* W. L. Wallis, Sharon, Pa. Eng. Pat. 20,202, October 23, 1894.

This invention is for the purpose of separating the gas evolved by smelting and other furnaces from its accompanying solid matter. The object is attained by forcing the fumes (by the aid of the blast from the tuyères) through a separator of frustro-conical shape, wherein they ascend in a spiral current, the centrifugal force driving the solid particles outward against the sides of the separator—which is lined with a refractory material to withstand the heat—where they fall down through a sliding trap-valve into a chamber and are removed thence at convenience for return to the furnace. The purified gas passes away at the top through a bend of decreasing diameter—whereby eddies are prevented—into a down-take, communicating with a combustion chamber or stove.—C. S.

## (*C.*)—DISINFECTANTS.

*Disinfecting Action of Guaiacol.* J. Kuprianow. Centralbl. f. Bakteriol. 1894, **15**, 933 and 981.

Previous experiments have usually been made with impure guaiacol, but the author has employed a chemically pure sample. As a disinfectant, guaiacol is much weaker than phenol and cresol, and therefore of little use for external application. Especially is this the case with dilute solutions, whilst with increase of concentration, the disinfecting value rapidly increases; by the addition of alcohol, the effectiveness of all known disinfectants is considerably heightened.

Bacterial germs are more easily killed than cultures. Guaiacol, like cresol, has a powerful action on tubercle bacilli. By direct action, the organisms of Itch (*Acarus Scabici*) are almost instantaneously killed, but the action becomes very slow when animals afflicted with itch are treated with guaiacol. Whilst cresol, even on external application, is poisonous on account of rapid resorption, and hence must be used externally only in very weak solutions, the absence of poisonous and caustic properties in the case of pure guaiacol on the other hand allows of its internal application. Internal treatment of cholera with guaiacol might perhaps be worth trying as a solution of 1 in 500 of this reagent completely prevents the development of the cholera bacillus.—J. S.

*Disinfecting Value of Pine Tar.* W. Adolphi. Pharm. Zeit. 1894, **39**, 429.

The author examined 21 kinds of tar from various places in Russia. Pine tar is composed of acetic acid and homologues, guaiacol and homologues, pimaric and resinous acids and indifferent oils. Its value as a disinfectant depends on its power of killing microbes and on its deodorising properties. Experiment has shown that its value as a disinfectant is greatest when the tar has a high specific gravity and corresponding to this, a large quantity of acid. The specific gravity should not be under 1·06 nor the acid less than 2·5 per cent. The deodorising action of the tar is higher than a great many of the strongest disinfectants. Decomposing fæces lose their smell in a few minutes.
—J. S.

*Sulphite Vapours from the Spent Liquors of Wood-Pulp Mills, as a Remedy for Pulmonary Diseases.* Papier Zeit. **19**, 1894, 2779.

An establishment has recently been opened at Hallein, Austria, for the treatment of patients suffering from lung and bronchial disorders, by inhalation of *ligno-sulphite* as proposed by Dr. Hartmann. The "Salzburger Fremden-Zeitung," published the following particulars as a portion of Dr. Kellner's address delivered at the opening of the Institute.

"Ligno-sulphite is the name given to the lignin compound of sulphurous acid. In the manufacture of sulphite-cellulose, by the treatment of wood with sulphurous acid at high temperatures and pressures, the lignin is converted into sulphurous acid derivatives. For the production of suitable compounds for inhalation, the digestion of the wood is conducted in a particular manner so as to obtain a considerable quantity of the volatile derivatives. For lung diseases, air is inhaled containing 0·003 volume per cent. of these volatile compounds (the compounds of the ethers of camphene and terebene with sulphurous acid being specially mentioned) the result of which is a distinct change in the bacillus expectorated.

"It is well known that a small quantity of sulphurous acid in the atmosphere kills coniferous trees, and the ash, obtained by burning the foliage of trees thus destroyed, contains a considerable quantity of sulphurous acid. It has been shown that these plants possess the power of taking in, through the *stoma* of the epidermis, sulphurous acid which is oxidised to sulphuric acid, and accumulates until it destroys the plant. The action of sulphurous acid in the serum of the blood is somewhat similar to that in the plants, and owing to the large surface of the bronchial tubes of the lungs, the compounds of lignin and sulphurous acid are readily brought into contact with the blood and absorbed. Tubercular laryngeal abscesses have been cured by a similar inhalation of antiseptic air."—S. P. E.

*Spontaneous Ignition in the Manufacture of Disinfecting Powders.* H. Köhler. Zeits. ang. Chem. 1894, 513.

*See under* III., *page* 23, *bottom of col.* 2.

### PATENT.

*An Improved Antiseptic, Disinfectant, or Deodorant.* S. Pitt, Sutton, Surrey. From the Chemische Fabrik auf Actien vormals E. Schering, Berlin. Eng. Pat. 24,531, December 20, 1893.

Para-formic aldehyde is intimately mixed with infusorial earth, or other porous material, and the mixture is scattered over the places or objects which are to be disinfected or preserved. In this condition, the polymerised compound readily and spontaneously changes into ordinary formic aldehyde, with its powerful antiseptic and disinfectant properties.—L. A.

## XIX.—PAPER, PASTEBOARD, Etc.

*Barium Sulphate.* (*Blanc Fixe.*) Papier Zeit. **19**, 91, 2910.

Natural sulphate of barium is used as a *loading* for paper, and also as a *carrier* of dyes for coloured papers. It has a specific gravity of 4·1 to 4·7. Important beds of this mineral are found in Hessen-Nassau, in Richelsdorfer mountains, in the Rhön, and in Spessart. Commercial sulphate of barium or powdered heavy-spar is of various degrees of purity and fineness, and the manufactured sulphate of barium, which is found in the market under the names of "blanc fixe," "permanent white," &c., is of a pure whiteness, and in the form of fine powder or pulverulent lumps. In the manufacture of white and coloured papers, it is employed as a paste with 25 to 30 per cent. of water, with which soluble dyes are readily mixed. *Blanc Fixe* gives a beautiful "finish" and "surface" to satin and ordinary glazed papers, and by many it is preferred to the natural sulphate. It is prepared by the action of sulphuric acid upon barium chloride: 10 parts $BaCl_2$ are dissolved in

100 parts hot water, to which is added sufficient $H_2SO_4$ to precipitate the barium as sulphate, the hydrochloric acid formed being subsequently removed by thorough washing with water. By the present method of using blanc fixe in the manufacture of paper, the author considers that a large percentage is lost on the machine (paper machine wire, sand traps, &c.). A method of using this material, which the author has tried with good results, consists in treating the fibres or "stuff" with a soluble sulphate, and then adding a solution of barium chloride. By this means the blanc fixe is precipitated in the fibres, and is more closely incorporated in the "paper-stuff." To 1,000 parts of "half-stuff" in the beating engine, 30 parts of sulphate of alumina are added, and then a paste of 35 parts of barium chloride, which is precipitated as blanc fixe or sulphate of barium. By this method it is claimed that the sulphate is more intimately mixed, and more thoroughly incorporated with the fibres, and is not lost in passing over the machine wire. For coloured papers the acid coal-tar dyes are dissolved in the sulphate of alumina solution, and mixed with the "paper-stuff," the barium chloride being then added. The colours are in this manner well fixed, and beautiful glazed surfaces are obtained, especially with the naphthol dyes which form a perfect solution in sulphate of soda or alumina.—S. P. E.

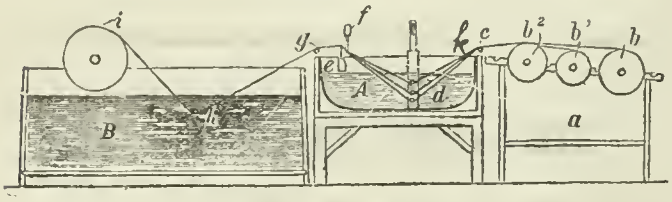
*Parchment Paper for Osmoses and other Purposes.* M. Lotter. Papier Zeit. **19**, 1894, 2942—2944, 3210 and 3243.

Parchment paper is prepared by the action of sulphuric acid upon unsized paper, preferably that made from cotton rags and free from such admixtures as wood meal (*ground wood*), which would become charred by the acid, forming small holes in the finished product. Sulphuric acid of 60° B. is used, and the paper is taken in rolls of about 30 kilos., a width up to 135 cm., and of a definite weight per square metre. The length of time allowed for the acid to act upon the paper depends upon the quality of the latter, whether porous or dense, thick or thin. By a prolonged contact with the acid, a thinner and clearer parchment is produced. The temperature of the acid is also important, and should not exceed 16° C.

The accompanying illustration shows the apparatus employed for the manufacture of parchment paper, the arrangement here represented being for the production of a three-fold thick quality.

A.—*For Single Thin Parchment Paper.*—Upon a wooden frame *a* (Fig. 1) is placed the roll of paper *b*, which is made to traverse the acid bath A, the cold-water bath B, and is then rolled upon a suitable reel *i*. A is a wooden tank containing a lead bath, surrounded by a cold-water jacket. *c*, *d*, *g*, and *h* are glass guiding-rolls, of which *c* and *g* are supported by the rim of the acid trough and *h* in the water bath. *e* and *f* are glass "doctors" supported in a leaden frame, the former being fixed and the latter movable. The guiding-rolls *d* are fixed in a leaden frame, which may be raised or lowered or entirely removed from the bath, and the number of rolls is according to the number of sheets employed, which for thin parchment is only one. To commence operations, the end of the paper is clamped between two strips of wood, and the attendant, who has his hands covered with a rubber glove, leads it under the glass rolls in the acid and water baths to the reel. The "doctors" *e* and *f* being properly set, squeeze out the excess of acid, which runs back to the trough. The reel *i* is wound by hand, the speed being regulated according to the quality of parchment being made. The reel of parchment paper is now unreeled as quickly as possible, and placed in a bath of cold water for 24 hours.

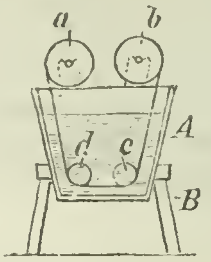
Fig. 1.



B.—*For Single Thick Parchment Paper.*—The apparatus is the same, except in the position of the doctors *e* and *f*, which are placed nearer the roll *g*, and the rolls at *d* are nearer the doctors, to make room for an additional small trough of acid at the point marked *k*. This trough contains a copper roller, well covered with caoutchouc, which revolves in the acid (also of 60° B.), and over which the paper travels.

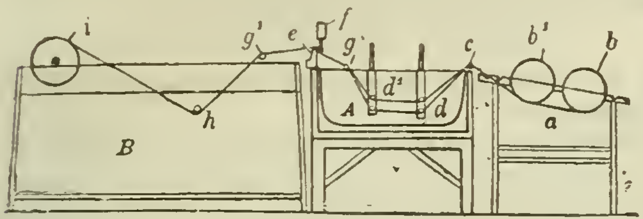
C.—*Double and Three-fold Parchment Paper from Various Papers.*—It is well known that if several unsized sheets of paper are dipped into sulphuric acid, and then placed one upon the other upon a smooth surface, such as a glass slab, and pressed or rolled with a glass roller, they become practically united. In the production of two- or more fold parchment paper, this operation is carried out by the arrangement shown in the illustration. The mode of working is similar to that described for single parchment paper, except that three rolls of paper *b*, $b^1$, $b^2$, are placed upon the frame, and three guiding rolls *d* are in the acid bath. The sheets of paper become united whilst passing between the doctors *e* and *f*. By means of a brake attached to the paper rolls, a tension is produced upon the paper, so that it travels through the baths and between the doctors tightly stretched. The three paper "trains" must run with uniform regularity and together, to prevent air bubbles being formed between the sheets, the presence of which would cause the latter to separate again after passing through the water bath. Three-fold parchment paper retains a considerable quantity of acid, and must therefore be rapidly unreeled and placed in a bath of water. Unless this is quickly done, the layers may unite with each other and so prevent them being unwound without tearing. As a rule thick, spongy paper works better than hard, dense paper. In the production of all kinds of parchment paper it will be found somewhat difficult to remove the last trace of acid, even when several water washings are resorted to. Some manufacturers pass it through a bath of water containing ammonia, using an apparatus shown in Fig. 2, which is also employed for the water-washing. A is a wooden trough, near the bottom of which two wooden rollers *c* and *d* are fixed, and *a* and *b* are the reels upon which the parchment is wound. The neutralisation of the acid is ascertained by placing a piece of litmus paper upon the surface of the parchment. The sulphate of ammonia is removed by washing in the same apparatus with water heated to 40° to 50° C., the parchment being made to travel through the bath from one reel to the other as often as necessary. The parchment so obtained is now passed between two brass rollers covered with linen to remove the excess of water previous to being passed over the drying machine. This latter machine consists of five copper drying cylinders of about 50 cm. diameter, which, like an ordinary paper machine, are heated by steam and made to revolve. The cylinders are set horizontally and upon the same level, and brass rollers are arranged for guiding the parchment over the cylinders. Great care has to be taken in drying to ensure the parchment having a smooth surface and the correct width. After drying, the parchment is passed through a calendering machine, consisting of two paper rolls, and two hollow steel rolls heated by steam, which produces a fine glazed surface.

Fig. 2.



D. *Osmose Parchment Paper.*—For production of this parchment, such as is required for sugar solutions, the paper must be free from blemishes and weak spots and a perfectly evenly-webbed paper. The parchmentising process is similar to that described under C., except that the paper is kept in contact with the acid for a longer period. Fig. 3 shows the arrangement adopted, the letters indicating the parts previously described. Two frames of lead *d* and *d′* containing the glass rolls for guiding the paper through the acid bath are here employed and the lower doctor *e* is made of lead instead of glass. To prevent the temperature of the acid bath from rising above 16° C., cold water is made to circulate upon the outside of the lead trough.

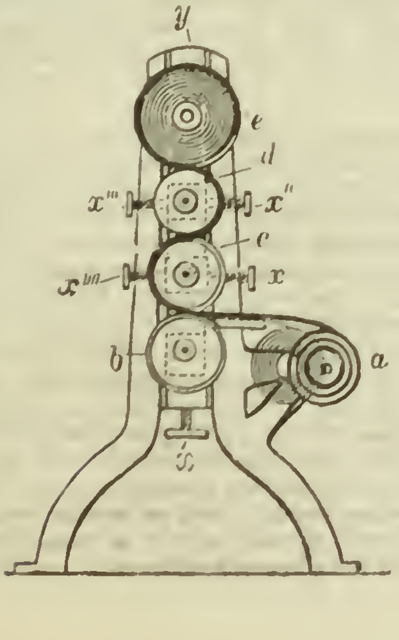
Fig. 3.



E. *Parchment Packing-Paper.*—For this purpose thin, long-fibred paper made from cotton rags is most suitable, and the process is similar to that described under A. The paper employed for making parchment should be kept as dry as possible, otherwise the acid will not produce the desired effect, and moist places will be less attacked by the acid, and appear in the finished parchment as cloudy spots. The parchment may be passed through a solution of acetate of alumina (5° to 10° B.), thence between brass rolls to remove the excess of the solution before passing over the drying machine. The heat of the drying cylinders decomposes the acetate, liberating the acetic acid, whilst the alumina remains in the parchment, rendering it more suitable for taking ink, &c. One or several baths of acetate of alumina may be given, according to the quality and purpose for which it is employed; the more alumina the parchment contains the more brittle and less transparent is the product.

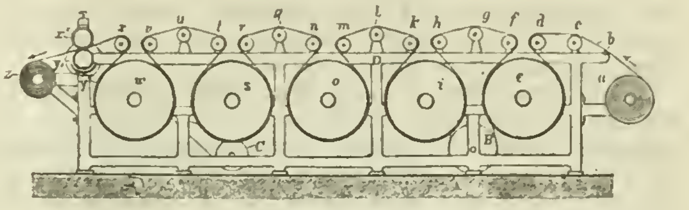
F. *Coloured Parchment.*—Paper of medium strength is employed for this purpose; the parchment is well washed, the aniline colours are dissolved in boiling water, and the dyeing operation is performed in a trough as shown in Fig. 2. The dyes generally used are for red, magenta, eosin, or "cerise"; for yellow, picric acid or the soda salt of this acid; for orange, aniline-orange or picric acid with magenta; for brown, Bismarck brown; for green, Malachite green; for blue, aniline-blue-violet; for black, a mixture of methyl violet, Malachite green, and cerise; for violet, methyl violet. Distilled or rain water is most suitable for dissolving the colours, and it is important that the dye is in perfect solution.

Fig. 4.



After the parchment is dyed it is well washed in water and then passed between brass rollers covered with linen. This apparatus is shown in Fig. 4, in which *a* represents a roll of the wet parchment, *b* and *c* are brass linen-covered rollers, and *d* an uncovered brass roll. After pressing the parchment between the above rolls, it is dried upon the machine represented in Fig. 5, in which *a* indicates a roll of parchment, *b* a glass guiding-rod, *c*—*z* brass guiding-rollers; *x′* and *y′* are brass rollers covered with linen, the lower one dipping into a trough of dilute glycerin. The machine is driven in a similar manner to an ordinary paper machine. By means of a brake attached to the roll *a* the parchment may be dried under any desired tension. For strong, double, and threefold, and osmose-parchment paper the glycerin solution consists of 1 part glycerin to 2 parts water. Most qualities of parchment-paper are glazed on one or both sides by passing through a set of calender rolls, consisting generally of two paper rolls and two hollow steel rollers heated by steam. Parchment paper intended for osmose is not as a rule passed through the calenders.

Fig. 5.



—S. P. E.

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*Industrial Applications of Cellulose Thiocarbonates and Products derived therefrom.* Arthur D. Little. J. Franklin Inst. 824, **138**, 111—116. See also this Journal, 1893, 498, and 1894, 900.

The cellulose thiocarbonates discovered by Cross, Bevan, and Beadle and prepared by the action of carbon bisulphide upon "mercerised" cellulose have been further investigated by the author, with special reference to the industrial application of the same. According to the author the applications of these new compounds have a wide range, as the samples exhibited—consisting of a thick, viscous solution which replaces glue; dense, hard masses resembling ebonite; films so thin as to be almost intangible; artificial leather; floor-tiles, and boiler coverings—serve in a measure to illustrate. Up to the present these materials are used in the form of:—(1.) The crude solution. (2.) Dense cellulose in the mass. (3.) Films and sheets. (4.) Films and sheets formed on cloth backing. (5.) Porous cellulose. The cellulose employed in the production of these samples is that known to papermakers as soda-fibre, prepared from poplar wood by digesting the latter with caustic soda under pressure, although other forms of cellulose may be used.

1. *The Application of the Crude Solution.*—(*a*) The fact that a solution of cellulose thiocarbonate in water has a high viscosity and tenacity, and when allowed to stand or dry the compounds suffer decomposition, liberating the cellulose in the form of an insoluble film, suggested the use of such a solution as a substitute for glue. A 5 per cent. solution is more viscous than a hot 50 per cent. solution of glue, and a 10 per cent. solution is the limit of strength at which it can be practically used. A 1 per cent. solution decolorised with sulphurous acid has been used successfully for bill-posting, bookbinding, and the manufacture of 3- and 4-ply straw boards. Two pieces of maple wood cemented with a 10 per cent. solution on a joint of 1 inch area required a strain of 500 lb. to separate them. The cellulose solution is considerably cheaper than glue, and it also possesses the advantage of being only slightly affected by a very moist atmosphere. (*b*) The decolorised solution may be used for the treatment of cotton and linen cloth, for the purpose of imparting a permanent stiffening or sizing, such as would ordinarily be obtained by starch. The

cloth is passed through the solution, the excess being removed by passing between rollers, and then dried, after which it is washed and bleached in the usual manner. By this treatment the threads and fibres are somewhat held together by a thin film of cellulose, and any degree of stiffening may be obtained. Starch, clay, and other fillers may be employed together with the cellulose, and are carried into the body of the fabric and made part of it. Cloth thus sized becomes soft and flexible in water, and again becomes stiff when dried and ironed.

(*c*.) As a vehicle for pigment printing the decolorised cellulose solution is mixed with the pigments and then printed upon the cloth, dried and washed in the usual way. The drying decomposes the compound, setting free the modified cellulose, which, together with the pigments, adheres firmly to the fibres of the cloth.

(*d*.) The addition of alum to a dilute solution of the cellulose thiocarbonate precipitates the cellulose in an amorphous flocculent condition—a reaction which, if brought about in the beating engine containing paper pulp, not only sizes the paper, but also assists in the retention of the china clay or other loading materials.

2. *Dense Cellulose in the Mass.*—This may be formed by allowing the solution to decompose spontaneously with the separation of the cellulose as a jelly. The by-products of the decomposition are removed by washing and the cellulose then dries to a dense mass of sp. gr. 1·53. It has the appearance of ebonite, takes a high polish and may be grained or coloured in the mass.

3. *Films and Sheets.*—These may be made either in the continuous way or by pouring the solution upon a glass plate with deckel edges to control the thickness, and then drying by steam or dry heat to decompose the compound, and removing the soluble inorganic by-products by washing. In this condition the sheets take colours readily, and may be made as clear as glass. Sheets thus prepared may be used for photographic films, glazing of binder's board, and by rolling them on paper durable glazed-papers may be prepared. The heavier sheets, ranging from $\frac{10}{1000}$ to $\frac{20}{1000}$ inch or more in thickness, may be stamped into small wares, embossed signs, &c., or they may be printed upon and used for book covers, &c.

4. *Films and Sheets on Cloth.*—These are either formed directly upon the cloth or by rolling the wet film on to the cloth. The material thus produced. especially with a film of about $\frac{30}{1000}$ of an inch thick, will take the fine impressions of the grain under a suitable die or roll, and is suitable for upholstery work, embossed hangings, and interior decorations; and the thicker sheets make a durable floor-covering.

5. *Porous Cellulose.*—By working the solution in such a manner that the recovered cellulose has a porous structure, a product suitable for fancy printing, embossed hangings, fancy boxes and similar articles is obtained.

6. *Mixtures of Cellulose and Foreign Substances.*—The solution may be mixed with such materials as ground wood, various fibres, clay and other mineral matter, producing novel and useful substances suitable for floor-covering, and may be made flexible as linoleum, or hard and rigid like tiles; insulating materials, embossed panels, trunk boards, and many other articles have been made in this manner.

—S. P. E.

*Detection of Ground Wood-Pulp in Paper.* F. Wolesky. Ber. österr. Ges. z. Förder. d. Chem. Ind. 1894, **16**, 169.

*See under* XXIII., *page* 72.

*Sulphite Vapours from the Spent Liquors of Wood-Pulp Mills as a Remedy for Pulmonary Diseases.* Papier Zeit. **19**, 1894, 2779.

*See under* XVIII. C., *page* 57.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Sulphite of Bismuth and its use in Therapeutics.* Cesaris and A. Racchetti. Bull. Chim. Pharm. 1894, **10**, through Répert de Pharm. 1894, **56**, 363.

Two methods may be employed for the production of sulphite of bismuth: (1) by the action of sulphurous acid gas upon freshly precipitated carbonate of bismuth; thus—

$$Bi_2(CO_3)_3 + 3SO_2 = Bi_2(SO_3)_3 + 3CO_2$$

(2) By the action of sodium sulphite upon neutral nitrate of bismuth; thus

$$2Bi(NO_3)_3 + 3Na_2SO_3 = Bi_2(SO_3)_3 + 6NaNO_3$$

This method is more practicable than the former, owing to the fact that the reaction in the first method is very slow, and the removal of the remaining sulphurous acid is somewhat difficult. The therapeutic use of bismuth sulphite depends upon the liberation of sulphuretted hydrogen "in corpore" from the freed sulphurous acid. Bismuth sulphite possesses antiseptic properties, and retards fermentation and putrescence and can be used in cases of abnormal fermentation in the stomach and intestines. According to the experiments of Pollaci, a dose of 12 grms. of the preparation may be given to a dog of medium size, without producing any injurious action after nine days. Bismuth sulphite may also be used as an *anthelmintic* (intestinal worm killer).

—S. P. E.

*Glycerophosphates and Tests for Same.* A. Peht and M. Polonowsky. Chem. Zeit. **18**, 1192—1193.

Recently the salts of glycerophosphoric acid have attained some importance in therapeutics. They are employed in the forms of solutions, syrups, pills, &c. But some of the preparations appear in commerce much adulterated; *e.g.*, the authors have met with an article labelled "*Chemisch-reines Natrium Glycerin-phosphat*," which was nothing but sodium phosphate soaked with glycerin!

The synthetic preparation of glycerophosphoric acid is best effected by warming together equal weights of concentrated glycerin and dry metaphosphoric acid on an oil-bath for several hours, pouring the viscid mass into cold water, supersaturating the solution with milk of lime or baryta water, filtering, precipitating the excess of alkali by $CO_2$, and re-filtering. The filtered solution is concentrated on the water-bath, and the residue washed with strong alcohol until no more glycerin is detected in the washings. To ensure complete removal of glycerin and insoluble carbonates and phosphates, re-dissolve in water and repeat the whole operation. The other salts of glycerophosphoric acid are prepared from the barium- or calcium-compound by double displacement.

Both glycerophosphoric acid and its salts are unstable, the former being split up by warmth, as are also the acid salts when digested with warm mineral acids. The normal salts mostly have an alkaline reaction, and are less affected by heat, being able to withstand a temperature of 120°—130°.

All the glycerophosphates are thrown down by a solution of lead acetate, yielding a precipitate soluble in nitric acid or acetate of ammonia, but less so in acetic acid.

The precipitants of phosphates are without effect on the glycerophosphates, though the excess of nitric acid used in the molybdate test may partly decompose glycerophosphates and produce a yellow precipitate. Uranium acetate causes turbidity with the calcium salt only, after a short time, turning into a gelatinous mass, which is probably a double compound of calcium glycerophosphate and uranium acetate. Most of the salts contain moisture as well as water of crystallisation, and the glycerophosphates of the alkalis and alkaline earths are, like the simple acid orthophosphates, converted at red heat into pyrophosphates. The re-conversion into orthophosphates and subsequent estimation of the phosphoric acid therein, affords a means for determining the purity of the glycerophosphates.

In testing these salts a preliminary examination of their physical and chemical properties, and for the presence of impurities, should be made. The characteristics and reactions of the most important are given in the subjoined table.

Moisture is determined by drying at 130° for three hours, and the calcined residue estimated by incinerating 1 grm. of dried substance, moistening with pure nitric acid, and exposing to red heat till the ash has become quite white, when it should consist solely of pyrophosphate.

The method of phosphoric acid estimation varies with the base. For the Na, K, Mg, and Li salts the calcined residue is fused with carbonates of sodium and potassium, and the aqueous solution of the mass titrated with uranium acetate after neutralisation with acetic acid. With the salts of the remaining alkaline earths or of the heavy metals the first step is conversion into the sodium compound by agitating with sodium carbonate, followed by filtration and the evaporation of the filtrate to dryness. The final stage is identical with that already described.

It may be remarked that all the glycerophosphates form highly susceptible culture media for bacteria and fungi, and on this account cannot be stored long unless sterilised.

| Properties and Reactions. | Calcium Glycerophosphate. | Strontium Glycerophosphate. | Iron Glycerophosphate. | Lithium Glycerophosphate. | Sodium Glycerophosphate. |
|---|---|---|---|---|---|
| 1. Appearance of the dry salt. | White powder | White powder | Greenish-grey powder. | White crystalline powder. | White hygroscopic mass. |
| 2. Appearance of the aqueous solution. | Colourless | Colourless | Brown | Colourless | Colourless |
| 3. Percentage of dry salt in solution saturated at 20°. | 5·5 per cent. | 8·8 per cent. | 17·7 per cent. | 44·6 per cent. | Soluble in all proportions. |
| Easily soluble | 1 part in 30 parts water at 20°. | 1 part in 20 parts water at 20°. | 1 part in 10 parts water; warming facilitates solution. | 1 part in 3 parts water | In all proportions |
| 4. On heating the solution to boiling | The salt separates out as white scales. | Separation of the salt. | No separation | No separation | No separation |
| 5. Reaction of the aqueous solution. | Alkaline | Alkaline | Faintly acid | Alkaline | Alkaline |
| 6. Solution precipitated by | Soluble oxalates, carbonates, phosphates, and lead salts. | Oxalates, carbonates, phosphates, and lead salts. | Oxalates, carbonates, phosphates, lead salts, and alkalis. The latter a greenish-brown precipitate. | Only with carbonates, phosphates, and lead salts. | With lead salts only |
| 7. The solution should give no precipitate with | Magnesia mixture, ammonium molybdate in the cold (partial decomposition occurs in the warm), and uranium acetate. The first drops of uranium solution should be detectable by ferrocyanide, but an insoluble, yellow, gelatinous double salt soon separates out. | The same reagents. No insoluble compound with uranium acetate. | The same reagents, also with barium salts and sulphates. | The same reagents | The same reagents |
| 8. Loss of moisture at 130° should not exceed | 3 per cent. | 4 per cent. | 4—5 per cent. | 2—3 per cent. | First solid at 140° |
| 9. Pyrophosphatic calcined residue. | 55·5—56·5 per cent. | 63—64 per cent. | 56—57 per cent. | 54—55 per cent. | 56—57 per cent. |
| 10. Phosphoric acid ... | 30—31 per cent. | 26—27 per cent. | 27—2 per cent. | 38—38·8 per cent | 30—30·5 per cent. |
| 11. Treatment with absolute alcohol and driving off the latter on the water-bath should not leave any residue. | No glycerin | No glycerin | No glycerin | No glycerin | No glycerin |

—C. S.

*Cream of Tartar Substitutes: their Chemistry and Analysis.* W. E. Wadman. J. Amer. Chem. Soc. 1894, **16**, 333—344.

All the cream of tartar substitutes used in the manufacture of baking powders, in self-raising flours, and directly in baking, have monocalcium phosphate ($CaH_4P_2O_8$) as the active ingredient, which liberates carbon dioxide from the sodium bicarbonate. But they may be divided into two primary classes, according to the method of manufacture. First, those known as *leached goods* are prepared by treating calcium phosphate (generally bone black) with sufficient sulphuric acid to produce monocalcium phosphate, filtering off the calcium sulphate formed in the reaction, crystallising out the phosphate, grinding it with starch, and drying the mixture. The resulting mixture of monocalcium phosphate and starch contains also from 1 to 6 per cent. of free phosphoric acid, with some insoluble phosphates, chiefly of calcium—but often of iron and aluminium also. The other class is known as *sulphate of lime base goods*, and is formed by treating pure white bone-ash with the correct amount of sulphuric acid to form the monocalcium phosphate, and drying and grinding the resulting mixture without separation. Like the other class, these samples contain free phosphoric acid and insoluble phosphates, but rarely contain much (if any) starch; the calcium sulphate left is often wrongly reported as an adulterant, whereas it is an essential part of the mixture, and plays an important part in the reaction of the powder, as described later. The following are typical analyses of extreme types, between which most other samples will be found to range:—

| — | Class 1. | Class 2. |
|---|---|---|
| Moisture | 4·41 | 2·42 |
| Monocalcium phosphate (crystallised) | 49·67 | 29·48 |
| Monomagnesium „ „ | 2·75 | 3·54 |
| Free phosphoric acid (hydrated) | 2·02 | 0·73 |
| Insoluble calcium phosphate | 13·08 | 8·66 |
| Calcium sulphate (anhydrous) | 0·85 | 48·70 |
| Silica, &c. | 0·30 | 0·13 |
| Starch | 26·00 | 3·27 |
| Alkaline salts, water, and undetermined. | 0·92 | 3·07 |
| 100 lb. will neutralise sodium bicarbonate. | 45 lb. | Cold 27·5 lb.<br>Hot 48·5 „ |

With powders of the first class, the reaction with alkalis mainly results in the formation of $Ca_2H_2P_2O_8$ and $Na_2HPO_4$; and as both phosphoric acid and calcium monophosphate are readily soluble in cold water, the action takes place in the cold, and dough made with them must be hurried into the oven rapidly if advantage is to be gained from their use. With those of the second class the primary reaction is the same as above, but on heating to the boiling point a secondary reaction sets in, probably represented by the equation—

$$3Na_2HPO_4 + 3CaSO_4 = Ca_3P_2O_8 + 3Na_2SO_4 + H_3PO_4,$$

which is equivalent to a liberation of fresh acid, and thus tends to lighten the dough, because it is gradually evolved as the temperature rises: in this way they are better substitutes than powders of the first class for cream of tartar, which also acts slowly by reason of its much higher solubility in hot water than in cold. It should be remarked that most of the calcium sulphate originally present is converted into sodium sulphate, and the actual proportion of this compound in the bread is very small.

In analysing these products the neutralising power may be determined either by titration with standard alkali or by an estimation of the amount of carbon dioxide evolved from sodium bicarbonate; but very different results are thus obtained, and either may be quite erroneous unless the process is applied with knowledge. Monocalcium phosphate and sodium bicarbonate react to form hydrogen-di-sodium phosphate, and evolve an equivalent of carbon dioxide; but this salt is alkaline to phenolphthalein so that the two methods of determination must vary even at best; but, further, the volume of carbon dioxide from a given weight of powder will vary with time, temperature, &c. The author considers that Catlin's method of valuation (J. Anal. Chem. **4**, 4) which combines the two acidimetric processes is less reliable than titration alone. The best method of working is to titrate 1 grm. of the powder suspended in 30 cc. of water with caustic alkali free from carbonate, using phenolphthalein as indicator. A very large volume of the indicator is required, and titration is made to a fair pink, the alkali being added drop by drop with vigorous stirring to break up the clots of precipitated phosphates formed. The use of a normal amount of phenolphthalein gives results which are far too high. With leached goods the titration is practically complete in the cold, but with sulphated goods the appearance of a permanent pink marks the end of the "cold test"; the solution is then raised to the boiling point sharply, and more alkali is added, if necessary, to restore a faint pink colour. A first approximate reading having been thus obtained, a second test is made in which nearly the full amount of alkali is added initially, and then more on boiling, until a faint pink colour remains permanent for one minute at a boiling temperature. This time (one minute) of boiling should not be exceeded, as it is rarely exceeded in actual use. The use of alkali in excess followed by titration back with acid, as also the filtration of the insoluble portion, are both inadmissible. The free phosphoric acid is found by titration with standard alkali and methyl orange, which gives a neutral reaction with the salts $R'H_2PO_4$; the results are a little high owing to the formation of a slight precipitate, but are sufficiently accurate for technical purposes. The total phosphoric acid must be determined by any suitable process, and also that soluble in water by shaking the powder with water in a graduated flask, filtering, and working with an aliquot part. By deducting the weight of the water-soluble from the total phosphoric acid, the insoluble phosphoric acid is obtained (generally present as $Ca_3P_2O_8$ and $Ca_2H_2P_2O_8$), and by subtracting the weight of free acid from that soluble in water, the phosphoric acid present as $CaH_4P_2O_8$ is obtained. Any calculation based on determinations of the total lime and total phosphoric acid are quite misleading as, all statements to the contrary notwithstanding, free phosphoric acid can exist side by side with tricalcium phosphate. A protest is made against the reporting of the calcium sulphate as gypsum, plaster of Paris, and the like; combined water and water of crystallisation should be included with the compounds to which they severally belong, and reports should be made out as in the tabulated results above, the "neutralising strength" being the weight of sodium bicarbonate neutralised by 100 parts of the sample. Hot and cold neutralisation tests should be quoted. The best grades in the market give a "strength" of 44 to 45.

—W. G. M.

### *Aluminium Boroformicicum.* J. Martenson. Chem. Zeit. 1894, **18**, 1541. (Versamm. Gesell. Deutscher Naturforscher u. Aerzte. Vienna, September, 1894.)

Freshly precipitated and thoroughly washed alumina is added to a mixture of two parts of formic acid, one part of boric acid, and six to seven parts of water, until the mixture is saturated. The clear solution yields glittering crystals of the double salt on concentration. The salt dissolves slowly but completely in water and in dilute alcohol, has an acid reaction and a sweet and slightly astringent taste. The alumina is not precipitated by the caustic alkalis, ammonia, nor by the alkaline carbonates. The clear solution obtained as above, differs somewhat in its properties from a solution of the crystallised salt; it yields a copious precipitate with the alkaline carbonates and coagulates at about 50° C. or thereabouts, according to the degree of concentration. On cooling, the solution becomes clear again. This form of the salt is regarded as a modification of the crystalline product. The composition of the salt is: Alumina 33·50 per cent., formic acid 14·90 per cent., boric acid 19·68 per cent., and water 31·02 per cent.

This product possesses the antiseptic and astringent properties of aluminium compounds, but is less irritating in its action than the latter, and can, consequently, be taken for a longer time.—C. A. K.

### *Simple Method for Purifying Commercial Ethyl Ether.* M. Ekenberg. Chem. Zeit. 1894, **18**, 1240.

Ether, pure enough for most analytical purposes, may be easily obtained from ordinary ether containing water, alcohol, and oxidation products, by adding 5—10 per cent. by volume of liquid paraffin and then distilling between 40°—50° C.

The paraffin, the boiling point of which lies above 300° C. remains behind in the retort and retains the impurities, so that pure ether only, distils over. In cases where the ether contains large quantities of water, this liquid separates out and forms a distinct layer below the paraffin. By heating the paraffin afterwards at 120° C. all the impurities are driven off and it can therefore be used over and over again. This method suffices to free ether from acids, peroxides, and badly-smelling substances. Starting from a product which is not altogether too impure, it is possible, by careful distillation, to prepare ether which contains only minute traces of water and alcohol. The method may also be advantageously employed to separate higher boiling fractions and impurities from petroleum ether and light benzine, aldehyde, chloroform, &c.—J. S.

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*The Constituents of Piper Ovatum.* W. R. Dunstan and H. Garnett. Proc. Chem. Soc. 1895, [145], 237.

This is a West Indian medicinal plant growing in Trinidad. When chewed it gives rise to a tingling sensation and profuse salivation, accompanied by temporary local anæsthesia. The leaves were found to contain a terpene, and a considerable quantity of physiologically active resin, which is also present in the root and stems. From this "resin" the authors were ultimately able, by a tedious process, to separate a crystalline highly active substance, which they name *piperovatine.* Its composition is expressed by the formula $C_{16}H_{21}NO_3$, and it appears to possess an alkaloidal structure, but is, nevertheless, devoid of basic properties. It is nearly insoluble in water and in dilute acids and alkalis, but dissolves readily in alcohol, and the alcoholic solution exhibits the curious property of setting to a "jelly" of very minute crystals when water is added to it.

Piperovatine acts as a temporary depressent of both motor and sensory nerves, and also as a heart poison. It produces a powerful stimulating effect on the spinal cord, causing a tonic spasm resembling that of strychnine.

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*Note on the Active Constituent of the Pellitory of Medicine.* W. R. Dunstan and H. Garnett. Proc. Chem. Soc. 1895 [145], 237.

The similarity in the physiological effect produced by *Piper Ovatum* and by the Pellitory of medicine (*Anacyclus pyrethrum*), led the authors to examine this plant, the activity of which is usually ascribed to a resin. The authors have separated from this resin a crystalline, intensely active substance which they name *pellitorine.* In most of its chemical and physical properties it closely resembles piperovatine; but so far it has always exhibited certain small differences which may possibly disappear when the substance has been further purified. Both piperovatine and pellitorine appear to be pyridine derivatives but neither possesses any appreciable basic power.

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*Essential Oil of Hops.* A. C. Chapman. Proc. Chem. Soc. 1894 [144], 227—228.

In a preliminary communication (this Journal, 1893, 783) the author gave a brief account of a sesquiterpene prepared from the essential oil of hops by fractional distillation. Since then three other and much larger samples of the essential oil have been more fully examined with more definite results. All of these samples are of known origin and genuineness. The relative densities and specific rotatory powers having been determined, these samples of oil were submitted to fractional distillation under a pressure of 60 mm. of mercury, the fractions of corresponding boiling points being mixed after their identity had been ascertained.

After prolonged fractionation the following fractions were obtained :—(1) 86°—91°; (2) 145°—150°; (3) 163°—168°; (4) 168°—173°.

Nos. 1 and 4 were the main fractions, the remaining two being small. Fraction No. 4 corresponded to nearly two-thirds of the oil used.

Fraction No. 1 was a colourless, mobile liquid, of characteristic smell. After purification by distillation over sodium under a pressure of 50 mm. it boiled at 86°—89° at atmospheric pressure; boiling point, 166°—171°, rising afterwards to about 230°, owing to polymerisation and oxidation. Its relative density at 20°/20° was 0·799, and it was optically inactive.

It would appear to consist of two hydrocarbons, $C_{10}H_{16}$ and $C_{10}H_{18}$. The latter is probably tetrahydrocymene (boiling point 167°), whilst the former may be one of the "olefinic terpenes" described recently by Semmler. It is at least certain that the greater part, if not the whole, of the lower fraction consists of hydrocarbons other than the ordinary terpenes.

Fraction No. 2 (145°—150°) occurred in such small quantities that its complete identification was not possible. It was a colourless oil having a pleasant smell of oil of geranium, with an after-smell of oil of rue. It united readily with bromine, and in many of its properties appeared to bear some resemblance to geraniol.

Fraction No. 3 (168°—173°) was by far the largest. It consisted of a sesquiterpene, $C_{15}H_{24}$; the following are its chief properties : — Boiling point, 263°—266° (corr.); relative density at 15°/15° = 0·9001; molecular refraction, 66·2; a sesquiterpene with two pairs of "doubly-linked" carbon atoms requiring 65·7; it was optically inactive, and unites with 4 atoms of bromine to form an oily bromide.

This sesquiterpene is not identical with either cubebene (cadinene), caryophyllene, clovene, or cedrene, the only four sesquiterpenes of which we possess any definite knowledge, and it is therefore proposed to name it "*humulene.*" In three out of the four samples of oil examined, humulene was the main constituent.

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*Scoparine.* G. Goldschmiedt and F. v. Hemmelmayr. Monatsh. für Chem. 1894, **15**, 316.

In a former paper (Monatsh. **14**, 202) the authors have shown that scoparine has the composition $C_{20}H_{20}O_{10}$, and contains a methoxyl and at least one hydroxyl group. By boiling with caustic potash solution, scoparine is broken up. Acetovanillone, $C_6H_3(OH)(OCH_3)(COCH_3)1:2:4$, being formed and small quantities of phloroglucinol. Phenyl hydrazine unites with scoparine to form a molecular compound in which the hydrazine is very loosely combined. Scoparine is also able to form very easily decomposable molecular compounds with hydrochloric acid, bromine, &c. Finely-powdered scoparine treated with concentrated hydrochloric acid is coloured dark citron-yellow; on treatment with water it becomes white again. Ice-cold bromine water dissolves scoparine; very soon, however, a dirty green substance separates out, which is decomposed by water and leaves scoparine. Scoparine is coloured red by bromine water, sodium hypochlorite, and bleaching powder. Stenhouse states that the latter substance colours it dark green. Scoparine dyes yellow upon alumina mordants; the colour is, however, not very intense.

Stenhouse has stated that scoparine is a strong diuretic; he used, however, simply a decoction of *Spartium Scoparium* which had been freed from sparteïn. The authors find, using pure scoparine, that it has not the slightest diuretic action.

The strong analogy between the behaviour of scoparine and other bodies found in plants, such as gentisine, quercetine, daphnetine, &c., all of which contain a pyrone ring, makes it probable that such a ring is also contained in scoparine.—T. E.

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*A New Synthesis of Phenol Alcohols.* (Preliminary Communication.) L. Lederer. J. Prakt. Chem. **50**, 223—226.

Beyond the hydroxybenzyl alcohols only very few phenol alcohols are known. Some occur in nature as glucosides, such as salicin, populin, and coniferin, and are decomposed by ferments, such as emulsin, with the formation of phenol alcohols. The phenol alcohols are of interest, both on account of their occurrence in nature and of their relation to the hydroxycarboxylic acids and aldehydes, which are largely employed for the preparation of colours and of medicinal products. Saligenin itself (1:2 hydroxybenzyl alcohol) has long been used for therapeutic purposes. It has proved more especially useful in cases of rheumatism, typhus, neuralgia, malaria, and influenza.

The phenol alcohols have been prepared synthetically by the reduction of the corresponding acids, aldehydes, or amides by sodium amalgam; and by the action of methylene dichloride on phenol in presence of sodium hydrate, 1:2 hydroxybenzyl alcohol has been obtained. (Greene, Comptes rend. **90**, 40.) These methods are too indirect to be of practical interest. Recently several attempts have been made to substitute methylene dichloride by formaldehyde, but the formation of resinous products in the reaction has prevented the success of this method. This fact is really due to the ease with which the phenol alcohols formed are converted into resinous products, especially in presence of acids, and by taking due account of their instability in this respect, the condensation of phenols with formaldehyde can be readily effected. The alcohol group takes up either the ortho- or the para-position, as in Reimer's hydroxy-aldehyde synthesis, but by suitable choice of condensation agents the reaction can be restricted to the formation of either almost entirely ortho-compounds, or to a considerable excess of the para-compounds.

This reaction has been found successful with phenol, cresol, xylenol, cumenol, thymol, carvacrol, guaiacol, and eugenol.

The physical properties of 1:2 and 1:4 hydroxybenzyl alcohol, of four hydroxymethylbenzyl alcohols, of hydroxymethyl-propylbenzyl alcohol, and of hydroxymethoxyallyl alcohol, are described.—C. A. K.

### *Reuniol, a New Terpene Alcohol.* A. Hesse. J. Prakt. Chem. **50**, 472—479.

Of the methods hitherto proposed for the isolation of terpene alcohols from mixtures, that in which use is made of the compounds formed with calcium chloride is the best, but this, as employed for the separation of geraniol from geranium oil, does not completely extract the alcohol. In order to effect a better separation of the terpene alcohols, the author converts them into non-volatile esters, from which the non-alcoholic impurities are removed by distillation with steam. The esters are then saponified, and the resulting alcohols fractionated. By applying this process to geranium oil and to German rose oil, a second terpene alcohol, in addition to geraniol, is obtained, which, since it was first isolated from a geranium oil obtained from Reunion Island, has been named "*Reuniol.*" For its preparation, the oil is saponified by alcoholic potash, and subsequently distilled with steam. The distillate is then heated with camphoric anhydride to 140° C. for six hours, to convert it into the non-volatile esters, which are saponified after distilling off the non-alcoholic constituents of the mixture. The separated Reuniol which forms 50 per cent. of the original oil, has a very pleasant rose-like smell, a faint blue colour, boils at 225°·5—226° C., has a specific gravity of 0·865 at 20° C., and a rotatory power of +1° 45′. Analysis points to the formula $C_{10}H_{18}O$. Its acetyl derivative boils at 124°—125° C. under a pressure of 17 mm., and has the sp. gr. 0·899 at 20° C. Algerian, French, Spanish, and German geranium oils all contain Reuniol in addition to geraniol, the Spanish product (Vera Cruz) consisting essentially of Reuniol. The paper concludes with references to the product "Rhodinol," obtained from rose-oil and from pelargonium oil by Barbier (This Journal, 1894, 834), and which the author regards as a mixture of geraniol and Reuniol.—C. A. K.

### *Action of Water on Cinchonine Tri-Hydriodide.* G. Pum. Monatsh. Chem. **15**, 446—452. (See also this Journal, 1893, 288.)

On heating cinchonine tri-hydriodide with 20 times its weight of water in a sealed tube at 150°—160°, Lippmann and Fleissner (Monatsh. Chem. June 1893) obtained, besides cinchonine and isocinchonine, a new isomeric base which they called pseudo-cinchonine. The author has repeated their experiments, but was unable to discover any trace of a new base. He also found that cinchonine and isocinchonine may be prepared by simply boiling the tri-hydriodide with a large quantity of water at the ordinary pressure, and he concludes that if other isomeric bases are produced at all, it can only be in extremely small quantity.
—J. S.

### *New Morphine Reactions.* Lamal. Semaine Médicale. 1894, **14**, 267.

*See under* XXIII., *page* 77.

### *Reactions of Acetanilide similar to those of the Alkaloids.* E. Schär. Arch. Pharm. 1894, **232**, 249.

*See under* XXIII., *page* 72.

### *The Detection of Acetanilide in Phenacetine.* G. Guasti. Selmi. 1894, **4**, 96.

*See under* XXIII., *page* 77.

### *Detection of Adulteration in Raspberry Juice.* A. von Asbóth. Chem. Zeit. 1894, **18**, 1276.

*See under* XXIII., *page* 77.

## PATENTS.

### *Improvements in the Treatment or Purification of Commercial Toluene Sulphamide.* B. Willcox, London. From Dr. F. von Heyden, of Radebeul, near Dresden. Eng. Pat. 6198, March 27, 1894.

Commercial toluene sulphamide consists mainly of ortho- and para-amide. Up to the present time only one of these substances, *namely*, the ortho compound, has been of commercial value as the initial material for the manufacture of orthobenzoyl sulphonic imide (saccharine). In this manufacture the para compound is not only superfluous, but also greatly increases the cost of manufacture by reason of the increased consumption of oxidising agents, because, whereas the ortho compound becomes oxidised to form the sweet benzoylsulphonic imide, the para compound is simultaneously oxidised to form the sour para-sulphamine benzoic acid. The new method of separating the para compound from mixtures of the two isomers is based on the fact that these amides are capable of forming solid crystallised salts of the alkalis, and that the ortho salts are more insoluble than the para salts. The melting point of the ortho compound is 155° to 156°, and that of the para compound 137°. Mixtures have, of course, a lower melting point.—D. B.

### *A New and Improved Process for the Production of Ozone.* J. T. Donovan and H. L. Gardner, Mass., U.S.A. Eng. Pat. 19,127, October 9, 1894.

*See under* XI., *page* 42.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### *The Solubility of Chloride, Bromide, and Iodide of Silver in different Inorganic and Organic Solvents.* E. Valenta. Monatsh. für Chem. 1894, **15**, 249.

The solubility of the halogen compounds of silver in aqueous solutions of sodium and ammonium thiosulphates and sulphites, ammonia, ammonium carbonate, potassium cyanide, ammonium, calcium, barium, and aluminium sulphocyanides, and of thiourea and thiosinamine, was determined. The quantity dissolved was always less than that calculated, on the assumption that a chemical reaction such as—

$$3Na_2S_2O_3 + 2AgCl = Ag_2S_2O_3.2Na_2S_2O_3 + 2NaCl$$

had taken place.

*Sodium and Ammonium Thiosulphates* behave similarly (the ammonium dissolves rather less than the sodium salt). They dissolve about equal quantities of AgCl and AgBr, but very much smaller quantities of silver iodide.

*Sodium Sulphite* dissolves about $\frac{1}{10}$ as much AgCl as the thiosulphate, and only traces of AgBr and AgI. Ammonium sulphite dissolves less than the sodium salt. Ammonium carbonate dissolves AgCl slightly, AgBr and AgI not at all. Aqueous ammonia is a good solvent for the silver haloids, but attacks the photographic films and papers.

*Potassium Cyanide* is the most energetic solvent examined. Unlike those already mentioned, it dissolves more silver iodide than chloride. Its solvent power for the bromide lies between these limits.

The order of solubility of the silver haloids in the sulphocyanides used, is bromide, chloride, iodide. The solubility was proportionately much greater in the strong than in the weak solutions.

*Thiourea* is a poor solvent for the silver haloids, whilst *Allylthiourea* (*Thiosinamine*) dissolves silver chloride almost as well as sodium thiosulphate. Of the bromide and iodide, however, it dissolves much smaller quantities.

—T. E.

*Colour Photography by Lippmann's Interference Method.* Lumière Brothers. Bull. Soc. d'Encouragement, 1894, 346—349.

In Lippmann's method of colour photography, a sensitised plate, film inwards, forms one wall of a mercury trough. On exposure, the direct and reflected light interfere, so as to form successive planes of light and darkness within the substance of the film, which thus, on developing and fixing, acquires a laminated structure, and gives colours, when illuminated by white light, like a soap-bubble or a Newton's rings apparatus, the colours at any part of the area of the plate corresponding with those which originally formed the laminæ there.

The authors point out that to realise practical success with the method, it is necessary to have perfectly transparent films, free from grained structure, and that the films must be orthochromatic, or equally sensitive to light of all wave lengths. They employ a film made by making 5 per cent. gelatin solutions containing respectively 0·5 per cent. potassium bromide and 0·6 per cent. silver nitrate, and mixing these in equal bulks. The solution is spread over plates, dried, washed with cold water, and again dried. To "orthochromatise" this preparation they add determinate amounts of cyanine and erythrosine, and have thus succeeded in getting plates of the spectrum which, by transmitted light, show all the colours in the same relative intensities as when the spectrum is viewed directly.

They point out that many small details of preparation are important, and mention that the plates, after fixing, are covered by prisms of very obtuse angle, cemented on by Canada balsam, which augments the apparent intensity of the colours by doing away with the light reflected from the front surface of the film.—J. T. D.

### PATENTS.

*Improvements in the Treatment of Gelatinous Matter and the Production of Photographic Films.* A. Zimmermann, London. From The Chemische Fabrik auf Actien vorm. E. Schering, Berlin, Germany. Eng. Pat. 2036, January 30, 1894.

It is found that gelatin is rendered insoluble in water by treatment with formic aldehyde. For example, if 100 grms. of warm 20 per cent. solution of gelatin be mixed with 3 cc. of a 36 per cent. solution of formic aldehyde, the gelatin sets to an insoluble non-fusible jelly. This result also occurs when dry gelatin is dipped into a solution of formic aldehyde. When very small quantities of formic aldehyde are added to a warm gelatin solution the gelatin will set on cooling, and can easily be remelted, but when spread on a surface it will, after drying, form a flexible skin, which is perfectly insoluble in water.

Formerly, in the collodion emulsion process, adhesion of the sensitive film to the glass plate was procured by the application of chrome gelatin to the glass plate prior to pouring on the sensitive collodion emulsion. To substitute formic aldehyde gelatin for the chrome gelatin, a solution of 1 grm. of gelatin in 250 cc. of warm water is made, and, after cooling, a few drops of aqueous solution of formic aldehyde (36 per cent.) are added; the plates are damped with water and then painted once or twice with this solution, drained, and allowed to dry. They are now fit for use in the wet collodion and collodion emulsion processes.

For making sensitive films the following procedure is recommended:—On a well-cleaned plate of glass or metal is poured a solution of gelatin containing an amount of formic aldehyde which is varied according to the desired toughness and brittleness of the film, but is not enough to prevent the gelatin solution from being poured. Such a solution may contain: Gelatin, 30 grms.; water, 200 grms.; alcohol, 20 grms.; glycerin, 3 grms.; formic aldehyde, 0·55 cc. (36 per cent. solution). When this film is dry the sensitised gelatin emulsion is poured upon it, and, after setting, the two films are stripped together from the plate.—A. G. B.

*Improvements in or connected with the Process of Printing from a Photographic Negative.* A. P. Negley, London. Eng. Pat. 20,864, October 31, 1894.

The object of this process is to print directly from the negative upon portrait paper, without first preparing the latter with gelatin.

The plain paper is first salted in a solution of iodide and bromide of potassium, to which a little chrome alum solution has been added; the second operation is to sensitise the paper with a solution of silver nitrate made acid with nitric and acetic acid. A print having been obtained, it is developed in a solution of ferrous sulphate prepared in a special manner; finally the print is cleaned in a solution made by dissolving iodine in potassium iodide, which is brightened by the addition of potassium cyanide.—J. C. C.

## XXII.—EXPLOSIVES, MATCHES, Etc.

*The Occurrence of Perchlorate in Saltpetre.* C. Haeussermann. Chem. Zeit. 1894, **18**, 1206.

*See under* VII., *page* 35.

### PATENTS.

*Improvements in or relating to the Manufacture of Smokeless Powder.* M. von Förster, Berlin. Eng. Pat. 1074, January 17, 1894.

This invention relates to the production of a very bulky smokeless powder, which is made by using a powder paste of incompletely gelatinised nitrocellulose, which gives a loose structure to the material, which, after being rolled into thin strips 0·1 mm. in thickness, is cut into flakes having a large surface in proportion to their slight thickness. The flakes are dried "as rapidly as possible, whereby a crumpled or curved corrugated form and a rough surface is given to the individual flake."—W. M.

*Improvements in Exploders or Fuses for Projectiles.* A. G. Brookes, London. From W. J. Smith, Newhaven, Conn., U.S.A. Eng. Pat. 19,098, October 9, 1894.

The original specification must be consulted for the details of construction by which the inventor causes the fuse to explode at a given time, either after the discharge of the projectile from the gun, or after the impact of the projectile on the object fired at.—W. M.

*Improvements in Smokeless Explosives.* G. Hübner, Gernsbach, Germany. Eng. Pat. 19,299, October 11, 1894.

"The cellulose is subjected to the action of a solution of sodium hyposulphite, with or without the addition of sulphurous and fuming sulphuric acid, and is then nitrated. The nitrocellulose thus obtained is then mixed or treated with nitronaphthol, or is submerged in a solution of ether-alcohol and nitronaphthol."—W. M.

*An Improved Process for Producing Nitropenta-erythrite and a Smokeless Explosive therewith.* B. Thieme, Sieburg, Germany. Eng. Pat. 20,281, October 23, 1894.

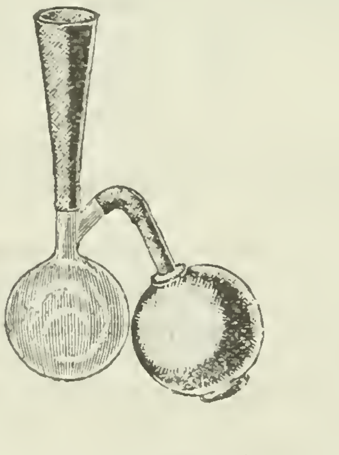
Nitropenta-erythrite is produced by nitration of penta-erythrite, which results from the condensation of acetaldehyde and formaldehyde in presence of lime. The nitropenta-erythrite is a crystalline body which melts when heated in a flame and burns away quietly. It may be pressed or brought into a granulated form for use as an explosive, or it may be intimately mixed with nitrocellulose by means of a solvent and converted into powder according to known methods.—W. M.

## XXIII.—ANALYTICAL CHEMISTRY.

### *APPARATUS, ETC.*

*A Convenient Suction Apparatus for Use with a Siphon, and an Arrangement for Collecting very small Quantities of Liquid (Mercury).* C. Bohn. Chem. Zeit. 1894, **18**, 1278—1279.

The arrangement shown in the figure is to obviate using the mouth in sucking a liquid up a siphon tube. It is attached to the outflow tube of the siphon by means of the rubber tube, which at the upper portion has an internal diameter of 20 mm. (or more), and at the lower portion is 1 mm. in width; it has a length of 75 mm. It may therefore be used with tubes as narrow as 1 mm. A glass flask with a side tube is attached to the lower end of the rubber tube, and the side tube of the flask is connected with a rubber ball. When this ball is compressed with the hand, the air which it contains escapes through the liquid which it is desired to draw off. But this may be avoided by compressing the ball before introducing the siphon tube into the liquid, or by interposing a glass ⊤ piece, which is closed either by the finger or by a tap.



To transfer small quantities of liquid, such as drops of mercury which are in an inaccessible place, the rubber ball is connected with a narrow glass tube of about 15—20 cm. in length, which near the extremity is blown out to a bulb from which issues a fine tube bent at right angles. When the last-mentioned fine tube is directed on to the liquid which it is desired to transfer, the rubber ball being simultaneously compressed, on allowing the ball to become reinflated the drops are sucked into the tube and thence into the bulb.—A. R. L.

### PATENTS.

*Automatic Recording Pyrometer.* W. Crooke, junior, Frodingham. Eng. Pat. 23,947, 1893.

The invention relates to an improved automatic pyrometer for recording temperatures of air, gas, steam, water, &c. The apparatus consists of a cylinder, containing dry air or gas, connected by means of a capillary tube with a diaphragm, to which is attached a lever terminated by a pen for graphically representing any movement of the diaphragm upon a revolving drum. When the cylinder is placed in the furnace or whatever has to be tested, the air or gas expands or contracts with an increase or decrease of temperature, and through the capillary tube this change in volume is transmitted to the diaphragm and recording pen. —S. P. E.

*Improvements in and relating to Processes and Apparatus for Analysing Gases and Gaseous Mixtures.* E. A. Uehling and A. Steinbart, Birmingham, U.S.A. Eng. Pat. 9049, May 7, 1894.

The apparatus is permanently attached to the gas supply to be tested and, at any moment, indicates the composition of the gas which is passing. The inflow of gas is controlled by a supply cock, and of the gas which passes, the larger proportion is run through a specific gravity meter, the remainder flowing through a filter to a tube connected by means of a minute aperture with an absorption vessel, and thence through another similar aperture to a regulator attached to an aspirator. The suction of the aspirator is rendered practically constant at any required pressure by the regulator, which may consist of a closed vessel partly filled with water, the gas inlet and outlet being placed above the water level, and a safety-tube communicating above with the outer air, dipping to any desired depth under the water; the aspirator is so regulated that air is constantly bubbling though this tube. Separate manometer tubes are connected with the absorption chamber and with the air-space in the regulator. Since the pressures in the supply tube and the regulator are practically constant, the only variation in pressure throughout the apparatus will be produced by fluctuations in the percentage of the gas absorbed, and a direct indication of this is given by the manometer attached to the absorption tube. Corrections for alterations in density, shewn by the specific gravity meter are automatically made by means of a ruled indicator card. The absorption tube is filled with fragments of glass or felspar, which are kept moistened by a continuous flow of the required reagent. Several constituents of the gas may be determined simultaneously either by passing it through a series of these tubes, or by placing several of them in parallel circuit connected with the same supply tube and the same regulator, but with separate perforated diaphragms for each tube.—W. G. M.

*An Improved Pyrometer.* K. V. Karlander and O. Meyer son, Stockholm. Eng. Pat. 7444, April 14, 1894.

This apparatus is shown in section and plan in Figs. 1 and 2, and consists of a receiver *a* containing air or other suitable gas, and communicating with a vacuum indicator *c* by means of a tube *b*. This indicator is essentially a tubular spiral manometer spring, one end of which is fixed and opens into the tube *b*, whilst the other free end actuates an index *f* by means of a suitable lever with toothed segment and driver. When the air in the receiver is heated, the expansion tends to straighten the manometer pipe and move the index proportionally. Taking the co-efficient of expansion of air at 0·00367 for each centigrade degree of temperature; if the inner pressure at normal temperature or at 0° C., were equal to the outer pressure (1 atmosphere), by heating to 2000° C. it should amount to 7·34 atmospheres. To avoid such a great pressure which might injure the instrument, rarified air might be employed. The vacuum indicator is enclosed in a hermetically-sealed box *d* to prevent the temperature in the vacuum indicator from influencing the pressure in the receiver *a*, whereby a wrong indication would be given:—

Fig. 1.

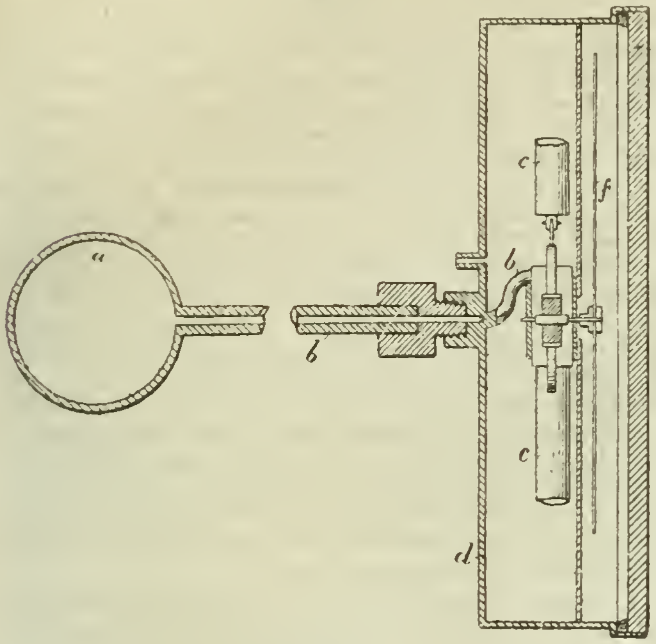
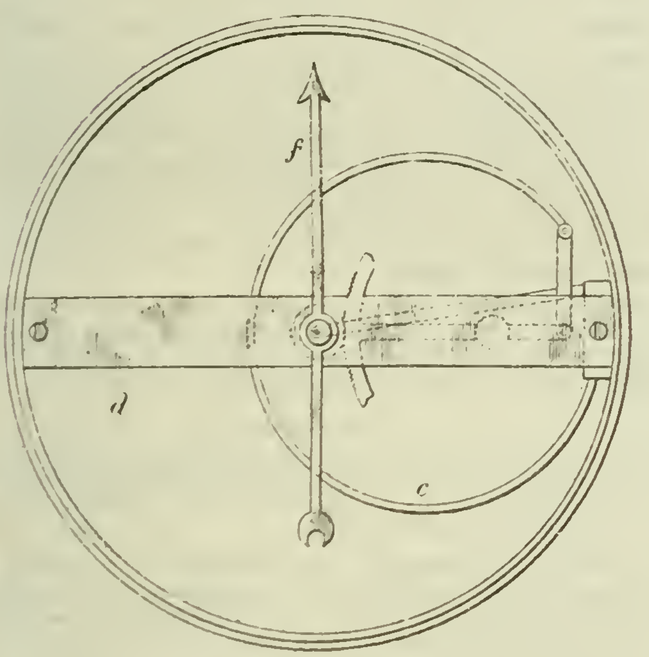


Fig. 2.



If W is the volume in the receiver *a*,
V „ „ vacuum indicator *c*,
P the pressure in the receiver *a* at 0°,
*h* „ „ „ *t*°,
*p* the pressure in the box *d* at 0°,
P′ „ „ *t*′°,
*a* the co-efficient expansion for gases,

then—

$$h = \frac{P(W + V)(1 + a t)}{W + V(1 + a t)}$$

when *a* has been heated to *t*′, *c* still has 0°, and the difference in pressure between *c* and *d* on this occasion is = $h - p$. If the vacuum indicator *c* and the box *d* are supposed to obtain a temperature *t*′, then the pressure in the vacuum indicator is increased to—

$$h' = \frac{h(W + V)(1 + a t')}{V + W(1 + a t')},$$

whilst the pressure in the box *d* is increased to—

$$p' = p(1 + a t').$$

The difference in pressure between *c* and *d* is in this case—

$$h' - p' = \frac{h(W + V)(1 + a t')}{V + W(1 + a t')} - p'(1 + a t').$$

From this it will be seen that the pressure has been increased in *c* as well as in *d*, but, by properly choosing the constants W, V, and *p*, the difference of pressure $h' - p'$ may be made almost constant for different temperatures on the vacuum indicator, or, what is the same, the indication of the vacuum indicator only depends on the pressure in the receiver *a*.

For instance—

If W is supposed to be = 40 cub. cent.
„ V „ „ = 1 „
„ P „ „ = 0·2 atmospheres at 0°
„ *p* „ „ = 0·02 „ 0°

and further, suppose that the pyrometer ball is heated to 6 × 273 or 1638°, while the box *d* is still kept at 0°; then—

$$h = \frac{P(W + V)(1 + a t)}{W + V(1 + a t)} = \frac{0{\cdot}2(40 + 1)\left(1 + \frac{1}{273}.6{\cdot}273\right)}{40 + 1\left(1 + \frac{1}{273}.6{\cdot}273\right)}$$

$$h = \frac{0{,}2.41.7}{40 + 7} = \frac{57{,}4}{47} = 1{\cdot}22$$

and $$h - p = 1{,}22 - 0{,}02 = 1{\cdot}200.$$

If now the same suppositions are made for the quantities W.P., *p*, and *t*, but we admit instead that the box *d* during the experiment obtains a temperature

$$= 54{\cdot}6\left(-\frac{273}{5}\right),$$

then—

$$h' = \frac{h(W + V)(1 + a t')}{W + V(1 + a t')} =$$

$$\frac{1{\cdot}22(40 + 1)\left(1 + \frac{1}{273}.\frac{273}{5}\right)}{1 + 40\left(1 + \frac{1}{273}.\frac{273}{5}\right)}$$

$$h' = \frac{1{,}22.41.1{,}2}{1 + 40.1{,}2} = \frac{60{,}024}{49} = 1{,}225,$$

and

$$p' = p(1 + a t') = 0{,}02\left(1 + \frac{1}{273}.\frac{273}{5}\right)$$

$$p' = 0{,}02.1{,}2 = 0{,}024.$$

Or—

$$h' - p' = 1{,}225 - 0{,}024 \qquad \underline{1{,}201}$$

that is to say, almost constant.

As these values of the temperatures in the box, viz., 0° and 54·6, may be considered as being the extreme values, it is easily understood that the temperature of the box has no influence on the indication of the spring.—S. P. E.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

*Detection and Estimation of Minute Quantities of the Nitrogen Acids.* G. Lunge and A. Levoff. Zeits. angew. Chem. 1894, 345—350.

LUNGE's method of making the solution of diphenylamine, for the test of the presence of nitrogen compounds in sulphuric acid, already described in his published works on the soda industry, provides for a certain amount of water in making the solution. It is as follows:—0·5 gr. of diphenylamine are dissolved in 100 cc. of concentrated pure sulphuric acid to which is added 20 cc. of water; the heat evolved on adding the water suffices to effect the solution of the base, and this liquid may be kept for a long time without change (turning brown) in a well stoppered bottle.

To apply the test a few cubic centimeters of either the reagent or the acid to be tested, whichever be specifically the heavier, are poured into a test tube and covered by a small quantity of the specifically lighter liquid, and it is then observed whether a cornflower blue ring forms at the juncture of the two liquid surfaces which is the evidence of the presence of nitric and nitrous acids.

All the authors' efforts to apply this test quantitatively failed, but they succeeded in adapting the brucine test in such a manner as to give a very satisfactory quantitative method of determining nitric acid in the presence of nitrous acid.

Their method of making the determination is as follows:—A solution of brucine is made by dissolving 0·2 grm. of brucine in 100 cc. of concentrated pure sulphuric acid. It was found impossible to make sulphuric acid which did not give a faint colour to this solution, but as only 1 cc. of it is used, added to 50 cc. of the sample to be tested, the slight colour of the reagent does not affect the process. A standard solution is also made, which contains $\frac{1}{100}$ mgrm. of nitrogen in the form of nitric acid in 1 cc. of sulphuric acid. This is prepared by dissolving 0·0721 grm. of pure potassium nitrate in 100 cc. of distilled water, and 10 cc. of this solution are then added to 90 cc. of pure concentrated sulphuric acid. The liquid to be tested, if it be sulphuric acid of not less than 1·7 specific gravity, may be used direct, but aqueous solutions or weaker acids must be mixed with concentrated sulphuric acid so as to contain about the same amount of nitrogen as the standard solution, *e.g.*, water itself must be mixed with 3 volumes of concentrated acid. Colourless glass cylinders, graduated to 50 cc., are used for comparing the tints. Into one of these cylinders 1 cc. of the standard solution and 1 cc. of the brucine solution are placed, and it is filled to the 50 cc. mark with concentrated pure sulphuric acid; the mixture is then transferred to a flask warmed to 70°—80°, and, after the sulphur yellow colour becomes established, it is cooled and returned to the cylinder. The liquid to be tested is treated in exactly the same way, a preliminary test being made for the purpose of seeing whether it can be used as it is, or whether it should be mixed with more of the concentrated acid. The depth of colour of the columns of liquid in the two cylinders is then made alike by removing part of the liquid from one or other of them, and the quantity of nitric acid in the sample may then be calculated in the usual way.

Selenious acid, as Lunge has already shown (Ber. 1887, 2031; this Journal, 1887, 679), has no action on brucine. In the presence of considerable quantities of iron salts the test for nitric acid is not quite so delicate because the colours to be compared are then not quite alike in tint.

For the quantitative colorimetric determination of nitrous acid, several reagents which have been mentioned by Griess have been tried by various chemists. These all depend upon the formation of azo-colouring matters with nitrous acid and of course give no reaction with nitric acid. The authors, in the process they describe, have fallen back upon the most delicate of Griess' reagents, viz., the combination of α-naphthylamine with sulphanilic acid, but they adopt Ilosvay's improvement (Bull. Soc. Chem. 1889 (3) 2 S. 347) of substituting acetic acid for hydrochloric acid in the test. On the other hand, they keep the two components mixed together instead of separate, as prescribed by Griess and Ilosvay. When kept mixed together, any slight contamination by nitrous acid from the air is at once shown by a red colour in the liquid, which can be at once removed by shaking with zinc powder and filtering. The "reagent" may be kept unchanged for any length of time in a well stoppered bottle. The "reagent" is made as follows:—0·1 grm. of pure (white) α-naphthylamine is dissolved in 100 cc. of water by boiling for a quarter of an hour, 5 cc. of glacial acetic acid or its equivalent of weaker acetic acid are added and then a solution of 1 grm. of sulphanilic acid in 100 cc. of water, is mixed with it. One cc. of this solution will indicate 1/1000 mgrm. of nitrogen as nitrous acid in 100 cc. of water after standing 10 minutes. For making the determination, the colour produced in a sample is compared with that of a definite quantity of a standard solution of sodium nitrite in sulphuric acid. This standard solution is made by dissolving 0·0493 grm. of pure sodium nitrite (= 10 mgms. N.) in 100 cc. of pure water and adding 90 cc. of pure sulphuric acid to 10 cc. of this solution; a standard solution is thus obtained, each cc. of which contains 1/100 mgrm. of nitrogen as nitrite.

Aqueous solutions can be at once tested with the reagent, but the presence of a small quantity of free mineral acid delays the reaction and larger quantities prevent it. To overcome this difficulty in testing sulphuric acid, a sufficient quantity of sodium acetate in a solid form must be added to saturate the whole of the sulphuric acid. In carrying out the determination 1 cc. of the "reagent" is placed in each of the colorimetric cylinders together with about 40 cc. of water; 5 grms. of solid sodium acetate are then added to one cylinder and 1 cc. of the standard solution of nitrite; and into the other cylinder 1 cc. of the acid to be tested, mixed with 5 grms. of sodium acetate. The liquids are then well mixed in each cylinder, and the red colour produced in each compared together.

With regard to the time required for the development of the colour, it was found that usually they might be compared at the end of five minutes, but the intensity of the colour goes on increasing for several hours.—H. S. P.

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### *The Volumetric Separation of Hydroxides, Carbonates, and Bicarbonates.* C. Kippenberger. Zeits. f. angew. Chem. 1894, 16, 495—501.

The author has examined the behaviour of a number of indicators, such as haematoxylin, gallien, and Poirrier's blue, towards the hydroxides and carbonates of the alkalis and alkaline earths, and of magnesia. The following table shows the colour changes which are produced with these bodies:—

| ——— | Haemat. | Gallein. | Alcannin. | Gent. Blue. | Lyons Blue. | Poirrier's Blue. |
|---|---|---|---|---|---|---|
| Hydroxide | Blue | Blue | Blue | Dark blue | Red | Red |
| Alkaline carbonate | Red | Blue, becoming red. | „ | Red | „ | Red. conc. sol.<br>Blue dil. sol. |
| „ bicarbonate | „ | Red | Red | Blue | Blue | Blue |
| „ earth carbonate | „ | „ | „ | „ | „ | „ |
| „ „ bicarbonate | „ | „ | „ | „ | „ | „ |
| Magnesia carbonate | Blue | Blue | Blue | „ | Red | „ |
| „ bicarbonate | Red | Red | Red | „ | Blue | „ |

Of these, the most generally useful incidators appear to be alcannin and Lyons blue, which allow of an estimation of a mixed carbonate and bicarbonate or carbonate and hydroxide in the same manner as does phenolphthalein, the total alkalinity being, of course, determined by means of an indicator of the class of methyl-orange. Alcannin and Lyons blue, especially the former, are said to give sharper reactions than phenolphthalein.—B. B.

### *Electrolytic Determination of the Halogens.* G. Vortmann. Monatsh. für Chem. 1894, **15**, 280.

THE determination is carried out as follows:—To the solution containing the iodine (solutions of KI were used for the experiments) a few grammes of Rochelle salt and 10—20 cc. of a 10 per cent. caustic soda solution are added. The whole volume of the solution is 100—150 cc. The cathode consists of a plate of platinum 5 cm. in diameter, or, if the electrolysis is performed in a platinum vessel, of the vessel itself. For the anode a plate of the same size, of pure silver, or of platinum covered with a deposit of electrolytic silver, is used. An electromotive force of about 2 volts, and a current of 0·03 to 0·07 ampères is sufficient. The iodine separated out on the silver plate unites with it, forming a firmly adhering deposit of silver iodide. The complete separation of the iodine is best obtained by removing the silver plate after the electrolysis has gone on for some hours, and putting a fresh plate in its place and continuing the passage of the current till the new plate no longer increases in weight. The plates, after removal from the solution, are washed with water and alcohol, dried over a Bunsen burner, and finally heated until the silver iodide is partially melted. A small quantity of silver passes into solution from the silver anode. In order to determine this, the solution must be further electrolysed with a platinum electrode and the increase in the weight of the cathode determined. Anodes of pure silver gave the best results. The heating of the silver iodide to its melting point is necessary in order to decompose a small quantity of silver peroxide which is formed, and the addition of the tartrate and caustic soda to the solution is needed to obtain a sufficiently adherent deposit of silver iodide. The silver iodide is easily reduced again to silver by using the plate as cathode in a solution of potassium cyanide; after rubbing off the spongy silver the plate is again ready for use. By this method between 76·292 and 76·52 per cent. of iodine was found in KI, instead of 76·427 per cent. calculated.—T. E.

### *The Electrolytic Determinatiom of Nickel and Cobalt in Ammoniacal Solution of their Chlorides.* F. Oettel. Zeits. f. Eletrotech. u. Elektrochem. 1894, **6**, 192—196.

THE author has studied the conditions necessary to be observed in precipitating nickel and cobalt in ammoniacal solutions, especially in the presence of ammonium chloride. In testing for the completion of the precipitation of nickel by the addition to the solution of a drop of ammonium sulphide, regard must be had to the bulk of the liquid, which should not exceed 100 cc. When a larger volume is used, ammonium thiocarbonate may be substituted for the sulphide, although even then 1 mgrm. of nickel is the smallest quantity that can be detected in 200 cc. of the solution. As the result of a series of experiments with varying proportions of ammonium chloride and free ammonia, the author arrived at the conclusion that at least 10 per cent. by volume of ammonia, of sp. gr. 0·92, should be present to prevent the precipitation of nickel oxide. The quantity of ammonium chloride used has but little influence, provided that sufficient be present to ensure the formation of the double chloride of ammonium and nickel. The current density may vary between 0·2 and 0·4 ampère per 100 sq. cm. If allowed to fall below this minimum, the deposition of nickel is much delayed, while to exceed the maximum quoted, is only advisable when especial need for rapidity exists. There appears to be no upper limit to the concentration of the solution which may be used. The presence of nitric acid or ammonium nitrate greatly hinders the precipitation and the solution should therefore be freed therefrom before the electrolysis is begun.

With regard to cobalt, its precipitation is less easily conducted than that of nickel. A higher current density is required, *e.g.*, 0·4—0·5 ampère per sq. cm. The quantity of ammonium chloride present must be at least four times the weight of the cobalt; an excess as high as thirty times the weight is not harmful. The liquid should contain about $\frac{1}{7}$ its volume of free ammonia (sp. gr. 0·92). The concentration of the solution should be adjusted so that 100 cc. of the liquid do not contain more than 0·25 grm. of cobalt. It is true both of nickel and cobalt that the last trace—1 mgrm. or under—is separated slowly and with difficulty, a circumstance of little importance in most technical determinations.—B. B.

### *The Determination of Manganese, Magnesium, Zinc, Cobalt, and Nickel by Means of Classen's Oxalate Method.* G. Nass. Zeits. f. angew. Chem. 1894, **16**, 508—509.

THE method in question, as originally prescribed for the determination of manganese, is carried out by precipitating the manganese salt with neutral potassium oxalate, dissolving the precipitate in excess of the reagent, heating the solution to boiling, and adding strong acetic acid until the precipitation of manganous oxalate is complete. The precipitate, after standing for six hours at 50° C., is filtered, washed with a mixture of equal volumes of strong acetic acid, alcohol, and water, ignited, and weighed as $Mn_3O_4$. The author has critically examined this method, and finds it useless for all the metals mentioned in the title of this abstract with the exception of zinc and magnesium. As the standard methods for the determination of these metals are satisfactory and simpler of execution than the oxalate process, the author does not anticipate an extended use for Classen's method.—B. B.

### *Quantitative Analysis of the Heavy Metals by Titration with Sodium Sulphide.* G. Neumann. Monatsch. f. Chem. **15**, 1894, 495.

THE fact of most of the heavy metals being quantitatively precipitated from their solutions by sodium sulphide, can be utilised for their volumetric estimation by employing an excess of sulphide for precipitation and titrating back the excess. This latter operation cannot be performed acidimetrically, owing to the destructive action of sodium sulphide and sulphuretted hydrogen upon the indicators. The method is, therefore, carried out in this manner, that, after the precipitation of the metal, a certain quantity of a 20 per cent. solution of sodium chloride is added, to assist the settling of the precipitate, then the whole is made up to a definite volume with water. The liquid is then quickly separated from the solid part by filtration through a dry filter. An aliquot portion of the filtrate is next boiled with an excess of $\frac{1}{10}$-normal solution of sulphuric acid until every trace of sulphuretted hydrogen has disappeared. Then the excess of sulphuric acid is titrated back in the usual manner, and from the result, the quantity of sodium sulphide used for the precipitation can now be calculated. The sodium sulphide solution is standardised in the same manner, by first boiling a definite quanity of it with an excess of $\frac{1}{10}$-normal $H_2SO_4$, and titrating back with $\frac{1}{10}$-normal KHO. This method, of course, is not applicable if the solutions contain any free acid. Solutions of chlorides containing free hydrochloric are first evaporated on the water-bath, the residue moistened with alcohol, and again evaporated to dryness. Sulphates are first converted into chlorides by treatment with barium chloride and hydrochloric acid, and the solutions so obtained are treated as before described for the removal of the free hydrochloric acid. Nitrates are twice evaporated to dryness with concentrated hydrochloric acid, excess of the latter being finally removed in the above-mentioned manner. From a great number of analyses, this method appears to give uniformly good results.—C. O. W.

### *Estimation of Phosphoric Acid soluble in Citrate Solution in Thomas' Slag and Mineral Phosphates.* P. Wagner. Chem. Zeit. 1894, **18**, 1153—1154.

IN a recent work (Düngungsfragen, Berlin, 1894) the author has recommended the estimation of the degree of solubility of phosphate materials in acid ammonium citrate solution as a valuation test for these substances as well as one serving to detect adulterations therein. He now describes two methods of carrying out this test. The first gives values in better consonance with agricultural experiments, but the second is to be recommended for practical purposes as the more simple of the two.

*Method I.*—The phosphoric acid soluble in citrate solution, is estimated by allowing the finely-pulverised phosphatic material to remain in contact with acid ammonium citrate solution containing an amount of free citric acid corresponding with the basicity of the phosphatic material. The basicity of the phosphatic material is estimated by introducing 5 grms. of the sample in fine powder into a half litre flask, and then filling the flask up to the containing mark with 1 per cent. citric acid solution. The mixture is agitated in a shaking apparatus for half an hour and then filtered. 50 cc. of the filtrate are titrated with $\frac{N}{4}$ caustic soda and phenolphthaleïn. 5 grms. of the phosphatic material are now introduced into a half litre flask together with about 200 cc. of water; after this the quantity of 5 per cent. citric acid solution, calculated from the basicity experiment, is added together with 200 cc. of ammonium citrate solution (see below) and water as far as the containing mark. The mixture is shaken for half an hour and filtered; 50 cc. of the filtrate are treated with 100 cc. of molybdenum solution (see below), warmed to about 80° C., and, after cooling, filtered. The molybdenum precipitate is treated in the known manner.

*Method II.*—In this no regard is paid to the basicity of the substance under investigation. 5 grms. of the finely-pulverised phosphatic material is introduced into a half-litre flask, 200 cc. of water added, and subsequently 200 cc. of acid ammonium citrate solution II. (see below), it is then made up to the containing mark with water. The mixture is shaken for half an hour and the filtrate treated in the manner described.

*Preparation of Solutions.*—The acid ammonium citrate solution used in method I. contains exactly 160 grms. of citric acid and 28 grms. of nitrogen as ammonia per litre. Its titre is established by analysis. The solution used for method II. contains 150 grms. of citric acid and 23 grms. of nitrogen as ammonia per litre.

*Molybdenum Solution.*—125 grms. of molybdic oxide are dissolved in 2½ per cent. ammonia, avoiding a large excess of the solvent, and, after adding 400 grms. of ammonium nitrate, the solution is diluted to 1 litre, and poured into 1 litre of nitric acid of sp. gr. 1·19. After remaining for 24 hours at 35° C. the reagent is filtered.—A. R. L.

### *The Direct Estimation of Citrate Soluble Phosphoric Acid.* B. B. Ross. J. Amer. Chem. Soc. 1894, **16**, 304—308.

The estimation of the citrate-soluble phosphoric acid by the molybdate method would save much time as compared with the present process, but the presence of citric acid causes difficulty. Its removal by precipitation, hot, as calcium citrate has proved unsuccessful owing to the co-precipitation of a trace of calcium phosphate. Kuntze (Zeits. f. Rübenzuck. 1892, 860) has tried wet oxidation methods, and the author now finds that the best results are obtained through the use of the Kjeldahl digestion process. The sample is digested for half an hour with 100 cc. of citrate solution, which is then filtered into a dry burette; 25 cc. of the filtered liquid is run into a 250 or 300 cc. flask; 15 cc. of strong sulphuric acid is added, and the mixture is boiled over a moderately brisk flame, the flask being supported on wire gauze. In about eight minutes it will have become concentrated, and will begin to darken and to froth, but not dangerously unless the flame be too high or too low; about three or four minutes later it will appear quite black and tranquil, when 1 grm. of mercury or of mercuric oxide should be added and the digestion continued over a high flame. Within from 25 to 30 minutes from the start a clear and almost colourless liquid is obtained, which is cooled and, the solution having been washed into a beaker, is mixed with a slight excess of ammonia, acidified with nitric acid, and precipitated as usual in the molybdate process in presence of ammonium nitrate. When 50 cc. are operated upon (equivalent to 1 grm. of sample) only 10 cc. of sulphuric acid is first added, and the flask used is larger; as soon as blackening has commenced and foaming is in progress, the flame is removed, another 15 cc. of sulphuric acid is introduced, the flask is again heated over a low flame for two or three minutes, and then the mercuric oxide is added and the operation completed. Results quoted are good. Potassium nitrate cannot conveniently be employed in lieu of mercuric oxide, as several additions of the salt are required and the time required is lengthened. Gunning's modification of the Kjeldahl process is also objectionable by reason of much frothing.—W. G. M.

### *Examination of White Lead in Oil.* R. Hefelmann. Pharm. Central-H., N.F. 1894, **15**, 314.

White lead in oil is often adulterated with chalk and powdered heavy spar, and is best examined in the following manner:—

Five grms. are dissolved in a deep porcelain basin, covered with a watch glass, in the smallest possible quantity of very dilute nitric acid, finally with the help of a gentle heat. The oil which separates swims on the surface. The whole is then filtered through a wet filter, washed with boiling water until all the lead is removed when the oil and any lead sulphate, alumina, gypsum, and heavy spar, remain behind on the filter. In order to estimate the *lead sulphate*, the residue is extracted with a warm concentrated solution of ammonium tartrate or acetate until the lead reaction disappears; the filtrate is then evaporate, in a weighed porcelain crucible, and after the addition of a few drops of sulphuric acid to regenerate the lead sulphate it is ignited and weighed.

The gypsum is extracted from the residue, freed from lead sulphate with the smallest possible quantity of hot nitric acid (sp. gr. 1·2) evaporated in a platinum crucible, ignited and weighed. The residue insoluble in nitric acid can only contain *sand*, *alumina*, and *heavy spar* and is ignited and weighed. It is then fused with the carbonates of potassium and sodium, dissolved and filtered. From the filtrate, after acidifying with hydrochloric acid and boiling off the carbonic acid, the sulphuric acid is precipitated with barium chloride. The total weight of the ignited residue minus the weight of *barium sulphate* represents the *sand* and *alumina*.

*Estimation of the Lime.*—The first nitric acid solution (filtrate) is concentrated, nearly neutralised with ammonia in a 200 cc. flask and sufficient 25 per cent. hydrochloric acid added in order that the whole liquid may contain about 10 per cent., of free hydrochloric acid. On cooling to the ordinary temperature almost all the lead separates as chloride. The flask is then filled to the mark with 10 per cent. hydrochloric acid, violently shaken several times, allowed to settle and 50 or 100 cc. of the clear liquid removed with a pipette. This is neutralised with ammonia and a few drops of ammonium sulphide added to remove any lead that may be present. After filtration the lime is determined as calcium oxalate in the filtrate.

—J. S.

### *Chemical Constitution of Basic Slag and the Determination of its relative Manurial Value.* P. Wagner. Chem. Zeit. **18**, 1933—1935.

The citrate-solubility of basic slag does not depend, as Hoyermann states (preceding abstract), on the smallness of the amount of free lime present; there seems to be no definite relation between the solubility and amount of lime. The increased solubility of the slag after fusion with sand depends on the production of a readily decomposed lime silicate phosphate.

To determine the citrate solubility of the slag 5 grms. are shaken for 30 minutes with water (200 cc.) and citrate solution (200 cc.); it is at once filtered. 50 cc. of the filtrate are treated with molybdate solution (100 cc.), heated at 80° C., cooled, and filtered. The precipitate in dissolved in ammonia and precipitated with magnesia mixture, filtered after two hours, washed with 2 per cent. ammonia, dried, and ignited. The solutions are prepared as follows :—

1. *Ammonium Citrate.*—Citric acid (1,500 grms.) is dissolved in about 2 litres of water and 3·5 litres of 8 per cent. ammonia, the whole, when cold, being made up to 8 litres. 25 cc. of this solution is diluted to 250 cc., and the ammonia determined by distillation with magnesia. Water and ammonia of known strength are then added in the amounts necessary to obtain 10 litres of solution containing citric acid (1,500 grms.), ammonia (279·3 grms. $NH_3$).

2. *Molybdate Solution.*—Molybdic acid (125 grms.) is dissolved in 2·5 per cent. ammonia, avoiding a great excess. Ammonium nitrate (400 grms.) is added, the whole diluted to 1 litre, and mixed with nitric acid (sp. gr. 1·19, 1 litre). After being kept at 35° for a day it is filtered.

3. *Magnesia Mixture.*—Magnesium chloride (110 grms.) and ammonium chloride (140 grms.) in 8 per cent. ammonia (700 cc.) and water (13 cc.). After some days the solution is filtered.—N. H. J. M.

### *The Determination of Nitrates in Potable Water by the Phenolsulphonic Acid Process.* A. H. Gill. Tech. Quarterly **7**, 1894, 55—62.

This process originated with Sprengel (Annalen **121**, 188); was again described by Grandval and Lajoux (Compt. rend. **101**, 62); since when it has been referred to by Fox (Tech Quart. **1**, 1), Lindo (Chem. News. **58**, 1, 15, 28), Rideal (Chem. News. **60**, 261), Johnson (Chem. News. **61**, 15), Smith (Analyst **10**, 199 and **12**, 152; also this Journal, 1887, 679), Bartram (this Journal, 1891, 951), and Hazen and Clark (Jour. Analytical and Applied Chemistry, **5**, 1). Recent criticisms show that the conditions for its successful working have not been fully understood, and as the process is so very simple and rapid, the author was led to study it further in order to determine the conditions necessary for success.

*The phenolsulphonic acid* used should be the pure *di*-sulphonic acid $C_6H_3(OH)(SO_3H)_2$, which, with nitric acid, gives picric acid even in the cold (Kekulé. Lehrbuch, III., 236). To prepare it, 3 grms. of pure phenol and 37 grms. (20·1 cc.) of pure sulphuric acid of 1·84 sp. gr. are mixed in a flask and heated for six hours to 100° in a water bath. The acid, as thus prepared, may crystallise out on standing, but may be brought into solution again by reheating for a short time.

*The method.*—The author takes 1 or 2 cc. of the water (diluted if necessary), containing about 0·0007 mgrm. of nitrogen as nitrate, and rapidly evaporates over a steam bath, in a 2½ inch porcelain dish, the dish being removed as soon as dry, or, preferably, when just a drop remains. With "ground waters," 10 cc. of a portion which has been decolourised by alumina in the cold are evaporated. The residue is treated in the dish with enough of the acid to cover it, 10 drops (= 0·7 cc.) being usually sufficient, and by stirring with a glass rod every part of the residue is moistened. Seven cc. of water are added and stirred, and then 3 cc. of ammonia solution (no strength stated, but excess) and the solution again stirred. The colour is compared with the standard, either in a similar dish, or both are poured into tubes 1⅝ inch deep and ⅝ inch internal diameter.

*The standard solution* of potassium nitrate is made by dissolving 0·720 grms. $KNO_3$ in water, diluting to 1 litre, evaporating 10 cc. *in vacuô* over sulphuric acid, treating the residue with phenolsulphonic acid, as above, and diluting to 1 litre. One cc. of this solution contains 0·001 mgrm. nitrogen. A measured volume of it is made alkaline with ammonia as required.

The author concludes from his experiments that :—

1. The pure di-sulphonic acid gives the best results.

2. No advantage is gained by treating the water residue with the acid at 100°, as Sprengel directs; equally good results are obtained in the cold; but if the temperature be as low as 0°, decidedly low results are obtained.

3. The amount of acid used makes very little difference so long as there is enough used.

4. There is a loss of nitrogen during evaporation, which is least if the evaporation take place *in vacuô* over sulphuric acid, or rapidly in an open dish at 100°; slower evaporation, at 65°, caused more loss, and the dry residues, if further heated, lose nitrogen. The addition of sodium carbonate does not prevent the loss.

5. Chlorine does not interfere if less than two parts per 100,000 be present; if more be present, evaporation should be conducted *in vacuô*; but if the chlorine exceed seven parts per 100,000 it should be removed by pure silver sulphate before evaporation.

6. In comparing the colours the most accurate estimations are made when the intensity of the colour does not exceed that produced by 1 cc. of a water containing about 0·05 parts nitrogen per 100,000. The colour produced by 0·10 part per 100,000 is very difficult to match accurately.

7. The process does not estimate the nitrogen as nitrite, as the action of nitrous acid results in the formation of nitrosophenol $C_6H_4(NO)(OH)$, which is colourless in dilute solutions.—L. A.

### *New Method of Estimating Carbon Dioxide in the Air.* F. Kratschmer and E. Wiener. Monatsh. f. Chem. **15**, 429—432.

In this preliminary note the authors publish the outlines of a new method for estimating the amount of carbon dioxide in the air, which is based on the fact that a solution of potassium or sodium carbonate, coloured with phenolphthaleïn, reacts acid when exactly one-half of the alkaline carbonate has been decomposed by the addition of standard sulphuric acid. It is imperative, however, that the titration be conducted at the ordinary temperature, as on continued boiling the alkaline bicarbonate which is at first formed is decomposed, and it then becomes necessary to add the theoretical amount of sulphuric acid in order to produce an acid reaction. The equation representing the first reaction is—

$$2Na_2CO_3 + H_2SO_4 = 2NaHCO_3 + Na_2SO_4$$

or on continued boiling—

$$2NaHCO_3 + H_2SO_4 = 2CO_2 + H_2O + Na_2SO_4$$

Caustic alkali prepared in the ordinary way contains a certain amount of carbonate, which can be very accurately estimated by this method.

A bottle containing a known volume of the air to be examined is taken, and into it are introduced 100—200 cc. of a dilute solution of caustic alkali, which has been titrated immediately before the experiment with standard sulphuric acid of such a strength that 1 cc. corresponds exactly to 1 mgrm. of carbon dioxide. It is also advisable to introduce some broken glass or glass beads in order to increase the surface of liquid in contact with the air on shaking. After shaking the closed bottle for about half an hour, the carbon dioxide is completely absorbed, and it is then only necessary to add a few drops of phenolphthaleïn solution, and titrate with the standard sulphuric acid until the colour disappears.

If $a$ cc. of the sulphuric acid is the titre of an equal quantity of the caustic alkali before the absorption of the carbon dioxide, and $b$ cc. the titre afterwards, then $(a - b) \times 2$ represents the amount of carbon dioxide in mgrm's. contained in the volume of air used.—J. S.

### *Loss of Gold and Silver during Scorification Assay.* W. P. Mason and J. W. Bowman. J. Amer. Chem. Soc. 1894, **16**, 313.

*See under X., page 39.*

### *Cream of Tartar Substitutes, their Chemistry, and Analysis.* W. E. Wadman. J. Amer. Chem. Soc. 1894, **16**, 333.

*See under XX., page 61.*

### *Glycerophosphates and Tests for Same.* A. Petit and M. Polonowsky. Chem. Zeit. **18**, 1192.

*See under XX., page 60.*

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *Detection of Artificial and Natural Colouring Matters on the Fibre.* A. Lehne and A. Rusterholz. Färber Zeitung, 1891, *et seq.*

Every dyer or colourist has frequently to decide the question as to what dyestuff has been used to produce the colour of a given dyed or printed textile fabric. After he has acquired this knowledge, the problem of the production of a shade of equal value, fastness, and beauty is much simplified.

In the year 1874 a small work was published (in German) by W. Stein under the title of "*The Testing of Textile Colours and Dyeing Materials,*" which comprised an introduction to the detection and valuation of dyestuffs as well as to the determination of their fastness. This work is now quite obsolete; for in the place of many natural dyestuffs, which played an important rôle in the year 1874, artificial colouring matters have been introduced.

Hummel ("The Dyeing of Textile Fabrics") and Lepetit (Zeits. angew. Chem. 1888, Heft 19) have published tables for the qualitative detection of dyes on the fibre.

The present authors have constructed new and comprehensive tables for the detection on the fibre of the dyes at present used; they have made use of the facts already ascertained, adding to them such extensions as were necessary. The attempt has been made to do this in such a way that the tables shall be accessible to the colorist who possesses no chemical knowledge. (See pages 73 to 76.)

As a rule, therefore, only such methods will be adopted for the investigation of the dyes which can be carried out with the simplest means as quickly and with as much certainty as possible. The reactions are described in great detail in order to avoid misunderstanding.

As the same dyestuff is frequently sent into commerce under a variety of names, these names will be given together with those of the colour manufacturer. With the permission of Dr. G. Schultz, the authors have followed the plan adopted in the well known tables (Systematic Survey of the Organic Colouring Matters. Translated and edited by A. G. Green, 1894), and the under-mentioned abbreviations are made use of:—

[A.] = Actiengesellschaft für Anilinfabrikation in Berlin.
[B.] = Badische Anilin—und Sodafabrik in Ludwigshafen a Rh.
[B.S.S.] = Brooke, Simpson, and Spiller.
[Bi.] = Actiengesellschaft für chemische Industrie (vorm. Bindschedler und Busch) in Basel.
[By.] = Farbenfabriken vorm. F. Bayer und Co. in Elberfeld.
[C.] = L. Cassella und Co. in Frankfurt a M.
[Cl. Co.] = Clayton Aniline Co.
[D.] = Dahl und Co. in Barmen.
[D.H.] = L. Durant und Huguenin in Basel.
[F.] = A. Fischesser in Lutterbach i. Elsass.
[K.] = Kalle und Co. in Biebrich a Rh.
[L.] = A. Leonhardt und Co. in Mühlheim in Hessen.
[M.] = Farbwerke vorm. Meister Lucius und Brüning in Höchst a M.
[Mo.] = P. Monnet und Co. in La Plaine bei Genf.
[N.] = Farbwerke Griesheim a M. (W. Noetzel und Co.)
[O.] = K. Oehler in Offenbach a M.
[P.] = Société Anonyme des matierès colorantes et produits chimiques de St. Denis, Paris (Poirrier).
[R.H.] = Read, Holliday, and Sons.
[Sch.] = The Schöllkopf Aniline and Chem. Co., Buffalo, U.S.A.

The single dyes are marked "Animal fibre" or "Vegetable fibre" to denote their principal application. Later, however, further tables will follow in which, for example, the most important yellow dyes are inserted, that are employed for cotton, jute, and linen, &c., and also the yellow dyes used in fast wool dyeing, and so on. Also later, the detection of several dyes in the presence of one another, so far as this can be accomplished with certainty, will be dealt with.

The dyes are arranged according to the shades for which they principally serve, this being the most convenient arrangement for the dyer and colorist.

*Reagents Employed.*

Concentrated hydrochloric acid. = 21° B.
Dilute hydrochloric acid ........ = 1 part of 21° B. to 3 parts of water.
Concentrated nitric acid ........ = Sp. gr. 1·40.
Dilute nitric acid ............... = 1 part of sp. gr. 1·40 to 2 parts of water.
Concentrated sulphuric acid .... = 66° B.
Dilute sulphuric acid ........... = 1 part of 66° B. to 5 parts of water.
Concentrated soda-lye........... = 38° B.
Dilute soda-lye ................. = 1 part of 38° B. to 10 parts of water.
Ammonia....................... = Sp. gr. 0·960.
Alcohol......................... = 96 per cent.
Stannous chloride and concentrated hydrochloric acid. = Equal parts of each.
Ammonium acetate ............. = 5° B. Prepared by neutralising ammonia with pure acetic acid and diluting with water to 5° B.

*Modus operandi.*—The tests with concentrated acids and alkali are best made in small watch-glasses, which are placed upon white paper in order that the alterations in colour may be readily observed. Concentrated acids may be conveniently dropped upon the fibre from small dropping-bottles, such as can be obtained at all pharmacists, only sufficient being dropped upon the fibre to completely cover it. The test is allowed to remain for 4—5 minutes, and then the watch-glass is cautiously heated over a very small flame. The liquid should not be boiled. After again remaining for some minutes water is added. All other reactions are performed in test tubes, thus:—After introducing the coloured fibre the reagent is poured upon it, and some time allowed to elapse; it is then heated below the boiling-point, the action noted, and the liquid finally boiled. The solution is decanted and tested with alkali or acid. After testing the fibre with concentrated hydrochloric or sulphuric acid, it is rinsed with water, and examined to ascertain whether the original colour is restored.—A. R. L.

### *Detection of Ground Wood-pulp in Paper.* F. Wolesky. Ber. österr. Ges. z. Förder. d. Chem. Ind. 1894, **16**, 119.

The author recommends for detecting ground wood (woodmeal) in paper, a solution of 1 grm. of diphenylamine in 50 cc. of alcohol and 5 to 6 cc. of concentrated sulphuric or hydrochloric acid. According to the quantity of wood present a more or less orange colour is produced, specially distinct after drying.—S. P. E.

### *Reactions of Acetanilide similar to those of the Alkaloids.* E. Schär. Arch. Pharm. 1894, **232**, 249.

Tafel described certain reactions of anilides, for example of acetanilide in contact with sulphuric acid and chromates or with sulphuric acid and peroxide of lead, which are closely allied to the strychnine reactions. Flückiger also noticed that acetanilide gave a reaction similar to the morphine reaction with sulphuric acid containing nitric acid. The author has further investigated and compared these and other reactions of strychnine and morphine with the following results:—1. As regards the *strychnine* reaction there are two important differences. In the first place the initial coloration with acetanilide is not the well-known bluish colour resembling methyl violet, but rather a blood-purple-red coloration. In the second place various oxidising agents produce in the colour reactions of strychnine a *gradual* change from deep violet to cherry red, purple red, blood red, and finally to yellowish red, whilst in the case of acetanilide a *very rapid* change from purple or violet-red coloration to dirty bluish-green, usually olive green or brownish green, is to be noticed. 2. As regards the *morphine* reaction the chief point of disagreement is the *indifferent behaviour of acetanilide* towards sulphuric acid in combination with selenic acid, titanic acid, molybdic acid, and tungstic acid. On the other hand the reactions of morphine and acetanilide with sulphuric acid containing nitric acid are very similar, but their characteristic behaviour towards sulphuric acid and bismuth sub-nitrate is a protection against the possibility of mistaking them. *Morphine* gives a *deep red-brown* coloration, whereas acetanilide gives a *dark yellow* mixture which is *carmoisine red* near the edges.—J. S.

### * DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (LEHNE AND RUSTERHOLZ.)

### YELLOW AND ORANGE DYES.

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 1.<br>Picric acid.<br>(*Animal fibre.*) | *Conc.:*—Fibre decolorised; on addition of water—liquid yellow, fibre yellowish. *Dil.:*—Heated—fibre decolorised, liquid yellow. | *Conc.:*—Fibre at first decolorised, the yellow colour reappearing. On addition of water, liquid turbid and yellow. *Dil.:*—Heated—fibre at first decolorised, then again becomes yellow. | *Conc.:*—Fibre dirty yellow; heated—brownish-yellow, liquid brownish. On addition of water, fibre brighter. *Dil.:*—Heated—fibre decolorised, liquid colourless. With excess of soda-lye—yellow. | *Conc.:*—Heated—fibre, brownish-yellow, liquid yellow. *Dil.:*—Heated—fibre orange, liquid full yellow, acidified—turbid. | Liquid yellow on boiling. | Heated—fibre decolorised. | Extracts the colouring matter. | Alcoholic extract heated with potassium cyanide—liquid red, by formation of isopurpuric acid. |
| 2.<br>Martius' yellow, Jaune d'or, naphthol-yellow, naphthalene-yellow, naphthylamine-yellow, Manchester yellow.<br>(*Animal fibre.*) | *Conc.:*—Fibre paler, liquid colourless. *Dil.:*—Heated—fibre almost decolorised, liquid faintly yellow; with excess of soda-lye, deep yellow. | *Conc.:*—Heated—fibre paler, liquid yellow. *Dil.:*—Heated—fibre paler, liquid bright yellow; with excess of soda-lye, golden-yellow to orange. | *Conc.:*—Fibre yellowish-brown, liquid yellow. On addition of water—fibre dirty, almost decolorised. *Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Fibre orange to brown. *Dil.:*—Heated—fibre dark, later bright, liquid golden-yellow, white precipitate on acidification. | Heated—fibre bright, liquid deep yellow; acidified—faintly yellow. | Same as dilute hydrochloric acid. | Extracts the colouring matter on boiling, forming a greenish-yellow solution. | Alcoholic extract boiled with potassium cyanide—the yellow colour changes to red, with the formation of naphthylpurpuric acid. |
| 3.<br>Naphthol-yellow S. [B.] Naphthol-yellow Acid yellow S. Citronin A. [L.]<br>(*Animal fibre.*) | *Conc.:*—Fibre almost decolorised; heated—completely decolorised, liquid colourless. Colour restored on rinsing. *Dil.:*—Fibre decolorised after a long time, liquid colourless. With excess of soda-lye—liquid yellow. | *Conc.:*—Fibre orange; heated—liquid yellowish. *Dil.:*—Fibre decolorised, liquid colourless; heated—fibre again yellow. Liquid on addition of excess of soda-lye—yellow. | *Conc.:*—Fibre brownish; heated—after a long time reddish-brown, liquid brownish. On addition of water—liquid brownish-red, fibre red. *Dil.:*—Same as with dilute hydrochloric acid. | *Conc.:*—Heated—liquid somewhat yellow. *Dil.:*—After long shaking—liquid somewhat yellow; heated—deeper yellow. White precipitate on acidification. | Boiled—liquid yellow, decolorised on acidification. | Heated—fibre decolorised, liquid colourless. | Extracts the colouring matter. | Fibre boiled with alcoholic potassium cyanide, both liquid and fibre reddish-orange, with the formation of naphthylpurpuric acid. The sulphuric acid reaction serves to distinguish it from Martius' yellow. |
| 4.<br>Metanil-yellow [B.], [O.], [A.] Orange MN [Bi.]<br>(*Animal fibre.*) | *Conc.:*—Heated—fibre reddish-violet, liquid violet; on addition of water—rosaniline-red, fibre dark violet. *Dil.:*—Fibre at first reddish-brown, later violet; heated—liquid deep rosaniline-red, fibre dark violet. With excess of soda-lye—bright yellow. Colour restored to the fibre by washing. | *Conc.:*—Fibre at first violet, then ponceau-red, liquid red. On addition of water—liquid yellow, fibre red, finally liquid and fibre bright yellow. *Dil.:*—Fibre immediately violet, liquid reddish-violet; heated—liquid and fibre at first yellowish-red, later bright yellow. With excess of soda-lye—orange. | *Conc.:*—Fibre dark violet, liquid violet. On addition of water—liquid rosaniline-red. *Dil.:*—Same as with dilute hydrochloric acid. | *Conc.:*—Heated—fibre yellowish-brown, liquid yellow. On addition of water—liquid deep yellow, fibre after some time brighter. *Dil.:*—Heated—liquid yellow, magenta-red on acidification. | Same as dilute soda-lye. | Cold—fibre yellowish-brown, liquid colourless; warmed—fibre violet, liquid colourless; immediately decolorised on boiling. | Extracts the colouring matter on addition of acid, forming a magenta-coloured solution. | .. .. |

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DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 5.<br>Uranine [B.], [A.], [M.]<br>(*Animal fibre.*) | *Conc.*:—Fibre greenish; heated—liquid yellow. On addition of water—fluorescence.<br>*Dil.*:—Fibre paler, liquid greenish-yellow; with excess of soda-lye—very strong fluorescence. | *Conc.*:—Fibre greenish-yellow, liquid same; heated—fibre bright, liquid intense greenish-yellow. On addition of water—strong fluorescence.<br>*Dil.*:—Heated—liquid greenish-yellow, slight fluorescence; with excess of ammonia very strong fluorescence. | *Conc.*:—Liquid yellow; heated—fibre brown, liquid yellow. On addition of water—dirty olive. Fluorescence.<br>*Dil.*: Same as with dilute hydrochloric acid. | *Conc.*:—Heated—fibre reddish-orange, liquid colourless. On addition of water—fibre bright orange; viewed from above, green. Strong fluorescence.<br>*Dil.*:—Heated—fibre orange, liquid fluoresces strongly; acidified—liquid faint yellow; fluorescence disappears. | Same as dilute soda. | Heated—Fibre brighter, liquid yellow without fluorescence. | Boiled with addition of soda-lye, fluorescence. | .. .. |
| 6.<br>Fast yellow extra [B.], [By.]<br>Acid yellow [A.]<br>Fast yellow G. [K.]<br>Jaune acide.<br>Solidgelb.<br>Neugelb L. [K.]<br>(*Animal fibre.*) | *Conc.*: Fibre scarlet, then rosaniline-red; heated—liquid red.<br>*Dil.*:—Fibre orange to red; heated—rosaniline-red, liquid bluish-red. With excess of soda-lye—yellow. | *Conc.*: Fibre rosaniline-red, liquid red, then orange; heated—fibre yellow, liquid colourless. On addition of water—liquid yellowish.<br>*Dil.*: Fibre red to rosaniline-red, liquid colourless; heated—fibre yellow. | *Conc.*:—Fibre dark orange; heated—still darker, liquid brownish. On addition of water—liquid rosaniline-red, fibre scarlet.<br>*Dil.*: Same as dilute hydrochloric acid. | *Conc.*: Heated—fibre darker. On addition of water—liquid yellow, fibre bright.<br>*Dil.*: Heated—liquid yellow, fibre bright; turbid and red on acidification. | Heated—liquid yellow; acidified—red, not turbid. | At first red, later decolorised. | .. .. | Ammonium acetate extracts the colouring matter. Solution—red on acidification. |
| 7.<br>Azoflavine S. [B.]<br>Acid Azo-yellow [A.]<br>Azo-Yellow [M.]<br>Indian yellow [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-brown; heated—liquid reddish. On addition of water—fibre and liquid yellow.<br>*Dil.*:—Heated—liquid yellow, fibre brighter. With excess of soda-lye—violet. | *Conc.*:—Fibre rosaniline red, then ponceau-red, liquid red. After some time—fibre orange, liquid reddish. On addition of water, fibre decolorised, liquid yellowish.<br>*Dil.*:—Fibre darker; heated—brighter, liquid yellow. With excess of ammonia—orange. | *Conc.*: Fibre rosaniline-red, liquid, dark red; heated—fibre brownish-red. On addition of water, liquid yellow, fibre red. Fibre rendered pale at point of contact with water. Finally—liquid yellow, fibre dirty.<br>*Dil.*: Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre black. On addition of water—fibre brown, liquid brownish.<br>*Dil.*:—Fibre dark; heated—brown, then colourless, liquid violet-red. On acidification—yellow. | Heated—liquid yellow. | Fibre decolorised, liquid colourless. | Colouring matter slowly extracted by boiling. Soda-lye cautiously added—violet at the junction of the two liquids. | Ammonium acetate extracts the colouring matter. Solution—violet on addition of soda-lye. |
| 8.<br>Chrysamine G [By.]<br>(*Vegetable fibre.*) | *Conc.*: Fibre olive-brown; heated—fibre brighter, liquid colourless. On addition of water—fibre yellow.<br>*Dil.*:—Heated—fibre brighter, liquid colourless. | *Conc.*:—Fibre at first rosaniline-red, later reddish-brown, liquid reddish; heated—liquid reddish-yellow. On addition of water—fibre bright yellow, liquid yellowish.<br>*Dil.*:—Fibre brownish; heated—again yellow, liquid colourless. | *Conc.*: Fibre rosaniline-red, liquid bluish-red; heated—fibre redder, liquid violet-red. On addition of water, liquid reddish, fibre decolorised.<br>*Dil.*:—Same as dilute hydrchloric acid. | *Conc.*: Heated—fibre orange.<br>*Dil.*:—Heated—fibre orange, liquid reddish; with excess of soda-lye,—colourless. | Fibre somewhat orange, liquid colourless; heated—fibre darker. | Heated—fibre decolorised; liquid colourless. | .. .. | Ammonium acetate does not extract the colouring matter. Boiled with ferrous sulphate or copper sulphate—fibre yellowish-brown. |
| 9.<br>Tartrazine [Bi.], [B].<br>(*Animal fibre.*) | *Conc.*: Fibre yellower; heated—liquid yellow. On addition of water—fibre brighter.<br>*Dil.*:—Liquid yellow on boiling. | *Conc.*:—Same as concentrated hydrochloric acid.<br>*Dil.*:—Heated—liquid somewhat yellow. | *Conc.*:—Fibre olive; heated—liquid yellow. On addition of water, liquid deep yellow.<br>*Dil.*:—Heated liquid somewhat yellow. | *Conc.*:—Heated—liquid yellow, fibre darker.<br>*Dil.*:—Same as dilute hydrochloric acid. | Same as dilute soda-lye. | Fibre decolorised, liquid colourless. | .. .. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 10.<br>Auramine O. [B.], [Bi.]<br>Auramine.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brighter; heated—liquid colourless. On addition of water—liquid and fibre yellow.<br>*Dil.*:—Heated—fibre decolorised, liquid colourless. | *Conc.*:—Fibre at first decolorised, then again brownish; heated—liquid yellow.<br>*Dil.*:—Heated—liquid yellow; with excess of soda-lye—orange. | *Conc.*:—Fibre yellowish-olive; heated—fibre reddish-brown, liquid brownish. On addition of water—liquid yellow, fibre reddish; finally—fibre decolorised.<br>*Dil.*:—Heated—fibre decolorised, liquid colourless; with excess of soda-lye—yellow. | *Conc.*:—Heated—fibre somewhat darker, liquid somewhat yellow.<br>*Dil.*:—Heated—liquid somewhat yellow. | Same as dilute soda-lye. | Fibre decolorised | Colouring matter extracted on boiling. | .. .. |
| 11.<br>Quinoline yellow [A.], [B.], [By.]<br>Soluble quinoline yellow.<br>(*Animal fibre.*) | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faintly yellow; with excess of soda-lye—colourless. | *Conc.*:—Fibre orange. On addition of water—liquid yellow.<br>*Dil.*:—Heated—fibre brighter, liquid yellow with excess of ammonia—liquid intense golden-yellow. | *Conc.*:—Fibre yellowish olive; heated—reddish-brown, liquid brownish. On addition of water—dirty yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | .. .. | Heated—liquid faint yellow. | Heated—liquid deep yellow. | Colouring matter extracted after protracted boiling. | .. .. |
| 12.<br>Resorcinol yellow [A.]<br>Tropaeoline O. [C.]<br>Tropaeoline R.<br>Chrysoin [B.]<br>Chryseolin.<br>Yellow T. [Bi.]<br>Golden yellow [By.]<br>Acme yellow [L.]<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-orange, liquid yellow: heated—liquid deeper yellow. On addition of water—fibre brighter.<br>*Dil.*:—Heated—liquid intense yellow; with excess of soda-lye—red. | *Conc.*:—Fibre reddish-orange, liquid yellow; heated—fibre yellow, liquid bright orange. On addition of water—fibre brighter.<br>*Dil.*:—Heated—fibre almost decolorised, liquid faint orange; with excess of ammonia—intense golden yellow. | *Conc.*:—Fibre—dark orange; heated—fibre reddish-brown, liquid orange. On addition of water—fibre decolorised after a time.<br>*Dil.*:—Heated—liquid intensely yellow; with excess of soda-lye—red. | *Conc.*:—Heated—fibre scarlet, liquid colourless. On addition of water—liquid red.<br>*Dil.*:—Fibre scarlet, liquid colourless; heated—fibre orange, liquid brick-red, turbid and yellow on acidification. | Heated—liquid intensely yellow, almost decolorised on acidification. | Heated—fibre decolorised, liquid colourless. | .. .. | Ammonium acetate extracts the colouring matter. Solution reddened by soda-lye. |
| 13.<br>Aurantia.<br>Kaisergelb.<br>(*Animal fibre.*) | *Conc.*:—Fibre almost decolorised.<br>*Dil.*:—Fibre bright to pale yellow. Liquid colourless; with excess of soda-lye—rose-coloured. | *Conc.*:—Fibre at first decolorised, then becoming yellow again; heated—liquid faint yellow.<br>*Dil.*:—Fibre almost decolorised. | *Conc.*:—Fibre olive; heated—fibre dark olive. On addition of water—fibre almost decolorised, liquid somewhat brownish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre olive. On addition of water—liquid yellow.<br>*Dil.*:—Heated—fibre somewhat darker. | Heated—liquid somewhat yellow, decolorised on acidification. | Slowly heated—fibre at first brown, then brownish-red, and finally decolorised. | Colouring matter only slightly extracted. | .. .. |
| 14.<br>Chrysamin R. [By.], [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre grey, liquid pale rose. On addition of water—fibre yellow.<br>*Dil.*:—Heated—fibre lemon yellow, liquid colourless. | *Conc.*:—Fibre dirty violet, liquid colourless. On addition of water—fibre yellow.<br>*Dil.*:—Heated—fibre almost decolorised, liquid colourless. | *Conc.*:—Fibre intensely violet, liquid the same. On addition of water—liquid yellowish.<br>*Dil.*:—Fibre bright yellow, liquid colourless. | *Conc.*:—Fibre redder, liquid colourless; heated—fibre orange.<br>*Dil.*:—Fibre orange; heated—liquid reddish; acidified colourless. | Fibre somewhat redder, liquid colourless. | Fibre bright yellow; heated—fibre decolorised, liquid colourless. | Extracted on boiling with yellow colour: on addition of concentrated sulphuric acid solution changes to bluish-red. | Ammonium acetate extracts the dye slightly; solution on addition of concentrated sulphuric acid—reddish. |
| 15.<br>Chrysophenin [L.], [A.], [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre violet-grey, liquid colourless. On addition of water—fibre dirty yellow.<br>*Dil.*:—Heated—fibre bright yellow, liquid colourless. | *Conc.*:—Fibre violet. On addition of water—fibre yellowish-grey.<br>*Dil.*:—Fibre reddish-grey; heated—liquid reddish, fibre violet. With excess of soda lye—colourless. | *Conc.*:—Fibre rosaniline-red, liquid the same. On addition of water—violet.<br>*Dil.*:—Fibre bright yellow. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faintly yellow. | Heated—fibre bright yellow, liquid faintly yellow; acidified colourless. | Cold—decolorised | Colouring matter extracted on boiling; liquid faint greenish-yellow. On addition of concentrated sulphuric acid—reddish. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 16.<br>Phosphine.<br>Chrysaniline.<br>Leather yellow.<br>(*Vegetable fibre.*) | *Conc.* :—Heated—liquid yellowish.<br>*Dil.* :—Heated—liquid yellow. | *Conc.* :—Same as concentrated hydrochloric acid.<br>*Dil.* :—Heated—liquid faintly yellow. With excess of ammonia—intense golden-yellow. | *Conc.* :—Heated—fibre bright yellow.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—Fibre bright yellow, liquid colourless. | Fibre becomes immediately bright yellow. | Heated—fibre almost decolorised, liquid orange. | Extracts the colouring matter slightly. | .. .. |
| 17.<br>Curcumeïne [A.]<br>New yellow (Ter Mer).<br>Citronine.<br>(*Animal fibre.*) | *Conc.* :—Fibre at first Bordeaux, then rosaniline-red. On addition of water—fibre reddish-yellow, liquid reddish.<br>*Dil.* :—Heated—liquid reddish; on cautious addition of soda-lye—liquid at first yellow; with large excess of the reagent again reddish; after some time colourless. | *Conc.* :—Fibre at first rosaniline-red, then scarlet. Liquid the same. On addition of water—fibre and liquid lemon-yellow.<br>*Dil.* :—Fibre at first brownish-red, then rosaniline-red; warmed, fibre and liquid golden-yellow. | *Conc.* :—Fibre and liquid at first reddish-brown, then Bordeaux, finally rosaniline-red. On addition of water—fibre brown.<br>*Dil.* :—Heated—fibre orange, liquid bluish-red; on addition of excess of ammonia—faint but bright yellow. | *Conc.* :—Heated—fibre olive to black. On addition of water—fibre olive, liquid yellowish.<br>*Dil.* :—Fibre darker; heated—fibre olive; liquid brown, on acidification reddish, after some time colourless. | Heated—liquid bright yellow; on acidification—reddish. | Warmed—fibre at first bright yellow, then decolorised. | Some of the colouring matter extracted on boiling. | Ammonium acetate readily extracts the colouring matter. On addition of concentrated sulphuric acid the solution becomes bluish-red. |
| 18.<br>Brilliant Yellow S [B.]<br>(*Animal fibre.*) | *Conc.* :—Fibre and liquid violet; heated—reddish-violet.<br>*Dil.* :—Fibre reddish-brown; heated—violet, liquid intense reddish-violet. With excess of soda lye—yellowish. | *Conc.* :—Fibre and liquid at first violet, then rosaniline-red, ponceau-red, and finally scarlet. On addition of water—both yellow.<br>*Dil.* :—Fibre violet; heated—fibre and liquid yellow. | *Conc.* :—Fibre at first reddish-brown, then dark brown, liquid brownish. On addition of water—intense reddish-violet.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—Heated—liquid yellow; on acidification—intense reddish-violet. | Extracts the dye readily; on acidification, solution becomes reddish-violet. | Fibre at first reddish-brown, then dark violet; heated—bright violet, and finally decolorised. | Extracts the dye; on acidification, solution becomes reddish-violet. | Ammonium acetate extracts the dye very easily: on addition of sulphuric acid, solution deep reddish-violet. |
| 19.<br>Thiazol yellow [By.] Clayton yellow (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately orange, liquid colourless.<br>*Dil.* :—The same. | *Conc.* :—Fibre at first orange, then again yellow, becoming fainter. On addition of water, fibre decolorised, liquid slightly yellow.<br>*Dil.* :—Fibre orange; heated colourless. | *Conc.* :—Fibre somewhat darker.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre immediately reddish-orange; heated—scarlet.<br>*Dil.* :—Fibre reddish-orange; heated—fibre scarlet, liquid faint yellowish-red; on acidification colourless. | Dye extracted on boiling with a faint reddish-yellow colour; on acidification colourless. | Cold—fibre orange; heated—fibre decolorised. | Dye extracted on boiling. | .. .. |
| 20.<br>Cotton yellow G. [B.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre violet; heated—fibre browner. On addition of water—fibre again yellow.<br>*Dil.* :—Heated—fibre almost decolorised. | *Conc.* :—Fibre reddish-violet; heated—liquid faint reddish-violet. On addition of water, fibre dirty.<br>*Dil.* :—Fibre violet; heated—almost decolorised. | *Conc.* :—Fibre reddish-orange, liquid the same. On addition of water, fibre dark red, liquid rosaniline-red.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre after some time—redder; heated—fibre reddish-orange.<br>*Dil.* :—Fibre reddish. | .. .. | Immediately decolorised. | .. .. | .. .. |
| 21.<br>Carbazol yellow. [B.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre violet; on addition of water, fibre again yellow.<br>*Dil.* :—Heated—fibre almost decolorised. | *Conc.* :—Fibre reddish-violet; heated—liquid bluish. On addition of water—fibre almost decolorised, liquid colourless.<br>*Dil.* :—Fibre violet; heated—fibre completely decolorised. | *Conc.* :—Fibre at first olive-green, then dark green to greyish-blue.<br>*Dil.* :—Fibre decolorised. | *Conc.* :—Fibre redder; heated—dark red. On addition of water—fibre orange.<br>*Dil.* :—Fibre orange, liquid colourless. | .. .. | Fibre at first violet, then decolorised. | Some of the dye extracted. | .. .. |

—A. R. L.

### *The Detection of Acetanilide in Phenacetine.* G. Guasti. Selmi, 1894, **4**, 96.

Phenacetine gives the smell of phenyl-carbylamine when treated with chloroform and alcoholic potash, and hence the carbylamine test is not reliable for the detection of acetanilide in phenacetine. A more certain test is to shake 0·5 grm. of the phenacetine to be tested with 10 cc. of boiling water; on cooling the phenacetine separates out, whilst the acetanilide remains in solution. The solution is filtered, the filtrate concentrated, 1 cc. of concentrated hydrochloric acid added, and the whole heated to boiling for some minutes. On the addition of a drop of phenol and a drop of calcium hypochlorite to the solution and then an excess of ammonia, a blue colouration results if the quantity of acetanilide does not exceed 4 per cent. Another test proposed by Hirschsohn (Pharm. Zeit. 1888, **796**) is best carried out as follows:—1 grm. of the phenacetine is boiled for some minutes with 100 cc. of water, and the solution after cooling and filtering treated with bromine water. With even 1 per cent. of acetanilide a turbidity is formed and crystals of 1·4 bromacetanilide melting at 166°—167° C. separate.—C. A. K.

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### *New Morphine Reaction.* Lamal. Semaine médicale, 1894, **14**, 267.

A solution of uranium acetate added to morphine solutions gives a red-brown coloration. Acids cause the colour to disappear whilst caustic alkalis produce an intense red precipitate which turns yellow on the addition of excess of the reagent. When the red solutions are heated on the water-bath there is formed, especially in presence of an excess of morphine, an ochre brown precipitate which appears to consist of morphine uranate; in the presence of acetic acid no precipitate is formed. The above red precipitate is composed of a double salt of morphine and uranyl acetate. In practice the test is best applied as follows:—Two to ten drops of the morphine solution and the same quantity of a uranium acetate solution, which contains 0·015 grm. uranium acetate and 0·01 grm. sodium acetate in every 5 cc. of water, are placed in a porcelain basin and evaporated to dryness on the water-bath. Concentric bright red and hyacinth red rings are formed. The reaction is still visible with 0·000005 grm. of morphine hydrochloride and is very distinct with 0·00005 grm. of the alkaloid. Oxymorphine gives the same reaction. Toxine and most alkaloids do not produce the red colour. Salicylic acid leaves brick-red; tannic, gallic, and pyrogallic acids brown rings, phenol assumes a brown colour which slowly disappears on warming. The colour reaction produced by uranium is durable for any length of time and can therefore in forensic cases be produced in court as a proof. —J. S.

### *Detection of Adulteration in Raspberry Juice.* A. von Asbóth. Chem. Zeit. 1894, **18**, 1276—1277.

König (Die Menschlichen Nahrungs- und Genussmittel., 3 Aufl.) states that artificial raspberry juice is composed of syrup, organic acids, spices, and colouring matters, and is flavoured with artificial ethers. When adulteration is suspected, the juice is tested for free sulphuric acid, aniline dyes, and glucose:—"glucose is absent from artificial fruit juices." If however the case is one in which cheaper fruit juices have been sold for raspberry juice, the following process, devised by the author, may be used. Genuine raspberry must be procured for the sake of comparison. The colour of the genuine juice is always lighter than that of the sophisticated; the taste and smell are very aromatic, whilst artificial raspberry juice has a very faint raspberry odour and, so to speak, no taste of raspberries. When both are diluted, each with twice its volume of water and fermented, the artificial juice loses its taste and odour, whereas, under similar circumstances, both are preserved in the case of the true juice. "If both phosphoric acid and potash are present in the ash, the fruit juice is derived from natural sources." In order to determine the nature of the colouring matter and with what foreign plant juice the sample has been prepared, the following process is used:—(1.) 25 cc. of the juice are mixed with 2 cc. of 10 per cent. ammonia and 0·5 cc. of ammonium sulphide, and then diluted with water to 100 cc. The colour in the case of genuine raspberry juice is brownish-violet, in that of cherry juice, brownish-red; in that of elderberry, juice brown; of red beetroot juice, violet; of mallow juice, brown; and of Brazil wood, red. (2.) 25 cc. of 8·5 per cent. sodium bicarbonate solution is mixed with 25 cc. of the fruit juice and diluted with water to 250 cc. The colour of the mixture, in the case of genuine raspberry juice, is reddish-violet; in that of cherry juice, brownish-red; elderberry juice, dirty violet; red beetroot juice, bright violet; mallow juice, bluish-violet; and Brazil wood, bright red. (3.) 2·5 cc. of pure concentrated nitric acid are mixed with 25 cc. of juice and the mixture heated on the water-bath at 85°—90° C. for 10 minutes. The above-mentioned fruit juices are under these circumstances changed in colour to yellow. (4.) 100 cc. of 8 per cent. alum solution are mixed with 100 cc. of the juice and the mixture precipitated with 100 cc. of 10 per cent. ammonium carbonate solution and filtered. True raspberry juice gives a turbid brownish-grey liquid which filters with difficulty; cherry juice yields a brownish-grey precipitate and a very bright filtrate; elderberry juice gives a greyish-violet precipitate and a violet-red filtrate; red beetroot juice, a reddish-lilac precipitate and a red filtrate; mellow, a greyish-blue precipitate and a brownish-green filtrate; Brazil wood, a red precipitate and a red filtrate.—A. R. L.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Testing so-called Prepared Tar.* G. Lunge. Zeits. f. angew. Chem. 1894, **15**, 450—454.

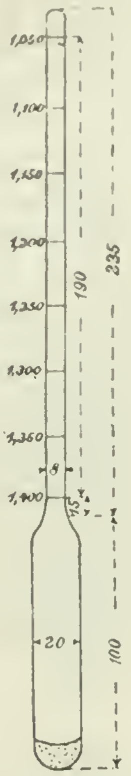
According to the quantity and quality of the added oils there are obtained products which are designated "*medium pitch*," "*soft pitch*," "*asphalt*," "*japans*," of various degrees of consistence, and lastly the so-called "*prepared tar*." The following scheme has been devised by the author for the valuation of the latter substance. The density, viscosity, and percentage of volatile constituents are determined.

1. *Density.*—In cases where an aërometer cannot be used, the determination is made in a cylindrical weighing bottle of 76 mm. in height, and 27 mm. diam. A small vertical channel, about 2 mm. wide is made with a file in the glass stopper of this weighing bottle. The weight of the bottle and stopper (*a*) empty, and (*b*) filled with water at 15° C. is then ascertained. The bottle is next dried, filled to about two-thirds with the tar under examination, and placed without the stopper into hot water for about an hour, until all the gases from the tar are expelled; after cooling the stopper is inserted and the weight (*c*) observed. The flask (still containing the tar) is now filled up with water at 15° C., the stopper inserted, and the weight again ascertained (*d*). From these data the density is then calculated by the formula $\frac{c - a}{b + c - (a + d)}$.

*Viscosity.*—This is determined by the instrument, shown one-fourth its actual size in the figure, which is referred to by the author as the "tar tester." The spindle of this instrument is graduated into specific gravity degrees; the instrument may be used as a viscosimeter for other liquids if its absolute weight be altered. In carrying out the test the tar is poured into a cylinder to such a height that its level is not far below the orifice of the cylinder when the tar tester is inserted. The sample is then well mixed by means of a wire stirrer, and its temperature determined within 0·5° C.; the observation is best made at 15° C., the cylinder being immersed in a vessel of water at that temperature. The "tar tester" is plunged into the tar to a certain height on the scale, say as far as the graduation 1·250, taken out again, and placed in a clamp immediately over the tar, where it is allowed to drain for three minutes. The time is noted when the instrument (released at the commencement of a minute) has sunk to the point 1·250.

3. *Percentage of Volatile Constituents.*—100 grms. of the tar are distilled over a free flame from a hard glass retort, which is surrounded with asbestos paper, until a determinate amount of distillate has passed over, which latter is collected in a graduated cylinder. The respective specific gravities of the distillate and the residue are then estimated, and the softening point of the residual pitch determined.

—A. R. L.



## *The Analysis of Varnishes.* P. C. McIlhiney. J. Amer. Chem. Soc. 1894, **16**, 344—352.

This paper deals with the analysis of fixed oil varnishes made from linseed oil, a resin (such as kauri or manilla or hard copal like Zanzibar), and turpentine; often with colophony as an adulterant. Kauri, which varies in price from 3 to 60 cents per pound, is most commonly used, and next to this, manilla. To determine the turpentine, Phillips' process (Chem. News, **63**, 275, and this Journal, **10**, 577) is not satisfactory, the naphtha from the coal-gas contaminates the turpentine, and condensation is incomplete owing to the absence of a condenser, whilst the residue is viscous and retains turpentine. Distillation in vacuo at 100°—120° C. gave low results, which were better, but still imperfect when 5 grms. was operated upon instead of 25 grms. By dissolving the residue in 2 or 3 cc. of petroleum ether of low boiling-point, and gently heating the flask, after exhausting it of air, the results were accurate. But the process is cumbersome, and gives no distinction between turpentine and other volatile substances. The exposure of 0·5 grm. of the varnish to a temperature of 100° C. for an hour gave approximate, yet unreliable, results. But, by distilling together 100 cc. of water and 25 grms. of the varnish, the whole of the turpentine is obtained in the first 90 or 95 cc. which comes over. The oil should be weighed into a 400 cc. flask, which already contains a fragment of tin (to prevent bumping) and 10 cc. of water, so that the bottom of the flask may not become greasy—a certain cause of bumping. After distillation, if any smell of turpentine be observed in the flask, the process must be repeated. Salt added to the water (to raise the boiling-point) is only of value if the residue has a higher specific gravity than unity, and would otherwise sink to and grease the bottom. The distillate is permitted to separate by gravity, and an allowance of 0·3 grm. per 90 cc. of water is made for dissolved turpentine; there is thus a direct determination of turpentine, the purity of which may be subsequently tested. Accurate results may be obtained within half an hour. Benzine in the turpentine is estimated by Burton's method (Amer. Chem. J. **12**, 102), which consists in converting the turpentine by means of nitric acid into acids soluble in water, whilst the benzine is unaffected. If the non-volatile residue is to be examined, the residual water should be poured away and alcohol added; this is distilled off, and the last trace removed by adding ether and evaporating this in its turn. The properties of resins have been examined by Hirschsohn (Pharm. J. **7**, 369, and **8**, 389); Schmidt and Erban (Sitz d. Wiener Akad. **94**, 917, and this Journal, 1889, 308); Mills (this Journal, 1886, 221); Mills and Muter (this Journal, 1885, 96); and Williams (Chem. News, **58**, 224). But the differences between the resins and linseed oil in solubility, and in the Hübl, Koettstorfer, and bromine absorption figures are so comparatively slight that the processes based on them are not available. The determination of acidity with the aid of phenolphthalein, and of the bromine addition figure, gave good results with ordinary mixtures of linseed oil and rosin, but the results obtained with varnishes were hopelessly inaccurate. Gladding's process (Amer. Chem. J. **3**, 416) depending upon the solubility of silver resinate, and the insolubility of silver oleate, in ether also failed when applied to varnishes. It is clear that the boiling together of the oil and resin, which is so essential to the production of a good varnish, causes a reaction that is not understood, but that profoundly affects the properties of the constituents.

—W. G. M.

## *Alimental Fats.* F. Wallenstein and H. Finck. Chem. Zeit. **18**, 1189—1191.

In view of the diversity of opinion existing as to the best method of estimating and separating hog's fat and other alimental fats, and the consequent discrepancy of results, the authors subjected the matter to a thorough investigation, experimenting with both German and American material.

The chief substances employed in the production of alimental fats are beef and mutton fats, tallow, and lard stearine as solid, and sesame-, arachis-, and cotton-seed oils as liquid constituents, together with cocoanut oil, &c. As a rule in Germany, owing to the fiscal regulations and other conditions, only cotton-seed oil and various tallows are used, and, for this reason, no attention was given to margarine, cocoanut butter ("lactine"), vegetable margarines, and those fats which are dissimilar to hog's fat.

In the present state of chemical knowledge the two chief bases on which the examination of these fats rests are:—

1. The presence of tallow is only proved when the microscopic examination reveals the characteristic horse-tail clusters of crystals, which cannot be separated into rhomboidal elements by pressure between the object- and cover-glasses.

2. The addition of vegetable oil is definitely and quantitatively (in an approximate degree) determined solely by the iodine number of the liquid fatty acids.

The Bechi, Welmans, and nitric acid reactions are not sufficiently reliable and must be regarded with caution when not very distinct, as certain pure hog fats, particularly such as are usually cooked with onions or seasoning, yield the same reactions.

The only certain method of determining the presence of vegetable oils is by separating the liquid fatty acids by means of the lead-salt-ether method, and determining their iodine number. This number is found not to exceed 97 in the case of unadulterated European lards, but is between 103 and 105 for pure American hog fat, the discrepancy probably resulting from the totally different methods of feeding pursued in the United States. For fats containing vegetable oils the number is 100—140, or above, according to the kind and quantity of oil.

Muter and de Koningh's method of preparing the liquid fatty acids is employed, but modified in so far that the oil burette is replaced by a more accessible apparatus, and the operation is carried on in a current of hydrogen to prevent oxidation of the ethereal solution of the lead-salt, which otherwise readily occurs, thus rendering the estimation unreliable.

About 3 grms. of fat are saponified with 30 cc. of about semi-normal alcoholic caustic potash in a 250 cc. flask, and, after boiling for a quarter of an hour on the water-bath, acetic acid (1 : 10) is added, phenolphthaleïn being the indicator, until the red coloration disappears, whereupon alcoholic caustic potash of the above strength is used to effect complete neutralisation, and the liquid poured in a thin stream into a boiling-hot solution of lead acetate (30 cc. lead acetate 1 : 10 + 200 cc. water) with constant stirring. To collect the lead soap the beaker is placed in cold water and the contents stirred for 10 minutes, being then left to settle for a few hours till the supernatant liquor becomes fairly clear. The lead soap being strongly adherent to the bottom and sides of the beaker-glass, the pouring off of the supernatant liquid, and a thorough washing with hot water can be effected without fear of appreciable loss or the necessity for a filter. After washing till no more lead is perceptible in the washings, the soap is well dried between filter paper and then dissolved in 80 cc. of ether, rinsed out with 30 cc. of ether into a Drechsel gas-washing flask, having the tube shortened about $\frac{2}{3}$. After passing hydrogen through for about a minute, the whole should be left to stand for about 12 hours. The ethereal solution will then be clear, and, in the case of white fats, almost colourless; whereas, if free access of oxygen had been permitted, a dark yellow oxidised solution would result.

Filter through a folded filter, shake up with 40 cc. of hydrochloric acid (1 : 4) in a separating funnel, and wash the ethereal layer with acidified water. Then draw off the ethereal layer into a beaker, to settle (or filter off), transfer to a small flask, which place in a boiling water bath, and pass a strong current of $CO_2$ through the liquid until the last traces of ether have been removed. This leaves the liquid fatty acids in a pure state, and 0·25—0·3 grm. may be weighed out (casting away the first few drops) into a glass for the determination of the iodine number, glass and oil being placed together in the testing flask.

This method applied to a number of natural fats, yielded the following results :—

| —— | Iodine Number of the liquid Fatty Acids. "Absolute" Iodine No. | Iodine Number of the Glycerides. |
|---|---|---|
| | (J.) | (*i.*) |
| Berlin ox tallow................ | 92·2 | 38·3 |
| Australian tallow.............. | 92·4 | 45·2 |
| Hungarian mutton tallow........ | 92·7 | 38·6 |
| American "Western Steam Lard" | 104·5 | 65·4 |
| Berlin hogs' lard................ | 96·6 | 52·7 |
| Hungarian hogs' fat............ | 96·2 | 60·4 |
| Viennese „ ............ | 95·2 | 60·9 |
| Roumanian „ ............ | 96·0 | 59·5 |
| White American cotton-seed oil.. | 147·5 | 108·0 |
| Yellow North American cotton-seed oil. | 147·3 | 107·8 |
| White English cotton-seed oil.... | 146·8 | 106·5 |
| Yellow Egyptian „ .... | 148·2 | 108·0 |
| White German cotton-seed oil (bleached in laboratory). | 147·1 | 107·7 |
| Yellow Peruvian cotton-seed oil.. | 147·8 | 106·8 |
| Rape oil........................ | 120·7 | 101·1 |
| Arachis oil...................... | 128·5 | 98·9 |
| Niger-seed oil.................. | 147·5 | 133·5 |
| Maize oil ...... ............... | 140·7 | 122·0 |
| Cocoa-nut oil.................. | 54·0 | 8·4 |

These figures show a marked difference between the animal and vegetable fats, the latter with the exception of cocoa-nut oil (which can, however, be detected by its saponification number), being much higher than the former. The figures themselves are several points higher throughout than those obtained by Muter and de Koningh, which is due to the prevention of oxidation in the present process.

As the iodine number of cotton-seed oil, 148·2, approximates to the theoretical number, 151, of a mixture of 2 mol. linolic acid and 1 mol. oleic acid, the opinion must be formed that 1 mol. of the formula—

$$C_3H_5.C_{18}H_{33}O_2(C_{18}H_{31}O_2)_2$$

forms—with stearin and palmitin—the basis of cotton-seed oil and Niger oil.

The percentage of liquid glycerides in a fat may be calculated from the formula :—

$$\frac{100.\ \text{Iodine number of the total fatty acids.}}{\text{Iodine number of the liquid fatty acids,}}$$

more readily than by weighing the separated liquid fatty acids, their lead salts being hard to collect.

In deciding qualitatively as to the purity of a fat it may be assumed that below the limit of 96 (iodine number) there is no admixture of vegetable oil (except it be cocoa-nut oil, which is however revealed by the saponification number of the sample). Between 96 and 105 much depends on the origin of the fat; for instance, Central European lards show 93 to 96, while American lards vary between 103 and 106, and additional confirmation by Welmans' or Bechi's test will be required to form a definite opinion.

When edible fats are referred to (for analysis), we may start with the assumption that only cotton-seed oil, hog's fat, mutton tallow, and ox tallow are likely to be present. Sesame oil, if suspected, can be detected by Baudouin's test, arachis oil by Souchère's reaction, and cocoa-nut oil by its saponification number. The first point to determine for the practical man, is the percentage of cotton-seed oil, and then, the nature and consistency of the remaining fats. These are indicated by the iodine number ($i$) of the fat, the iodine number (J) of the liquid fatty acids, and the microscopical examination.

The percentage of liquid fatty acids is found by dividing 10,000 $i$, by the product of the Hehner number and J, and is expressed, for the purpose of establishing a formula, as $C_1$ for the vegetable oil and $C_2$ for the animal fat. By taking the following additional values—

Average iodine number of cotton-seed oil.... $i_c$ = 108·0
Average iodine number of the liquid fatty acids in cotton-seed oil. $J_c$ = 147·5
Mean iodine number of the liquid fatty acids in German animal fats. $J_{\substack{t\\m}}$ = 94·0
Hehner number of the fats and oils under consideration. $h$ = 96·0
Percentage of cotton-seed oil in the mixture. = $x$
Percentage of animal fat in the mixture..... = $100-x$
Mean iodine number of the animal fat in the mixture. = $y$

the formula for the extracted liquid fatty acids can be built up thus :—

$$\frac{J}{100}\left[\frac{C_1 x}{100}+\frac{C_2(100-x)}{100}\right]=\frac{147\cdot5}{100}\cdot\frac{C_1 x}{100}+\frac{94}{100}\cdot\frac{C_2(100-x)}{100},$$

and that for the neutral fat as follows :—

$$i=\frac{108x}{100}+\frac{y(100-x)}{100}$$

Where oils other than cotton-seed oil are in consideration, the numbers for these oils must be substituted opposite $i_c$ and $J_c$. The value of $J_t$ is also a variable quantity, and depends on the result of the microscopic examination and the origin of the fat under consideration. Experiments with various mixtures of known composition confirmed the reliability of the formulæ.

Finally an example is given of an adulterated fat which had the saponification number 178·2. The isolated unsaponifiable portion contained 13 per cent. of mineral oil (by its low iodine number, 2·3). The other portion gave a saponification number of 205, an indication which, coupled with the odour, showed it to be cocoa-nut oil, amounting, according to the formula $\frac{205-195}{260-195}\cdot100$, to 15 per cent. The iodine number of the liquid fatty acids was 129·0, The positive Welmans' and Bechi's, and the negative Souchère's and Baudouin's reactions clearly indicated cotton-seed oil; the microscope revealed only tallow crystals, and there were present in addition 3 per cent. of water with 0·8 per cent. of salt and borax.—C. S.

### *Raffinose (Melitriose) and its Quantitative Estimation.* A. Bau. Chem. Zeit. 1894, 18, 1794—1798.

In this paper the author gives a most valuable and complete bibliographical summary of the chemistry of melitriose. The paper is published in a condensed form under the title of "Non-occurrence of Melitriose in Beer" in the *Wochenschrift für Brauerei* (see this Journal, 1895, 54).

The method devised by the author for the estimation of melitriose depends upon the fact that low-fermentation yeasts completely ferment this sugar, whereas high-fermentation yeasts convert it into a mixture of levulose and melibiose, of which mixture the last-named constituent remains unfermented. The facts hold good for mixtures of melitriose with other sugars; antiseptic substances must now, however, be present, such a case being presented by alkaline molasses, which must be rendered fermentable; the necessary experiments as to the means of effecting this have not, however, up to the present been carried out.

A 10—12 per cent. solution of the substance is prepared; in the case of sugars and syrups, a sufficient quantity of yeast extract is added to serve as nutrient for the yeast, but with plant extracts (such as from barley, malt, and also with beer-worts) no addition of nutrient material is as a rule needful. The solution is well mixed and divided into four portions, which are placed in flasks of 300—350 cc. capacity (compare Chem. Zeit. 16, 1474; 17, 392). The flasks are weighed, closed with a wad, and sterilised in a Koch's cylinder, and, after cooling, two are pitched with high-fermentation yeast and two with low-fermentation yeast, pure cultures being used in both instances. At the end of the fermentation two of the flasks (one with the high-fermentation and one with the low-fermentation yeast) are opened, whereas the two other flasks are allowed to remain an extra day for the sake of control. The contents of the flasks are then brought to their original volume with distilled water, and, after filtering or subjecting to centrifugal action, analysed. The rotatory power, reducing power, and amount of extract is determined. No correction is necessary for the weight of yeast, as it is the same in the two cases. By this experiment the amount of melibiose, $C_{12}H_{22}O_{11}$, is found, and by multiplying this value by 1·737 the corresponding quantity of crystallised melitriose, $C_{18}H_{32}O_{16} + 5H_2O$, is obtained. Figures are then quoted showing that the method yields satisfactory results in the case of worts or saccharose solution in which known amounts of melitriose have been dissolved. The author has provisionally taken the cupric reducing power of melibiose to be 83 per cent. that of maltose: he found (in one experiment only) that the rotatory power of this sugar was $[\alpha]_D + 139$, whereas Scheibler and Mittelmeier give the value $[\alpha]_D + 126{\cdot}7$ to $+ 127{\cdot}9$. The great disadvantage of this method is that the fermentation is only complete after 10—14 days.—A. R. L.

### *Estimation of Crude Fibre in Sugar Cane.* J. L. Beeson. J. Amer. Chem. Soc. 1894, 16, 308—313.

In estimating the proportion of sucrose in the whole cane, it is essential to know the true average proportion of fibre, but results are usually discordant, the mean variation on 100 consecutive samples tested, having been 0·736 per cent. In extracting the sugar from the chips by diffusion, the author finds that much time is saved by heating the water to 75°—80° C., which may be safely done, as the coagulating point of the soluble albuminoids lies between 80° and 90° C. On an average, from 75 to 85 per cent. of the sugar present in the chips may be extracted at each application of water, the diffusion being complete in 65 minutes if the temperature be 23°, in 45—50 minutes at 60°, or in 30—35 minutes at 75°—80° C. Five extractions should be sufficient if the sample contains 12 per cent. initially. But in preparing the samples considerable loss is caused by evaporation, and by the escape of juice from cells ruptured in the cutting process, and this is sufficient to affect the apparent percentage of fibre to a very appreciable extent. Thus, 10 grms. of chips lost 0·22 grm., mainly by the action of the scissors used in cutting them (a loss which would be exaggerated when comparatively blunt cutters are employed), whilst another batch lost 3·5 per cent. in two hours by evaporation when exposed in a beaker on a damp morning. But the chief source of error is the irregular distribution of fibre in the cane; samples cut through from the top, middle, and butt of a stalk of purple cane showed respectively 15·9, 15·9, and 18·2 per cent. in the nodes, and 8·6, 8·0, and 8·1 in the internodes. The irregularity is still more marked in comparing concentric rings cut from a stalk of purple cane: 10 grms. pared off all round from the rind showed 33·9 per cent. of fibre; 10 grms. from the inside rind or bast tissue gave 13·3 per cent.; from the layer next to the inside rind, 6·8; from that next to the middle, 4·8; and from the middle, 4·1 per cent. The diffusate from the inside bark (bast cells?) was yellow, and probably these cells are the source of the colouring matter in expressed juice. A further examination of a fragment of third-year stubble showed 21·3 per cent. of fibre in the nodes proper, 14·2 per cent. in the root nodes, 14·13 in the stalk next to these, and 11·19 per cent. in the remaining internodes. Having regard to these wide variations, and to the mechanical difficulty in securing an average sample, the author is of opinion that no accurate method of fibre estimation for technical purposes is feasible.—W. G. M.

### *The Analysis of Malt.* J. A. Miller. J. Amer. Chem. Soc. 1894, 16, 353—360.

From the brewers' standpoint the only analytical tests required for malt are the determination of moisture, the percentage of extract obtained by mashing on a small scale, the diastatic power, and the acidity (calculated as lactic acid) of the wort. The proportion of sugar formed, and the proteids calculated from the total nitrogen in the wort, are so dependent upon manufacturing conditions that laboratory experiments to determine them are valueless. Owing to discrepancies between results obtained by different analysts with the same samples of malt, the author has instituted comparisons between various processes. In determining the moisture equally good results were obtained with 2 grms. and 20 grms., by heating them to 100°, until the weight was constant; the former quantity is therefore to be preferred. Three methods for the determination of extract were tried, with the result that two gave nearly equally good results, whilst the third gave a number 5 per cent. too low. The process recommended is as follows:—50 grms. of ground malt are rapidly weighed into a weighed copper beaker, and mixed with 200 cc. of water at a temperature of 40° C. The mixture is gradually heated to 60° C. on an asbestos sheet, and maintained at this temperature with almost constant stirring for 20 minutes. A few drops of the liquid are then tested with iodine solution; if the starch or erythro dextrine reaction is produced, the mash is further heated, the temperature being raised 1° every two minutes until iodine ceases to give a reaction. The temperature seldom rises above 70°. The flame is then removed, the mash cooled, and water added to make the total amount of water up to 400 grms., so that the mash (malt + water) should weigh 450 grms. After thorough mixing, the mash is thrown upon a plaited filter, the first half of the filtrate being returned to the filter. Then the whole is collected, and its specify gravity is taken with the aid of a Westphal balance. From this the percentage given by Schultze's tables is ascertained, and that number multiplied by 8·75 gives the percentage of dry extract yielded by the malt. Or the percentage can be calculated from the formula—

$$\frac{(800 - \text{per cent. of water}) \times \text{per cent. Schultze.}}{100 - \text{per cent. Schultze.}}$$

It would seem that 8 should be the proper factor, instead of 8·75, but the result thus obtained is always too low. Instead of taking the specific gravity, the residue may be dried at 70°—75° C. and weighed. Drying at 105° C. is recommended by some authors, but this gives results uniformly too low, owing to a partial decomposition of the maltose at that temperature—an objection which applies equally in the determination of extract in beer. Washing the grains until no sugar reaction is obtained, with subsequent drying of the residue at 70°—75° C., may be accurate, but is impracticable except for scientific purposes, owing to the expenditure of time involved.—W. G. M.

*International Congress for Applied Chemistry at Brussels and Antwerp.* August 4—11, 1894. Chem. Zeit. 1894, **18**, 1279.

*See under* XVI., *page* 46.

## *ANALYTICAL AND SCIENTIFIC NOTES.*

### *Nitrogen Compounds of Manganese.* O. Prelinger. Monatsh. Chem. **15**, 391–401.

By the direct action of nitrogen on manganese at a red heat, a nitride of the composition $Mn_5N_2$ is formed. The product is a grey powder possessing a dull metallic lustre, and is readily decomposed by alkali with the evolution of ammonia. Heated in a current of hydrogen it forms ammonia, and in sulphuretted hydrogen, ammonium sulphide. The specific gravity at 18° C., compared with water at 4° C., was found to be 6·58 and 6·68 respectively in two samples prepared. The same compound is formed by the action of nitrogen on manganese amalgam. When the amalgam is heated quickly in the current of nitrogen until the mercury is distilled off, a violent reaction occurs, causing the manganese to glow vividly. A further heating in nitrogen, after the glowing is over, is necessary to convert the metal completely into the nitride.

Both manganese and manganese amalgam, when treated in a current of dry ammonia, yield a second nitride, $Mn_3N_2$. This has a more marked lustre than the above compound, and is less readily decomposed by alkali. It has a specific gravity of 6·21 at 18° C., and when heated in nitrogen yields $Mn_5N_2$. The latter yields $Mn_3N_2$ when heated in ammonia. The atomic volume of nitrogen in the solid state, as calculated from these compounds, is 4·42.

The manganese used was prepared as an amalgam by the electrolysis of the chloride, a mercury cathode being used.
—C. A. K.

### *Manganese Trichloride and Chloro-cupric Acids.* J. Neumann. Monatshefte d. Chem. **15**, 1894, 489.

On treating manganese perhydroxide at temperatures below zero with concentrated hydrochloric acid saturated with chlorine, on addition of either ammonium chloride or potassium chloride, the compounds ammonio-manganese perchloride, $(NH_4)_2MnCl_5$, in the one case, and potassio-manganese perchloride, $K_2MnCl_5$, in the other, were obtained. All attempts at the isolation of manganese trichloride failed. By similar treatment of cupric and cuprous chlorides, the compounds, $H_3CuCl_5$, chlorocupric acid, and $HCuCl_2$, chlorocuprous acid, were obtained.—C. O. W.

### *Oxidation of Normal Fatty Acids.* R. Margulies. Monatsh. für Chem. 1894, **15**, 273.

With potassium permanganate in presence of sulphuric acid as oxidising agent, at the temperature of boiling water, the following results were obtained:—

Acetic acid gave only carbon dioxide, propionic acid gave acetic acid, normal butyric acid also gave acetic acid, and normal heptylic acid gave acetic and traces of formic acid.

With potassium permanganate in presence of sodium carbonate all four acids were oxidised to oxalic acid, while butyric acid yielded also acetic, and heptylic acid gave acetic and formic acids.

Normal butyric acid was also oxidised with sodium peroxide in the cold, acetic and a little formic acid being produced.—T. E.

### *The Variety of Sugar in Indican.* C. J. van Lookeren. Landw. Ver.-Stat. **45**, 195.

The author some time ago expressed the opinion that the variety of sugar obtained by the decomposition of indican by means of acids or ferments, is dextrose. He now considers that he has furnished proof that the sugar termed indiglycin by Schunck, is really dextrose. Besides the dextrose, a very small quantity of levulose is present also, which, however, is present as such before the indican becomes decomposed. The indican used was the freshly expressed juice of the indigofera leaves, indican being decomposed with such extraordinary ease.—W. S.

## New Book.

Elementary Qualitative Chemical Analysis, adapted for use in the Laboratories of Colleges and Schools. By Frank Clowes, D.Sc., Professor of Chemistry in the University College, Nottingham, and J. Bernard Coleman. London: J. and A. Churchill, 11, New Burlington Street. 1894. Price 2*s.* 6*d.*

This is a smaller and more elementary work than the larger one already published by the same authors. In it are omitted the reactions and methods of detection of the less commonly occurring metals and acid radicles, and of organic substances. The general arrangement of the book may be gathered from the following abstract of the contents: — List of Bench Apparatus. I. The Preparation and Use of Apparatus. II. Experiments illustrating the preparation and properties of certain Gases and Liquids. III. Analytical Operations, descriptions illustrated by Experiments. IV. Analytical Reactions. Reactions for Metals and Reactions for Acid Radicles. V. Analysis of Simple Substances containing only one Metal and one Acid Radicle. VI. Full Analytical Course and Tables. Lastly, there follows an Appendix containing a list of Chemical Elements with their Symbols and Atomic Weights, and one of Chemical Formulæ with Chemical Names. The text is illustrated with 40 wood-cuts.

## Trade Report.

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### The Preparation of India-Rubber in Eastern Africa.

Mr. A. Carnegie Ross, Her Majesty's Consul at Beira, in a report to the foreign Office, dated the 22nd September, refers to the unskilful manner in which the rubber is prepared for sale by the natives of that district. He forwards fingers of the rubber which fetches a good price in the European markets, but owing to the fact that it takes much time and money to cut out the cores of wood and other substances round which the natives wind the rubber as they gather it, merchants at Beira are very chary of buying and exporting the fingers. As a large part of the india-rubber exported from Beira in 1893 went to England, Mr. Ross has thought it advisable to send home these samples in the hope that some British manufacturers may have in stock or might make a machine-knife which would do the cutting open and coring of these fingers so expeditiously and cheaply as to enable the local merchants to prosecute the rubber trade at a profit.—*Board of Trade Journal.*

### Encouragement of Native Industries in Bulgaria.

Sir A. Nicolson, Her Majesty's Agent and Consul-General at Sofia, in a report to the Foreign Office, dated the 10th December, encloses translation of a project of law for the encouragement of industries in Bulgaria, which has been submitted to the Sobranje by the Minister of Commerce. The Government hope, by the facilities offered in the law, to attract foreign capital into the country, as industrial development is greatly impeded by the poverty of the people. The Bill, which has passed the first reading, provides as follows:—

Art. 1.—Anyone who, within a period of ten years from the promulgation of this law, opens a factory for the production of any of the articles enumerated below, will enjoy the facilities prescribed in this law if his factory is supplied with proper instruments of labour, and if a capital of at least 25,000 francs is invested in the factory, and if he employs at least 20 workpeople.

The Minister of Commerce and Agriculture decides whether the factory which desires to profit by the above-mentioned facilities, fulfils the conditions above stated, and will base his decision on the certificate delivered by the Commune. In the event of disagreement, the interested party may appeal to the Council of Ministers, who will give a final decision.

Art. 2.—The articles which a factory must produce in order to claim the facilities are the following:—

1. Yarns; tissues; woollen goods of cotton, silk, wool, or hemp tissue; cords.
2. Stearine candles.
3. Earthenware table services, stoves, pipes, fire-bricks.
4. Window glass, glasses, bottles, &c.
5. Sugar, cellulose, and all kinds of paper.
6. Carriages.
7. Products of chemical industry, iron, phosphorescent matches, glue.
8. Products of mineral and metallurgical industries—iron products—and of other metals of the country.

Art. 3.—Factories which are established under the above conditions and for the above-mentioned articles. 1st. Are exempt during 15 years after their opening from the licensing tax (*droit des patentes*); and from the emlak (land tax). 2nd. Are exempt from the stamp tax, the contracts which may be concluded for the erection of the factory as well as the shares which may be issued for that object. 3rd. The machinery and their various parts which are imported from abroad for the erection and for the support of the factory are exempt from Customs duties, and are transported on the State railways at a reduction of 35 per cent. on the existing tariffs. 4th. The raw materials which the factory may require, and which are not to be found in the country, or are only found in an insufficient quantity, are exempt from Customs duties. The Council of Ministers in consultation with the Chambers of Commerce on each individual case decide what are the raw materials which are not found in the country or only in insufficient quantity. The raw materials which are imported from abroad, as well as those which the factory purchases in the country for its own use, are transported on the State railways at a reduction of 35 per cent. on the existing tariffs. 5th. The products of the said factories are transported on the State railways at a reduction of 35 per cent. on the existing tariffs.

Art. 4. In the case where the raw materials which the factory may require are products of the soil and are found in lands belonging to the State or to the Commune, they are granted to the factory in conforming with the law regarding mines and quarries.

Art. 5. The products of these factories have, in respect to the requirements of the State or of the Communes, the preference over foreign products, if they are of equal quality with the latter and if their price is not more that 15 per cent. above the latter, the Customs duties paid on the latter being deducted.

The State to meet its requirements may enter into contracts with these factories for a period of, at most, seven years. These contracts are concluded with the Council of Ministers, and may be made, on the necessary guarantee being furnished, even before the factory is established, in order to encourage the industry.

Art. 6. The State may grant gratuitously to the factories which fulfil the condition prescribed in Art. 1, the necessary sites on State lands and on waste lands. If in such places there is motive water power, that water power is given gratuitously to the factories. This grant will continue as long as the factory exists. If the factory is closed during a period of at least two years the ceded site reverts to the State.

Art. 7. In the event of the owner wishing to join his factory by a road or a railway with a State road or railway, the necessary ground will be granted gratuitously if it belongs to the State or to the Commune.

Art. 8. The factories at present existing in the country, and which fulfil the conditions prescribed in Arts. 1 and 2, will profit by the facilities enumerated in this law.

Those which already enjoy greater privileges than those offered by the present law, and which they have obtained from the National Legislature, retain such privileges till their expiration.

Art. 9. All wool and leather factories in the principality profit by the rights enumerated in Art. 3 (under headings 4 and 5) and in Arts 4 and 5.

Art. 10. In regard to factories for sugar, papers, yarns, tissues, cotton, woollen and silk, glass, candles, the manufacturer will have the monopoly for his special industry during a period of 10 years and within a prescribed radius.

The Council of Ministers, on the proposition of the Minister of Commerce and Agriculture, will decide whether the establishment should enjoy the above monopoly, and will fix the prescribed radius.

Art. 11. Regulations issued by the Minister of Commerce and Agriculture, and approved by the Council of Ministers, will settle the details for the application of this law.—*Ibid.*

### Cotton-Seed Mills in Europe.

*United States Consular Reports, October* 1894, 176—183.

In compliance with a request for information as to cotton-seed crushing mills in Europe, the United States Consular Officers in England, France, and Germany, report as follows:—

#### *England.*

More than three-fourths of all the mills in England are in Hull and its neighbourhood. There are also mills in Berwick-on-Tweed, Rochester, King's Lynn, and three or four in Liverpool. In addition to these places, cotton seed is imported into London, Bristol, and Glasgow. The seed used is almost exclusively Egyptian. Egyptian cotton seed comes unmixed with fragments of cotton fibre, and is therefore easier to handle than the American seed. The premium of insurance is also considerably enhanced where American seed, with its adherent fibre, is either handled or stored. The seeds are crushed undecorticated. The oil cake has not the excellent appearance of the American cake made from the decorticated seed, but the hardness of the latter renders it unsuitable for cattle feeding, and militates against its sale. The expressed oil finds a market in soap factories, fried-fish shops, and in the Mediterranean.

#### *France.*

The only cotton-seed crushing mills in France are at Marseilles. Within the last two or three months, however, experiments have been made in the manufacture of cotton-seed oil at Dunkirk and at Havre. But mills have not as yet been established in these places.

There is one large cotton-seed oil mill at Marseilles, that of Darier de Rouffio et Cie., and four smaller ones which operate in harmony with the first-named. Darier de Ruffio et Cie. secure their cotton seed from Egypt and the others from India. No American cotton seed is imported, but all the mills import American cotton-seed oil and refine it. The present quotations for cotton-seed oils are as follows :—

| | | Francs. |
|---|---|---|
| French, extra | per 100 litres | 100—110 |
| „ fine | „ | 80—90 |
| American, superior | „ | 72—80 |
| „ second | „ | 63—65 |
| English, Hirsch Union J. K. S. | „ | 63—64 |

### *Germany.*

Within the past two or three years two oil mills in Southern Germany have experimentally crushed American cotton seed, but have abandoned the experiment on account of the strong competition of American pressed oil. The reason is the impossibility of importing a raw material so bulky as cotton-seed, and manufacturing oil at a cost which can withstand American competition. Cotton seed is free of duty when imported into Germany, while cotton-seed oil bears a duty of 95 cents per 100 kilos.

## VEGETABLE PARCHMENT PAPER.

*U.S. Consular Reports, December* 1894, 479—489.

A circular, dated May 9, 1894, was sent to the principal United States Consuls in Austria-Hungary, Belgium, France, Germany, and the Netherlands, requesting particulars relative to the manufacture and export to the United States of vegetable parchment. The following are abstracts of the reports sent in reply :—Consuls at Havre and St. Etienne in France, at Annaberg, Berlin, Bremen, Dresden, Freiburg, Fürth, Hamburg, Nuremberg, Munich, and Weimar in Germany, Liège and Ghent in Belgium, and at Amsterdam and the Netherlands, reported that no vegetable parchment was manufactured in their districts.

*Austria-Hungary. Vienna Consulate.* — Vegetable parchment is manufactured at three mills in this district, one of which produces the cheaper qualities used as a waterproof packing paper; a second produces the finer qualities as *osmogene*, dialysing and drawing parchment paper. Only small quantities have been exported from Vienna to the United States. The present prices at Vienna are : for ordinary quality for wrapping, 22·3 cents; for wrapping butter, 32·4 cents; osmogene or dialysing parchment, 44·64 cents; tracing parchment, 55·88 cents per kilo. (2·2046 lb.) Freight on parchment from Vienna to Hamburg, 1·66 dol. to 1·90 dol. per 224 lb.

*Prague Consulate.*—There is only one vegetable parchment factory in Bohemia, producing between 500 and 600 tons annually. During the last four years 490 tons were exported to the United States. The market price for ordinary qualities average 9·30 dols. per 100 lb.

*Belgium. Brussels Consulate.*—Three firms only in this district manufacture this material, producing annually about 1,322 tons, two-thirds of which is used for wrapping and one-third for industrial purposes. The quality for wrapping is from 10 to 11 cents per lb.; for osmoses, 68 cents per kilo.; imitation leather and oil-cloth, 24 to 34 cents per kilo. The cost of transport from the mills to Antwerp, loading, and other charges, is from 15 to 20 cents per kilo. Most of the parchment paper manufactured here is sold in England and Germany. The invoiced quantities exported to the United States were : for 1890, 12,093 lb.; for 1891, 26,499 lb.; for 1892, 19,745 lb.; for 1893, 70,270 lb., and for the first six months of 1894, 18,344 lb. The principal shipping port is Antwerp, and the ports of destination New York, Chicago, and St. Louis. The total quantity of vegetable parchment shipped to the United States from 1st January 1890 to 15th June 1894 amounted to 142,951 lb. The import duty upon this material into Belgium is 77 cents. per 220 lb.

*Germany.*—

| Consular District. | No. of Mills. | Quantity Exported to U.S.A. | Price per Pound. | Cost of Transport. |
|---|---|---|---|---|
| Aix-la-Chapelle | 1 | 25 tons during past four years. | 9½ to 10 cents. | 2·5 dols. per ton to Rotterdam. |
| Cologne | — | 11·7 tons during past four years. | About 9 cents. | 24 cents per 220 pounds to Rotterdam. |
| Crefeld | 1 | None direct. | 9·7 to 11 per cent. | 18·7 cents per 220 pounds *viâ* Rhine freight boats. |
| Frankfort | None | None. | 10·5 to 12 cents. | 12 cents per 100 kilos. to Antwerp or Rotterdam. |
| Kehl | 2 | None during recent years (annual production 30,000 pounds). | 10 to 12 cents. | 16 cents per cwt. |
| Stettin | — | 220,000 pounds since 1893 invoiced at 8½ cents per pound. | 15 cents. | 2·84 dols. per ton to Stettin. |

The Consul at Frankfort reports that although no genuine vegetable parchment is manufactured in his district, *pergamene* or imitation vegetable parchment is produced at one mill, and is chiefly used for wrapping oily substances, envelopes, &c., and the price is from 10 to 15 cents per kilo. f.o.b. Antwerp. The report further states that a parchment substitute is manufactured which is applicable for nearly all purposes to which vegetable parchment is now used, and, being free from glycerin, is for some purposes preferable; the price of this substitute is from 16 to 17 cents per kilo. f.o.b. Antwerp. In the lower Rhine district there are five mills manufacturing genuine vegetable parchment. All grades of vegetable parchment coming into Germany are subject to a duty of 2·38 dols. per 221 lb.—S. P. E.

## ARTIFICIAL SILK IN ENGLAND.

*U.S. Consular Reports, December* 1894, 538—541.

THIS report, dated August 14, 1894, states that a company is being formed in Bradford for the manufacture of artificial silk. Patents have been secured in the United States by the inventor, Dr. Lehner, of Zürich. After describing the process of manufacture the report states that the promoters propose to form a company with a capital of 540,000 dols. Samples of yarn, brocaded silk, braids, &c., as well as the process of manufacture, were shown at a reception of representatives of various professions, trades, and press, and the general opinion appeared satisfactory. The manufacturers and textile experts of Bradford have nevertheless no confidence in the usefulness and practicability of the process. To Messrs. Lister and Company, the largest silk manufacturers in England, the process was offered, but they declined to entertain it, and the opinion of a dozen other experienced men is, that the invention will not prove a success. These opinions, however, may be somewhat prejudiced. Manufacturers have expressed doubts that it could ever be produced in quantities sufficient to make it a great factor in trade, though it may have a limited consumption as a weft with other material as a warp. The Bradford Conditioning House gave the following report upon samples :—(1.) The samples submitted are purely artificial, containing no filaments of pure silk. (2.) The relative strength, compared with Italian pure silk of the same counts (1,010 yards to the ounce) is as 68 to 100. (3.) Pure silk has but little elasticity, and when stretched does not return to its original length; neither does the artificial silk, but its stretching quality (before breaking) is as 73 to 100 relatively. (4.) Taken as a denier measure, the relative weight of the same average diameters of pure and artificial silk is 7·25 per cent. more in the latter. (5.) The artificial silk is much evener in counts (taking 20 tests of 10 yards each) than any pure silk. (6.) The denitrated artificial silk takes the dye in all shades perfectly even and brilliant.—S. P. E.

## *GENERAL TRADE NOTES.*

### Legislation affecting Adulterated Oils in Portugal.

The Portuguese Government has recently published regulations relative to the prohibition of the offering for sale of adulterated wines and oils. The French "*Journal Officiel*" publishes such of these regulations as relate to oil, providing as follows:—

Art. 34. The consignment, the sale, and the offering and placing for sale, of any oil other than olive oil are prohibited.

Art. 35. Oil extracted by a mechanical or chemical process from oil-cake shall not be consigned, sold, or placed for sale, except under the denomination of olive-cake oil.

Art. 36. Any other vegetable or animal oil shall not be consigned, sold, or offered for sale, except under the name of the substance from which it is extracted.

Art. 37. The mixture of olive oil with other oils shall not be consigned, sold, or offered for sale, except under the name of the oils entering into its composition.

Art. 38. Receptacles containing the cake-oil or other vegetable or animal oils should bear such an inscription in indelible characters of the nature of the oil: cake-oil, cotton-seed oil, mendolu oil, sesamum oil, fish-oil, &c., according to origin.

Art. 39 *et seq.* Offenders may be punished, as the case may be, by imprisonment from one month to a year, and by fines varying between 10,000 and 500,000 reis.—*Board of Trade Journal.*

### Proposed Increase in the Ether and Honey Duties in Germany.

The German Government have laid before the Reichstag a Bill for the revision of the Customs tariff. Among other alterations, the measure increases the import duty upon honey, not in the comb, from 20 m. to 36 m. per 100 kilos. (=9*s.* to 16*s.* 3*d.* per cwt.). The present duty is one of 20 m. for all kinds of honey, and comb-honey will be kept at that figure. The reason given for the proposed increase is that a great part of the substance now imported as honey is in reality nothing but glucose, and that artificial honey is now prepared in such a manner that it cannot be chemically distinguished from the natural product (*sic!*). Hence the sugar-duty, having been increased to 36 m. per 100 kilos. some time ago, it is now proposed to apply the same tax to honey, which may possibly consist partly or wholly of sugar. The duty on ether of all kinds (excepting sulphuric ether) is to be raised from 20 m. to 180 m. per 100 kilos., on the ground that the German manufacturers are compelled to use duty-paid spirit in the preparation of ethers, and that this duty amounts at present to 80 m. per hectolitre, which gives the foreign maker, who uses duty-free alcohol, an unfair advantage. The importation of ether into Germany has advanced from an average of 6,000 kilos. from 1880 to 1889; to 90,100 kilos. in 1891; 29,600 kilos. in 1892; and 31,300 kilos. in 1893. Sulphuric ether, which is made in Germany from duty-free spirit, is to remain dutiable at the rate of 20 m. per 100 kilos.—*Chemist and Druggist.*

### Drug-growing in British India.

We have recently received the Annual Administration Report on the Government Botanical Gardens and Parks, Nilgiri Hills, India, for the year ending March 31st, 1894. It contains several paragraphs of interest to pharmacists. The Botanical Gardens receive frequent inquiries for drugs and other products suitable for acclimatisation in India and are also often asked to identify specimens.

#### *Marathi Buds and Mathan Mast.*

Thus, in January last, Mr. Ommanney, of the Indian Hemp Commission, sent for identification samples of two native drugs, known as Marathi buds and Mathan mast, which are said to be frequently mixed with the hemp sold in bazaars for consumption, being reputed to increase the intoxicating properties of that article. The *Marathi buds* proved to be those of an *Eriolæna*, most probably *Eriolæna quinquilocularis*; and the *Mathan mast* the pollen-bearing scales of some *Cycas*, probably *Cycas circinalis*, but much smaller than usually found in that species. Neither of these drugs is known to possess intoxicating properties; the order *Sterculiaceæ*, to which the *Eriolænas* belong, is noted chiefly for its mucilaginous matters, and the *Cycas circinalis* contains no alkaloid or other principle that would account for its reputed narcotic action, so that the introduction of these two substances into hemp mixtures may be regarded as innocuous.

#### *Rubber-yielding Trees.*

Ceará and Castilloa rubber-trees have been cultivated in the Barliyar Gardens for several years, and have been tapped more than once, always with the most disappointing results so far as quantitative yield goes, though the Castilloa rubber, when purified, is of splendid quality. There is some doubt whether the unsatisfactory result of the operations be not due to the want of skill in tapping. It is therefore suggested that Government should send an expert rubber-tapper from Assam to try his hand on the trees.

#### *Eucalyptus Oil.*

Eucalyptus oil is now distilled in the Madras Presidency by private distillers in sufficient quantities to supply all the local requirements. One of the distillers has sent samples of his oil to London for examination, and was informed that it was of good quality and could probably compete successfully with many brands of *Globulus* oil. The colour, however, was rather dark.

#### *Gums Tragacanth and Ammoniacum.*

The Madras Government have also been asked by a planter at Nadivatam to procure for him, through the British Consuls in Persia, seeds of the tragacanth and ammoniacum plants. It is not considered likely, however, that either of these plants would do well on the moist western slopes of the Nilgiri Hills, as they require a high elevation where the climate is hot and dry in summer and cold in winter.

#### *Erythroxylon Coca.*

About 2,000 cuttings are now being raised in the hothouses in the Government Gardens at Ootacamund, half of which may be expected to grow into plants fit for planting out in July 1895. The coca fruits freely, and can be grown readily from cuttings, so that in a few years a large area can be placed under cultivation. At present it is not known to be attacked by any disease. Mr. Hooper some years ago made a small quantity of the hydrochlorate of cocaine, and reported that it could be easily manufactured in Madras. There can be no doubt that the *Erythroxylon Coca* can be grown in abundance on the Nilgiris: but it is not likely that it would prove remunerative to planters, because from 300 to 400 lbs. of very carefully dried leaves are required to produce 1 lb. of cocaine.—*Ibid.*

### Sulphuric Acid Making in Queensland.

At a recent meeting of the Balmoral (Queensland) Divisional Board, permission was granted, though not without some opposition, to Messrs. Elliott Brothers to establish chemical works, mainly for the manufacture of sulphuric acid at Bulimba, near Queensport. Mr. Elliott, who was present to support the application, said that the local manufacture of sulphuric acid would reduce the cost of that chemical, which is now imported from Sydney, from 25*l.* to 5*l.* per ton. The works will give employment to about 20 men at first; but it is expected that they will become the nucleus of a great industry, and indirectly, in a short time, will give employment to hundreds.—*Ibid.*

### Bismuth in the United States.

We recently announced the alleged discovery of bismuth-ore in Michigan, U.S.A. Further details on the subject hava been received, from which it appears that the discovery was made by some men engaged in prospecting for a continuation of the Ropes gold-mine vein near Ishpiming. From present indications a large quantity of the mineral has been found. An analysis of the Ropes rock shows it contains metal in sufficient quantity and quality to afford profit. There are apparently many thousands of tons of the rock holding the mineral, and it is said that the process of separating the bismuth from the rock is simple, and can be carried out very cheaply.—*Ironmonger.*

### Bismuth and Platinum in New South Wales.

The annual report of the N.S.W. Department of Mines and Agriculture mentions that mining for bismuth is nearly a dead letter in the colony. The Great Jinjera Company at Pambula sent away a few tons of bismuth ore during the year, but the mine is now shut down. On the Red Range, about 15 miles from Glen Innes, some old workings that were worked for bismuth some years ago are being reopened. The platinum found in the northern sea-beaches bordering the Clarence and Richmond mining district in New South Wales, although occurring in payable quantities, has not yet received much attention. Several leases have been granted, but so far, only one has been exploited, with the result that there is a considerable quantity of concentrates on hand. The extreme fineness of the metal found, and the want of knowledge how to separate it from its associated minerals, renders it of little commercial value to the miners of the district at present. Large deposits of chrome ore have been found during the year at Gundagai, but the principal deposit is on private land, and as capital will be required to open up the mines, no practical results have followed the discovery.—*Chemist and Druggist.*

### A Standard of Light.

The Imperial Institute at Berlin has approved an apparatus intended to give a unit of light as nearly constant as possible, and capable of being reproduced without change under similar conditions. The apparatus is somewhat complicated, but it is claimed the margin of error is not over 1 per cent. The standard is the light given out by a square centimetre of platinum leaf heated to a fixed temperature by an electric current. The complications in the apparatus are mainly due to the arrangements for regulating the current.—*Engineering and Mining Journal.*

### Utilising Blast-Furnace Slag.

*Engineering and Mining Journal, 29.12.94, p. 607.*

Another use for blast-furnace slag is suggested by "L'Industrie." It is pointed out that refined slag is a silicate of the basic type, the silicon being present as dioxide. It contains less silica and more basic oxides than acid silicates of various types. Now, the fusibility of these depends upon the fusibility of the oxides they contain. Therefore, double silicates are less fusible than the corresponding simple ones when their basic constituents are more fusible than silica, and the contrary is the case when they are less fusible than silica. Now the basic constituents of this slag are less fusible than silica. Therefore, a mixture of slag and quartz or sand, made so that the two materials shall be in the same proportions as they are found in their double silicates, will melt at a lower temperature than slag alone, and the melting-point of the mixture will be exactly the temperature at which the silicate obtained may be remelted. The melting-point of this slag is about as high as that of orthoclase (potassium feldspar). The latter only melts at a temperature sufficient to burn porcelain, and its melting-point is not lowered by the addition of silica; the mixture of slag and sand, on the other hand, melts at about the temperature necessary to burn bisque. The compounds formed of silica and feldspar are not transparent, while those formed of silica and slag, or a mixture of feldspar, slag, and silica are; perhaps because feldspar is rich in aluminium, and slag contains but a small percentage of this. The use of slags in manufactories of porcelain and fayence has therefore the following advantages: The glaze can be melted at a lower temperature when refined slag is added to the materials usually employed; *i.e.*, quartz and feldspar. At ordinary temperatures the glaze is clearer if slag be used. The use of slag lessens the amount of glaze necessary for the porcelain—a not unimportant consideration, for the porcelain loses in plasticity as the quantity of enamel is increased. Finally, slag may also be utilised in the manufacture of glass. The advantage of using it differs in different cases, and is largely dependent upon the qualities and relations of the elements which are to enter into the glass. Indeed, the energy with which different silicates enter into combination with each other is dependent largely upon their composition, and especially the proportion of silica they contain. Simple and triple silicates, containing the same bases, combine with each other very readily. Double and triple silicates react on each other with less energy, and simple silicates react very little. Easy and perfect combination of the elements entering into the composition of glass is very conducive to its good quality. Experiments have shown that pure slag is a great help in effecting this.

### Position of Chemical Industry in Italy.

G. Elter. Chem. Zeit. **19**, 34.

A considerable impetus has been given to the chemical industries of Italy during the last few years which promises to be still more marked in the future. The enormous development of the artificial manure trade has been accompanied by a similar increase in the manufacture of sulphuric acid, for which the country is adapted owing to the abundance of raw material. The number of sulphuric acid works has risen in 10 years from 2 to 15, the total production now being 620,000 ctr., of which more than half is employed in the manufacture of superphosphate.

One large works manufactures liquid carbonic anhydride as a by-product in the production of Epsom-salts. In Upper Italy it is proposed to manufacture sodium nitrite, utilising the refuse lead oxide for the production of lead acetate. Tartar emetic is not extensively manufactured, partly owing to the introduction of new dyes and partly to the competition of cheaper antimony salts from Germany. Oxalic acid, tannin, soda, and bleaching powder are not manufactured at all. As regards soda, there is plenty of cheap salt, and the Government would probably support the undertaking; but a larger amount of capital would be required than is available, owing to the prevailing uncertainty. Dextrin, distilled glycerine, water glass, zinc white, acetic, and nitric acids have long been manufactured on a small scale. Repeated attempts to manufacture dyes always failed. It is almost impossible to compete with the German and Swiss works, and the raw material would have to be obtained from England, since Italian tar only contains 1—2 per cent. of benzene.

Arsenic acid is obtained from mineral refuse in sufficient amount for the considerable consumption in Italy. Phosphorus is obtained from France. The consumption in Italy is 10,000 kilos. per annum. It has often been proposed to manufacture phosphorus in Italy, but such an undertaking would not be successful. Many products might be manufactured with advantage, but some of those to which some capitalists and manufacturers seem most inclined would only lead to disappointment. It must not be forgotten that Italy possesses no coal, and is so far dependent on England. Lignite occurs in some districts, and in Upper Italy great water-power is nearly everywhere available.—N. H. J. M.

### NITRATE OF SODA.

*Shipments, Consumption, Stocks, and Prices, from* 1891 *to* 1894.

| — | | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| Shipments from South American ports to all parts for the six months ending 31st December. | Tons | 494,000 | 373,000 | 550,000 | 623,000 |
| Do. for the 12 months ending 31st December .................... | „ | 759,000 | 784,000 | 939,000 | 1,073,000 |
| Afloat for Europe on 31st December .......................... | „ | 321,000 | 215,000 | 358,000 | 393,000 |
| Stocks in United Kingdom ports:— | | 23,000 | 20,000 | 9,100 | 17,300 |

| — | | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| Liverpool................ | Tons | 7,000 | 9,000 | 2,000 | 4,250 |
| London.................. | „ | 3,900 | 3,500 | 3,300 | 1,000 |
| Out ports................ | „ | 12,100 | 7,500 | 3,800 | 12,050 |

| — | | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|
| Stocks in Continental ports on 31st December.................. | Tons | 191,000 | 185,000 | 92,900 | 101,700 |
| Consumption in United Kingdom for the six months ending 31st December. | „ | 30,000 | 33,000 | 29,000 | 29,600 |
| Do. in Continent do. do........................... | „ | 153,000 | 192,000 | 231,000 | 246,500 |
| Do. in United Kingdom for the 12 months do............ | „ | 120,000 | 117,000 | 100,000 | 114,500 |
| Do. in Continent do. do.............................. | „ | 703,000 | 685,000 | 682,000 | 749,500 |
| Do. in United States do. do.......................... | „ | 100,000 | 100,000 | 104,000 | 100,000 |
| Do. *in the World* do. do. ........................... | „ | 923,000 | 902,000 | 886,000 | 964,000 |
| Visible supply on 31st December (including the quantity afloat, for Europo and Stocks in United Kingdom and Continent). | „ | 535,000 | 420,000 | 460,000 | 512,000 |
| Price on 31st December........................................ | per Cwt. | *9s. 1½d.* | *9s. 1½d.* | *9s.* | *8s. 10½d.* |

—W. MONTGOMERY & CO.'S CIRCULAR.

## *W. T. SARGANT AND SONS' ANNUAL METAL CIRCULAR.*

The broad outlines of the metal trade of this Kingdom for 1894 are summed up in a very few words. A further shrinkage of the whole volume of business, and a continuance of unremunerative rates in the best cases, with a further shrinkage of values in the others.

The Board of Trade returns for the exportation of metals from the United Kingdom were as follows:—

| 1894. | 1893. | 1892. | 1891. | 1890. |
|---|---|---|---|---|
| £<br>28,045,527 | £<br>30,837,175 | £<br>33,043,916 | £<br>39,230,009 | £<br>45,251,434 |

| — | | Quotations 31st December. | |
|---|---|---|---|
| | | 1894. | 1893. |
| | | £ s. d. | £ s. d. |
| G.M.B. Scotch iron ........ | Per ton | 2 1 9 | 2 3 6 |
| „ copper.............. | „ | 41 0 0 | 42 16 3 |
| Straits tin................. | „ | 61 0 0 | 74 0 0 |
| Soft pig lead.............. | „ | 9 10 0 | 9 12 6 |
| Spelter.................... | „ | 14 10 0 | 16 15 0 |
| Bar silver ................ | Per oz. | 0 2 $3\frac{7}{16}$ | 0 2 $7\frac{3}{4}$ |

It is generally recommended to pass over unpleasant subjects in the fewest possible words, but the wisdom of this course depends upon circumstances, and we propose to amplify the comparison, which is only one more straw on the camel's back, by stating a few facts, well known, but too much disregarded.

| — | 1873. | Value. | 1894. | Value. |
|---|---|---|---|---|
| | Tons. | £ | Tons. | £ |
| Exports of iron and steel | 2,957,813 | 37,731,239 | 2,656,125 | 18,731,140 |
| Products of British lead mines. | 54,235 | 1,440,000 | 20,000 | 200,000 |
| Products of British tin mines. | 10,000 | 1,300,000 | 8,000 | 560,000 |
| | Acres. | | Acres. | |
| Arable land in cultivation and wheat raised. | 3,900,000 | 39,000,000 | 1,985,000 | 8,000,000 |
| Population of the United Kingdom (census 1871). | 31,629,299 | .. | .. | .. |
| Population of the United Kingdom (census 1891). | .. | .. | 37,870,764 | .. |

Thus in four articles, selected because they are important British productions, there is a decreased value of 52,000,000*l.* as compared with 21 years ago, whilst the population has increased as stated.

Are those people unreasonable who complain that there is something amiss with British industry, or are those statesmen whose only duty it is to see that this nation exists under the most favourable conditions that can be secured for its development, doing their duty by advocating a system of laisser faire? So closely woven are industrial pressure and political chaos, that a little more laisser faire will bring us into the maelstrom of passionate resentment towards those who are too comfortably off to risk a little ease, or a momentary loss of popularity, by advocating changes which they know ought to be made, but fear might excite the opposition of the settled classes, who live on invested incomes and pensions.

Two duties have been clearly neglected by them. The first is the stimulation of our own trade by entering into preferential conditions with our colonies. The second is the refusal of this nation to enter into the Bi-metallic Convention which the other European nations and America were so desirous of doing.

The disadvantages of a high ratio of gold and silver are keenly felt by Eastern traders, but imperfectly understood by labourers, who suffer by the results. The superabundant foreign supplies of wheat and tin, which have so depressed the market value in this country, are both direct results of the large and stimulating payments of silver to the producers in silver-using countries. A further result of the same thing is developing rapidly, by the same stimulus being applied to many articles previously manufactured by England, but now made by natives of the East. This can only be cured by giving them less silver. The surplus silver let free by its demonetisation in the West has fertilised the East to the detriment of the West, and it is clearly the interest of England, as a trading and manufacturing country, not to refuse to adopt with other western nations those means that are best adapted to bring about a substantial rise in the value of silver. By our neglect of this obvious duty our trade and our productive capacity are decreasing by leaps and bounds.

The limitation of the currency produced by the throwing silver out of use is a thing not thoroughly comprehended in many quarters. By what Germany commenced in 1873, and what other nations have since superadded, the currency has been reduced from 1,400,000,000*l.* to 800,000,000*l.* No wonder that a sovereign buys double the quantity of merchandise that it did 20 years ago; but another way of putting the same thing is that a producer of merchandise has to give twice as much merchandise to obtain a sovereign. No doubt bondholders benefit by it, but only by increasing the pressure on the industrious poor who have to bear the severe pressure of taxation to pay the bond-holder's interest. Our apology for this digression is the long continuance and increasing severity of the trade depression in metals.

## Tin.

The tendency of the silver-using countries to displace the gold-using ones, as producers of this metal, is most marked. In 1873 the Straits shipments amounted to 6,963 tons; in 1894 they reached the total of 46,640 tons. In 1885 Bolivia sent to Liverpool 224 tons; in 1894 it sent 3,482 tons.

Per contra Australia, a gold currency country, in 1883 sent forward 11,121 tons, and in 1894 only 5,824 tons, whilst Cornwall, the ancient father of the industry, has steadily declined from 10,000 tons per annum to 8,000 tons in 1894. But it is not only this transfer of quantities that has to be noted. The producers in the silver-using countries are thriving, making handsome profits, whilst Cornish mines are the despair of all connected with them.

The following is a table of results of the 21 best mines there :—

| — | Dividends Paid. | |
|---|---|---|
| | 1893. | 1894. |
| | £ | £ |
| Dolcoath | 33,488 | 4,112 |
| Levant | 2,981 | 785 |
| Carn Brae | 6,000 | 750 |
| East Pool | 7,010 | 2,880 |
| Wheal Granville | 4,500 | 3,150 |
| Tincroft | 4,500 | 2,100 |
| South Condurrow | 1,071 | .. |
| Killifresh | 2,550 | 1,950 |
| West Kirby | 5,100 | 2,700 |
| | 67,230 | 18,427 |
| Calls made in 12 others | 36,522 | 52,040 |

We have further to note that these results of 1894, bad as they are, were obtained whilst Straits tin averaged 68*l.* 14*s.* 2*d.* for the year; now tin has since fallen to 59*l.* 5*s.*, or just about 9*l.* 10*s.* per ton less. That difference, if no further fall takes place, makes a total prospective loss of 88,000*l.* on balance for the 21 best placed mines in the county. Against such cruel and unfair competion they cannot stand. Either by a substantial rise in silver, which it is in the power of the statesmen of this country to obtain, they can revive and flourish; or by the laisser faire all round, they can wither and die; there is no middle course. But to turn from the fortunes of individual producers to the position of aggregate supply and demand, we note that, chiefly owing to a reduced demand from America, instead of an expanding one, the work of the year has resulted in creating a pretty considerable addition to the visible supply. We trust that with low prices consumption will again expand as it has in past years, and that producers will see the wisdom of not killing the goose that lays the golden eggs. In that respect events must be watched, and altering circumstances will necessitate altering views. Meantime it is sufficient to notice that we opened the year at 73*l.* 10*s.* per ton, and closed at 61*l.* Other details for the last 10 years are given below.

*Stocks of Foreign Tin and Quantities Afloat for England. Holland, and America.*

| — | 1894, Dec. 31. | 1893, Dec. 31. | 1892, Dec. 31. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Stock of foreign in London | 8,985 | 4,392 | 2,776 |
| Foreign landing in London | 1,189 | 817 | 1,346 |
| Straits afloat for London, including wire advices. | 3,778 | 3,470 | 2,170 |
| Australian afloat for London, including wire advices. | 650 | 909 | 957 |
| Banca on warrants in Holland | 1,006 | 319 | 868 |
| Billiton in Holland | 1,632 | 640 | 326 |
| „ afloat for Holland | 1,129 | 1,600 | 1,240 |
| Straits stock in Holland | 767 | 670 | 190 |
| Bolivian in Liverpool | 494 | 335 | 220 |
| | 19,630 | 13,152 | 10,093 |
| Estimated stock in America and quantity floating. | 3,820 | 2,730 | 5,492 |
| | 23,450 | 15,882 | 15,585 |
| Trading Co.'s reserves of unsold Banca— | | | |
| Stock in Holland | 5,770 | 4,200 | 3,480 |
| Floating for Holland | .. | .. | 139 |

*Production of Tin.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| English production.............. | 8,000 | 8,213 | 8,614 |
| Straits' shipments to Europe and America. | 46,640 | 39,670 | 34,648 |
| *Australian shipments to Europe and America. | 5,824 | 5,579 | 5,972 |
| Banca sales in Holland ........... | 5,626 | 5,244 | 6,300 |
| Billiter sales in Java and Holland. | 4,735 | 5,462 | 5,560 |
| Bolivian arrivals in England...... | 3,182 | 2,909 | 2,819 |
| | 74,307 | 67,077 | 63,913 |

* Our Australian figures include the shipments to California.

*Consumption of Tin.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Deliveries from London after deducting all shipments to America. | 18,050 | 18,663 | 14,122 |
| Deliveries from Holland after deducting exports to London and America. | 8,207 | 7,853 | 8,719 |
| English consumed at home ....... | 2,314 | 1,473 | 2,772 |
| Exports of English minus quantity shipped to America. | 5,686 | 6,554 | 5,648 |
| American consumption of all sorts | 16,650 | 19,000 | 18,750 |
| Billiton sent to other ports than Holland. | 862 | 1,912 | 9,605 |
| Straits direct to continent less re-exports to America and England. | 11,725 | 8,900 | 5,500 |
| Bolivian delivered from Liverpool. | 3,323 | 2,704 | 2,656 |
| | 66,817 | 67,966 | 60,772 |

*Prices of Foreign Tin.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. |
| Average .............. | 68 14 2 | 85 1 2 | 93 6 8 |
| Highest .............. | 74 0 0 | 95 10 0 | 103 15 0 |
| Lowest ............... | 60 17 6 | 74 0 0 | 88 12 6 |

TIN PLATES.

*Exportations from United Kingdom.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| To United States ........... | 226,879 | 255,583 | 278,479 |
| To other places ............. | 128,202 | 123,650 | 117,101 |
| Total tons .............. | 355,081 | 379,233 | 395,580 |

COPPER.

The shadow of the American depression of 1893 has followed us all through 1894; indeed some of the results were more apparent in 1894 than in 1893. The loss of American consumption in 1893 was followed by the transfer of their surplus to Europe. That commenced in July 1893, and continued till June 1894, during which period 94,849 tons arrived in Europe, as against the normal figure of 40,000 tons. From 1st July to 30th September the arrivals were 18,923 tons, and from 1st October to 31st December, 15,533 tons. For the first quarter of this year it looks as if 12,000 to 15,000 tons would be quite an outside expectation. By the methods of computing deliveries accepted by the trade as the best approximation that can be obtained, the declared deliveries of 1893 considerably overstated the actual consumption of that year, just as in 1894 the declared deliveries under-estimate it. No doubt by joining the two years we get the correct figures; and we think that for 1895 we start with the expectation of seeing figures that will accurately represent the position of the trade as regards its consumptive power. On such assumptions we may look forward to our table of supplies showing about 115,000 tons, or at outside 120,000 tons; whilst the deliveries should amount to 140,000 tons, or perhaps 150,000 tons. So far as statistics are concerned, we certainly start with expectations of a good healthy position.

As regards the movements of prices in 1894, they have been confined within a somewhat narrow range, but the tendency on balance has been to establish a lower basis. The extreme range of prices in 1894 has been: opening, 42*l.* 16*s.* 3*d.*; closing, 41*l.*; highest, 43*l.*; lowest, 37*l.* 17*s.* 6*d.*; average, 40*l.* 5*s.* 1*d.*, as against an average of 43*l.* 17*s.* 4*d.* in 1893, with fluctuations between 46*l.* 16*s.* 3*d.*, and 40*l.* 12*s.*

There have been many sensational rumours from time to time about leading finance houses bringing about agreements between producers to restrict production, and regulate prices. We always felt that the practical difficulties were extremely great, and doubted whether the result would be attained. So far as we can ascertain, the project is either abandoned or left to a more convenient opportunity.

*Comparative Statement of the Chief Sources of Copper Supplies.*

| — | | 1894. | 1893. | 1892. |
|---|---|---|---|---|
| | | Tons. | Tons. | Tons. |
| Spain, precipitate and metal imported into L. & S. W. | | 14,610 | 14,575 | 19,741 |
| Produce of pyrites, chiefly Spanish | | 13,681 | 13,788 | 13,599 |
| Spanish produce disposed of in other markets than L. & S. W.* | | 26,000 | 27,000 | 23,000 |
| Lake Superior ..... | United States America | 55,000 | 50,510 | 54,457 |
| Butte District ..... | United States America | 76,000 | 69,300 | 72,026 |
| Arizona District ... | United States America | 21,000 | 19,600 | 17,160 |
| Other United States supplies ......... | United States America | 8,000 | 7,800 | 9,000 |
| Chili, year's charters.............. | | 21,350 | 21,750 | 22,385 |
| Sundry minor sources† imports into L. & S. W. | | 13,669 | 14,516 | 19,400 |
| Sundry minor sources imports into France. | | 7,857 | 10,528 | 4,723 |
| Australia, shipments to Europe ... | | 6,700 | 6,650 | 4,800 |
| Germany ........................ | | 17,000 | 17,250 | 17,960 |
| Japan, surplus shipped to Europe. | | 3,200 | 2,400 | 4,600 |
| | | 284,067 | 275,667 | 282,941 |

* Estimated roughly. † Cape, New Quebrada, Bolco, &c.

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. |
| Highest............... | 43 0 0 | 46 16 3 | 48 0 0 |
| Lowest ............... | 37 17 6 | 40 12 6 | 43 7 6 |
| Average of the year... | 40 5 1 | 43 12 4 | 45 9 0 |

Stocks and quantities afloat for England and France :—

| — | 1894. 31st Dec. | 1893. 31st Dec. | 1892. 31st Dec. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Liverpool and Swansea stocks of Chili bars, ores, and regulus, reduced to the standard of fine copper. | 36,937 | 30,014 | 31,270 |
| Other furnace material, same ports | 6,872 | 5,253 | 8,723 |
| Continental stock and afloat ...... | 1,286 | 2,745 | 3,080 |
| London stock, chiefly Australian and Japan. | 5,669 | 4,733 | 7,672 |
| Chilian produce afloat, per mail and wire advices. | 3,000 | 3,700 | 4,050 |
| Australian do., per mail and wire advices. | 900 | 850 | 950 |
| Total tons ............ | 54,664 | 47,295 | 55,745 |

Quantity chartered at West Coast during December, 2,300 tons, making for the year as follows :—

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Estimated fine copper in round numbers. | 21,350 | 21,750 | 22,385 |

*Importation of Pyrites.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| Tons................. | 616,050 | 612,818 | 604,411 |

Yielding of pure copper on the basis of 2¼ per cent. :—

| | | | |
|---|---|---|---|
| Tons................. | 13,681 | 13,788 | 13,599 |

*Importations of Other Sorts of Copper into United Kingdom.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Ore from sundry places........... | 82,805 | 80,798 | 91,919 |
| Regulus from Chili ............... | 1,391 | 6,035 | 4,534 |
| Regulus and precipitate from elsewhere. | 77,454 | 112,675 | 120,634 |
| Chili bars........................ | 13,672 | 11,468 | 14,545 |
| Australian........................ | 5,105 | 4,288 | 3,788 |
| Other sorts ...................... | 37,975 | 26,262 | 16,724 |
| We estimate totals of above to produce in fine copper .........} | 87,000 | 90,000 | 98,000 |

*Summary of Copper Supplies in English Market.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Production of English mines...... | 1,000 | 1,000 | 1,000 |
| Imports of pyrites .......} as above | 13,861 | 13,788 | 13,599 |
| „ „ other sorts} as above | 87,000 | 90,000 | 98,000 |
| | 101,861 | 104,788 | 112,599 |

*Summary of Copper Exported from English Market.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Colonial and foreign ............ | 6,493 | 12,843 | 11,388 |
| English, unwrought............... | 19,457 | 28,344 | 42,301 |
| English, wrought ................ | 15,416 | 17,003 | 16,216 |
| Yellow metal .................... | 15,857 | 14,575 | 14,754 |
| | 57,223 | 72,766 | 84,659 |

## IRON.

During the last quarter of a century there is only one year, 1878, that shows an equally small volume of exports. Whilst increasing competition from Germany and Belgium may account for a small fraction of this unsatisfactory return, there is no doubt that the disturbed finances of India and other countries through the depreciation of silver is causing a suspension of railway extension and other public improvements which cause a large consumption of this metal. As regards home consumption, whilst shipbuilding has been active, railway work has been scarce. To this latter source we are inclined to look for improvement this year. In production, on the whole, there is very little change. Cleveland has increased, but Scotland and Barrow have decreased. Stocks are a little increased, but are very considerably below former years. Prices of pig have moved very little, but that little is in favour of buyers.

*Production.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Scotland .............. | 655,614 | 783,867 | 977,213 |
| Cleveland ............. | 2,963,419 | 2,724,184 | 1,937,469 |
| Barrow ................ | 1,100,120 | 1,133,800 | 1,008,000 |
| Total ............. | 4,718,153 | 4,641,851 | 3,922,682 |

*Stock at End of Year.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| Scotland.............. | 358,599 | 381,790 | 443,646 |
| Cleveland............. | 230,663 | 162,834 | 114,339 |
| Barrow ............... | 275,872 | 210,300 | 88,700 |
| | 865,134 | 754,924 | 646,685 |

*Scotch Pig.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Total production...... | 655,614 | 783,867 | 977,213 |
| Exports and home consumption. | 678,805 | 845,723 | 1,113,244 |
| Stocks on warrant .... | 287,886 | 320,851 | 340,288 |
| Stocks in makers' yards at end of each year. | 70,713 | 60,939 | 103,358 |
| | *s.* *d.* | *s.* *d.* | *s.* *d.* |
| Average price of warrants for whole year. | 42 3¼ | 42 3¾ | 41 10 |
| Highest price......... | 44 2½ | 55 0 | 47 0 |
| Lowest price.......... | 41 3 | 40 2½ | 40 0 |
| Furnaces in blast 31st December. | 73 | 43 | 67 |

*Cleveland Pig, including Hematite, &c.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Total production...... | 2,963,419 | 2,721,184 | 1,937,469 |
| Stock remaining 31st December. | 230,663 | 162,834 | 114,339 |
| | s. d. | s. d. | s. d. |
| Average price of G.M.B. No. 3. | 35 9 | 34 10 | 38 6 |
| Highest price......... | 36 6 | 36 4 | 43 0 |
| Lowest price.......... | 34 9 | 33 $7\frac{1}{2}$ | 35 6 |
| Furnaces in blast 31st December. | 94 | 84 | 91 |

*Hematite Iron in West Cumberland and Barrow Districts.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Total production...... | 1,100,120 | 1,133,800 | 1,008,000 |
| Stock remaining 31st December. | 275,872 | 210,300 | 88,700 |
| | s. d. | s. d. | s. d. |
| Average price of year . | 44 $3\frac{1}{2}$ | 45 $2\frac{3}{4}$ | 48 $1\frac{3}{4}$ |
| Highest price......... | 45 11 | 46 3 | 50 4 |
| Lowest price.......... | 42 9 | 44 $6\frac{1}{2}$ | 45 6 |
| Furnaces in blast 31st December. | 31 | 33 | 40 |

*Exports of Iron and Steel to United States of America for last Three Years.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Pigs .................. | 11,949 | 32,057 | 43,587 |
| Bars, &c............... | 992 | 2,174 | 2,565 |
| Rails ................. | 234 | 947 | 353 |
| Hoops, &c. ............ | 5,854 | 23,564 | 16,560 |
| Cast .................. | 2,432 | 4,296 | 4,036 |
| Old.................... | 1,447 | 4,601 | 15,910 |
| Unwrought steel...... | 23,960 | 19,410 | 20,849 |
| Total tons....... | 46,868 | 87,049 | 103,860 |

*Total Exports of Iron and Steel from United Kingdom.*

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| Quantity in tons...... | 2,656,125 | 2,857,743 | 2,740,217 |
| | £ | £ | £ |
| Value in sterling...... | 18,731,140 | 20,614,155 | 21,763,190 |

### LEAD.

Notwithstanding a decided fall off in the supply, the market has been dull. At the period of greatest depression 9*l.* was accepted, but the close is about 9*l.* 15*s.* for soft pig.

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Production of British mines. | 20.000 | 21,000 | 25,000* |
| Importation of foreign into United Kingdom. | 161,372 | 191,174 | 182,782 |
| Exports from United Kingdom. | 47,146 | 48,935 | 58,101 |
| | £ s. d. | £ s. d. | £ s. d. |
| Highest price of soft pig. | 10 2 6 | 10 5 0 | 11 5 0 |
| Lowest price of soft pig. | 9 0 0 | 9 5 0 | 9 17 6 |

* Estimated.

### QUICKSILVER.

There is no feature of interest to report in this article. The importations into London for the season ending 30th November 1894 were 51,114 bottles, against 51,350 bottles. The exports were similarly 41,046 and 42,265 respectively. Assuming a home consumption of 9,000 bottles, the stocks left are about the same. The price has not varied much, but closes at 6*l.* 12*s.* 6*d.*, as against an opening of 6*l.* 5*s.*, and 5*s.* 10*s.* in the spring months.

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Bottles. | Bottles. | Bottles. |
| Imports of Spanish into London.* | 42,414 | 41,670 | 47,321 |
| Ditto Italian*......... | 8,700 | 6,680 | 6,765 |
| Austrian production .. | 15,000 | 15,000 | 15,000 |
| Californian production | 32,000 | 30,164 | 25,554 |
| Total .......... | 98,114 | 96,514 | 94,640 |
| Exports from United Kingdom.* | 41,046 | 42,265 | 46,055 |
| | £ s. d. | £ s. d. | £ s. d. |
| Highest price of Spanish | 6 15 0 | 6 17 6 | 7 15 0 |
| Lowest price of Spanish | 5 10 0 | 6 2 6 | 6 1 0 |

* Calculated November to November.

N.B.—In Borneo, Algeria, Servia, Russia, and Mexico mines exist, but accurate returns are not obtainable.

### SHEET ZINC.

The demand has been poor, and prices have declined pro rata with spelter.

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Importations of foreign into United Kingdom | 18,452 | 18,842 | 19,006 |

Prices realised for London rolled zinc sold in our public sales :—

| | | | |
|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. |
| Highest ............... | 18 10 0 | 20 10 0 | 25 0 0 |
| Lowest ............... | 17 7 6 | 19 10 0 | 21 10 0 |

### SPELTER.

Has had a declining tendency throughout the year, and closes quite 2*l.* per ton cheaper. Lessened demand and inability of the convention of producers to come to terms are given as the reasons for the fall.

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Importations into United Kingdom. | 52,901 | 56,926 | 52,793 |
| | £ s. d. | £ s. d. | £ s. d. |
| Highest price for Silesian. | 16 15 0 | 18 2 6 | 22 15 0 |
| Lowest price for Silesian. | 14 0 0 | 16 15 0 | 17 15 0 |

### ANTIMONY.

Has declined about 5*l.* per ton, owing to the poor demand that has existed. We quote it now at about 32*l.* to 33*l.* per ton.

### BAR SILVER.

Opened at $31\frac{3}{4}d.$, and with intermediate fluctuations closed at $27\frac{7}{16}d.$, being a further fall for the year of $4\frac{5}{16}d.$ per oz. The fall in 1893 was $6\frac{3}{5}d.$ per oz., making a total for the two years of $10\frac{11}{16}d.$ As it is certain that the production has importantly declined during 1894, and will probably still further decline in 1895, we can only attribute this further fall to a diminised Indian demand. The Board of Trade returns for the last three years are as follows:—

| — | 1892. | 1893. | 1894. |
|---|---|---|---|
| | £ | £ | £ |
| Exports to East Indies | 9,450,906 | 8,696,789 | 5,934,173 |
| „ China...... | 230,934 | 2,334,897 | 3,151,189 |
| „ Japan ..... | 2,193,200 | 608,150 | 955,800 |
| | 11,875,040 | 11,639,836 | 10,041,162 |

We presume the returns are made at market value. It would be more valuable in ounces.

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Year ending 31st December | |
|---|---|---|
| | 1893. | 1894. |
| | £ | £ |
| Metals............................ | 20,629,506 | 19,062,612 |
| Chemicals and dyestuffs............ | 6,335,119 | 6,318,268 |
| Oils.............................. | 7,400,905 | 7,505,703 |
| Raw materials for non-textile industries. | 40,988,896 | 43,091,143 |
| Total value of all imports .... | 404,688,178 | 408,505,718 |

### SUMMARY OF EXPORTS.

| Articles. | Year ending 31st December | |
|---|---|---|
| | 1893. | 1894. |
| | £ | £ |
| Metals (other than machinery) .... | 30,837,175 | 28,045,527 |
| Chemicals and medicines .......... | 8,680,313 | 8,496,333 |
| Miscellaneous articles.............. | 29,230,140 | 28,267,710 |
| Total value of all exports..... | 218,094,865 | 216,194,239 |

### IMPORTS OF OILS FOR YEAR ENDING 31ST DECEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Cocoa-nut......... Cwt. | 155,347 | 299,131 | 202,885 | 360,737 |
| Olive ............. Tuns | 17,206 | 26,707 | 652,041 | 894,151 |
| Palm ............. Cwt. | 1,169,943 | 1,138,406 | 1,458,642 | 1,237,719 |
| Petroleum ........ Gall. | 155,125,607 | 163,052,262 | 2,540,760 | 2,484,876 |
| Seed ............. Tons | 30,164 | 29,951 | 718,837 | 653,937 |
| Train, &c.......... Tuns | 19,639 | 24,189 | 389,864 | 413,768 |
| Turpentine ....... Cwt. | 453,235 | 406,862 | 492,220 | 431,382 |
| Other articles .. Value £ | .. | .. | 939,656 | 1,029,133 |
| Total value of oils ... | .. | .. | 7,400,905 | 7,505,703 |

### IMPORTS OF METALS FOR YEAR ENDING 31ST DECEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Copper:— | | | | |
| Ore............. Tons | 80,898 | 82,803 | 486,022 | 493,625 |
| Regulus ........ „ | 118,710 | 78,845 | 2,832,940 | 1,767,965 |
| Unwrought .... „ | 42,021 | 57,052 | 1,914,317 | 2,364,318 |
| Iron:— | | | | |
| Ore............. „ | 4,065,864 | 4,414,802 | 2,792,028 | 2,983,597 |
| Bolt, bar, &c.... „ | 65,820 | 63,247 | 593,033 | 555,558 |
| Steel, unwrought.. „ | 8,934 | 8,588 | 90,506 | 76,859 |
| Lead, pig and sheet „ | 188,249 | 161,372 | 1,855,215 | 1,511,855 |
| Pyrites ........... „ | 612,818 | 616,050 | 1,065,407 | 1,051,702 |
| Quicksilver....... Lb. | 3,939,338 | 3,843,791 | 341,186 | 303,362 |
| Silver ore....... Value £ | .. | .. | 3,069,131 | 2,439,955 |
| Tin ............... Cwt. | 672,162 | 782,951 | 2,892,107 | 2,718,499 |
| Zinc .............. Tons | 56,926 | 52,901 | 1,007,397 | 819,749 |
| Other articles ...Value £ | .. | .. | 1,690,217 | 1,975,568 |
| Total value of metals | .. | .. | 20,629,506 | 19,062,612 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR YEAR ENDING 31ST DECEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Alkali............. Cwt. | 87,703 | 155,657 | 79,104 | 103,824 |
| Bark (tanners', &c.) „ | 318,617 | 319,889 | 121,528 | 124,356 |
| Brimstone ........ „ | 515,115 | 467,925 | 124,797 | 102,628 |
| Chemicals...... Value £ | .. | .. | 1,355,646 | 1,375,287 |
| Cochineal ........ Cwt. | 4,471 | 4,577 | 27,226 | 26,774 |
| Cutch and gambier Tons | 24,913 | 27,470 | 530,726 | 577,815 |
| Dyes:— | | | | |
| Aniline ....... Value £ | .. | .. | 188,386 | 314,629 |
| Alizarin ....... „ | .. | .. | 294,046 | 251,698 |
| Other ........ „ | .. | .. | 21,886 | 32,739 |
| Indigo ........... Cwt. | 66,981 | 59,922 | 1,389,461 | 1,149,057 |
| Nitrate of potash . „ | 242,568 | 289,363 | 213,873 | 265,559 |
| Valonia ........... Tons | 34,815 | 24,508 | 449,196 | 311,119 |
| Other articles... Value £ | .. | .. | 1,539,244 | 1,682,783 |
| Total value of chemicals | .. | .. | 6,335,119 | 6,318,268 |

## Imports of Raw Material for Non-Textile Industries for Year ending 31st December.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 77,022 | 58,252 | 119,983 | 106,527 |
| Bristles.......... Lb. | 3,466,244 | 3,677,327 | 518,757 | 532,816 |
| Caoutchouc...... Cwt. | 293,373 | 303,156 | 3,330,418 | 3,279,147 |
| Gum :— | | | | |
| Arabic......... „ | 65,745 | 53,116 | 169,502 | 135,109 |
| Lac, &c......... „ | 109,463 | 116,359 | 516,016 | 610,870 |
| Gutta-percha .... „ | 40,190 | 46,846 | 303,593 | 416,279 |
| Hides, raw :— | | | | |
| Dry............ „ | 357,115 | 419,225 | 632,036 | 987,922 |
| Wet ........... „ | 589,198 | 608,536 | 1,249,217 | 1,242,229 |
| Ivory ............ „ | 10,018 | 10,394 | 477,001 | 422,735 |
| Manure :— | | | | |
| Guano ......... Tons | 18,311 | 28,207 | 94 721 | 144,111 |
| Bones.......... „ | 44,924 | 88,664 | 198,592 | 412,627 |
| Nitrate of soda... „ | 86,767 | 125,674 | 806,197 | 1,169,153 |
| Phosphate of lime „ | 323,527 | 379,984 | 594,167 | 722,935 |
| Paraffin.......... Cwt. | 768,605 | 617,760 | 813,937 | 633,059 |
| Linen rags....... Tons | 20,750 | 20,956 | 199,155 | 192,098 |
| Esparto.......... „ | 185,450 | 184,910 | 870,431 | 818,116 |
| Pulp of wood .... „ | 215,920 | 280,188 | 1,184,265 | 1,432,747 |
| Rosin............ Cwt. | 1,570,173 | 1,478,544 | 394,252 | 341,161 |
| Tallow and stearin „ | 1,559,397 | 1,837,608 | 2,161,407 | 2,344,773 |
| Tar ..............Barrels | 107,216 | 111,040 | 60,921 | 71,356 |
| Wood :— | | | | |
| Hewn ......... Loads | 2,126,888 | 2,338,036 | 4,048,743 | 4,187,727 |
| Sawn .......... „ | 4,761,717 | 5,446,265 | 10,265,942 | 11,896,500 |
| Staves ......... „ | 131,708 | 132,157 | 512,811 | 540,819 |
| Mahogany ..... Tons | 64,817 | 65,494 | 559,670 | 521,859 |
| Other articles....Value £ | .. | .. | 10,576,772 | 9,898,468 |
| Total value ....... | .. | .. | 40,988,806 | 43,091,143 |

Besides the above, drugs to the value of 797,143*l*. were imported as against 806,282*l*. in 1893.

## Exports of Drugs and Chemicals for Year ending 31st December.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Alkali............ Cwt. | 5,832,700 | 5,979,460 | 1,857,928 | 1,629,779 |
| Bleaching materials „ | 1,327,700 | 1,290,864 | 550,700 | 504,909 |
| Chemical manures. Tons | 352,588 | 355,285 | 2,309,421 | 2,334,569 |
| Medicines....... Value £ | .. | .. | 945,483 | 982,995 |
| Other articles ... „ | .. | .. | 3,016,781 | 3,044,081 |
| Total value .......... | .. | .. | 8,680,313 | 8,496,333 |

## Exports of Metals (other than Machinery) for Year ending 31st December.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Brass........... Cwt. | 115,017 | 108,809 | 458,233 | 404,715 |
| Copper :— | | | | |
| Unwrought ..... „ | 566,884 | 389,152 | 1,367,292 | 851,117 |
| Wrought......... „ | 339,996 | 308,327 | 972,301 | 829,285 |
| Mixed metal .... „ | 290,987 | 317,145 | 682,174 | 687,031 |
| Hardware ..... Value £ | .. | .. | 2,046,606 | 1,838,126 |
| Implements....... „ | .. | .. | 1,226,145 | 1,184,597 |
| Iron and steel..... Tons | 2,856,574 | 2,656,125 | 20,592,577 | 18,731,140 |
| Lead ............. „ | 48,871 | 47,146 | 552,691 | 518,863 |
| Plated wares... Value £ | .. | .. | 300,802 | 306,668 |
| Telegraph wires „ | .. | .. | 1,062,887 | 1,417,446 |
| Tin ............... Cwt. | 134,775 | 117,025 | 606,399 | 432.190 |
| Zinc .............. „ | 194,513 | 184,483 | 158,631 | 127,129 |
| Other articles .. Value £ | .. | .. | 810,527 | 717,215 |
| Total value ......... | .. | .. | 30,837,175 | 28,045,527 |

## Exports of Miscellaneous Articles for Year ending 31st December.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1893. | 1894. | 1893. | 1894. |
| | | | £ | £ |
| Gunpowder...... Lb. | 7,665,300 | 8,247,900 | 194,277 | 198,368 |
| Military stores.. Value £ | .. | .. | 1,014,614 | 1,466,955 |
| Candles.......... Lb. | 19,041,300 | 19,252,500 | 352,670 | 330,799 |
| Caoutchouc ..... Value £ | .. | .. | 1,185,597 | 1,154,632 |
| Cement.......... Tons | 437,565 | 425,925 | 744,424 | 703.951 |
| Products of coal Value £ | .. | .. | 1,275,062 | 1.236,843 |
| Earthenware ... „ | .. | .. | 1,821,468 | 1,607,749 |
| Stoneware ...... „ | .. | .. | 163,256 | 150,671 |
| Glass :— | | | | |
| Plate........... Sq. Ft. | 1,684,500 | 1,336,236 | 86,051 | 72,835 |
| Flint........... Cwt. | 83,539 | 84,843 | 215,982 | 200,234 |
| Bottles......... „ | 639,202 | 634,924 | 305,781 | 302,825 |
| Other kinds.... „ | 194,316 | 177,827 | 158,126 | 140,583 |
| Leather :— | | | | |
| Unwrought .... „ | 145,115 | 136,225 | 1,372,681 | 1,231,283 |
| Wrought ..... Value £ | .. | .. | 322,123 | 279,645 |
| Seed oil.......... Tons | 66,193 | 58,169 | 1,438,070 | 1,220,487 |
| Floorcloth ..... Sq. Yds. | 17,536,600 | 20,165,600 | 706,677 | 751.847 |
| Painters' materials Val. £ | .. | .. | 1,433,780 | 1,374,725 |
| Paper ........... Cwt. | 909,757 | 900,362 | 1,474,280 | 1,413,490 |
| Rags............. Tons | 52,210 | 53,949 | 361,542 | 309,181 |
| Soap ............. Cwt. | 605,083 | 578,870 | 644,259 | 621 754 |
| Total value .......... | .. | .. | 29,230,140 | 28.267,740 |

## *EXTRACTS FROM BOARD OF TRADE RETURNS.*

### SUMMARY OF EXPORTS OF IRON AND STEEL FOR THE PAST TEN YEARS.

| —— | 1885. | 1886. | 1887. | 1888. | 1889. | 1890. | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| United States | 397,668 | 804,580 | 1,282,999 | 639,760 | 574,080 | 522,942 | 437,784 | 384,788 | 347,321 | 278,763 |
| British North America | 178,075 | 228,935 | 218,818 | 228,123 | 235,725 | 212,550 | 188,105 | 177,948 | 239,576 | 128,216 |
| British India | 453,710 | 433,112 | 562,181 | 511,757 | 441,056 | 414,192 | 300,637 | 276,989 | 317,727 | 278,246 |
| British South Africa | 25,256 | 10,424 | 20,102 | 35,030 | 66,613 | 86,305 | 109,069 | 67,626 | 79,813 | 82,612 |
| British West India Islands | .. | .. | 4,811 | 6,223 | 11,194 | 9,183 | 6,417 | 9,220 | 9,769 | 11,146 |
| Australasia | 334,229 | 311,537 | 319,394 | 285,773 | 367,360 | 331,240 | 381,717 | 212,530 | 194,221 | 185,836 |
| Russia | 123,929 | 153,400 | 92,501 | 72,192 | 87,394 | 121,028 | 113,656 | 112,431 | 205,441 | 183,266 |
| Sweden and Norway | 19,579 | 24,303 | 74,126 | 79,583 | 79,350 | 76,422 | 88,545 | 117,143 | 101,304 | 95,637 |
| Germany | 232,884 | 187,540 | 188,585 | 264,819 | 365,146 | 365,100 | 240,722 | 233,716 | 266,819 | 291,893 |
| Holland | 199,561 | 137,910 | 166,649 | 235,021 | 277,464 | 249,992 | 185,258 | 152,460 | 145,543 | 137,912 |
| Belgium | 30,729 | 29,651 | 41,982 | 89,602 | 71,790 | 69,341 | 41,314 | 30,019 | 42,074 | 30,708 |
| France | 97,136 | 65,038 | 47,329 | 71,368 | 65,766 | 80,013 | 71,726 | 64,267 | 61,415 | 52,194 |
| Italy | 93,277 | 101,937 | 257,354 | 113,389 | 169,632 | 149,768 | 111,464 | 113,404 | 147,489 | 153,413 |
| Spain and Canaries | 19,888 | 21,967 | 29,236 | 28,799 | 29,744 | 34,918 | 32,875 | 24,035 | 54,082 | 42,611 |
| Portugal, Azores and Madeira | .. | .. | 18,279 | 19,892 | 20,026 | 15,658 | 14,585 | 13,678 | 33,895 | 27,429 |
| Turkey | 8,913 | 6,764 | 9,961 | 7,989 | 5,622 | 4,420 | 4,946 | 2,765 | 1,884 | 2,395 |
| Egypt | 28,752 | 10,051 | 6,270 | 7,723 | 7,245 | 8,286 | 11,146 | 10,326 | 20,332 | 13,767 |
| Japan | .. | .. | 46,510 | 82,657 | 43,029 | 40,738 | 26,593 | 11,125 | 55,977 | 54,343 |
| China and Hong Kong | .. | .. | 31,764 | 25,743 | 21,300 | 27,462 | 34,557 | 39,318 | 41,843 | 34,197 |
| Mexico | 882 | 2,228 | 7,379 | 23,134 | 41,368 | 54,189 | 23,149 | 26,714 | 10,684 | 13,266 |
| Brazil | 32,472 | 31,173 | 21,017 | 30,920 | 45,840 | 84,041 | 61,830 | 39,827 | 54,255 | 50,590 |
| Peru | 3,272 | 4,202 | 4,597 | 12,705 | 4,606 | 5,866 | 16,386 | 4,572 | 3,917 | 3,798 |
| Chili | 10,137 | 9,394 | 22,216 | 25,314 | 44,454 | 56,535 | 26,640 | 32,803 | 43,111 | 52,710 |
| Argentine Republic | 98,042 | 84,170 | 150,762 | 376,303 | 414,247 | 361,810 | 122,654 | 67,441 | 63,836 | 50,317 |
| Destinations not specified | 712,291 | 729,969 | 495,966 | 592,769 | 698,163 | 619,221 | 589,230 | 525,041 | 315,387 | 405,240 |
| British Possessions | 991,270 | 984,008 | 1,145,306 | 1,167,308 | 1,122,497 | 1,053,776 | 985,975 | 744,314 | 841,136 | 686,686 |
| United States | 397,668 | 804,580 | 1,281,999 | 639,760 | 575,708 | 522,942 | 437,784 | 384,788 | 347,321 | 278,763 |
| Other Foreign Countries | 999,453 | 869,937 | 1,216,757 | 1,567,156 | 1,808,737 | 1,805,640 | 1,228,046 | 1,086,074 | 1,353,899 | 1,287,496 |
| Destinations not specified | 712,291 | 729,969 | 495,966 | 592,760 | 679,240 | 619,221 | 589,230 | 524,103 | 315,387 | 405,240 |
| Total Tonnage | 3,130,682 | 3,388,494 | 4,143 028 | 3,956,984 | 4,186,182 | 4,001,450 | 3,240,146 | 2,739,279 | 2,856,574 | 2,656 145 |
| Value | 21,717,136 | 21,772,951 | 24,992,314 | 26,416,666 | 29,142,129 | 31,565,337 | 26,877,000 | 21,765,768 | 20,592,577 | 18,731,140. |

### SEPARATE STATISTICS OF SHIPMENTS OF WIRE, TIN PLATES AND GALVANISED IRON FOR THE PAST FIVE YEARS.

| ——— | Quantities. | | | | | Value. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1890. | 1891. | 1892. | 1893. | 1894. | 1890. | 1891. | 1892. | 1893. | 1894. |
| | Tons. | Tons. | Tons. | Tons. | Tons. | £ | £ | £ | £ | £ |
| Iron and steel wire (except telegraph wire) and manufactures thereof. | 61,567 | 67,516 | 47,350 | 37,041 | 34,820 | 1,083,175 | 1,143,127 | 793,915 | 647,461 | 921,422 |
| Telegraph wire and apparatus connected therewith. | .. | .. | .. | .. | .. | 1,602,205 | 1,434,020 | 909,917 | 1,662,897 | 1,417,146 |
| Tin plates and sheets | 421,797 | 448,379 | 395,449 | 379,172 | 354,081 | 6,361,477 | 7,166,655 | 5,320,216 | 4,991,300 | 4,330,247 |
| Galvanised iron (flat and corrugated). | 150,726 | 163,490 | 157,119 | 166,668 | 169,832 | .. | .. | .. | .. | .. |

—*Brooker, Dore and Co.*

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### Applications.

24,672. G. Field. *See* Class XVII.

24,829. J. McNeil and H. W. Aitken. Improvements in multiple effect evaporators. December 21.

25,361. C. W. H. Bullard. Improvements connected with thermometers for ascertaining temperatures of liquor in mash-tuns, vats, and other vessels. December 31.

1895.

10. W. Brothers. Improvements in or connected with the softening of hard water. Complete Specification. January 1.

104. J. A. Yeadon and W. Adgie. Improvements in revolving retorts or furnaces. January 2.

105. S. Hey.—From The E. J. Roche Green Cutter Company, United States. Improvements in machines for comminuting bone and vegetable matter. January 2.

108. J. Osman. Improvements in continuous firing kilns. January 2.

129. R. Tervet, jun. *See* Class VII.

211. R. W. Woosnam and The Dairy Supply Co. Lim. Improvements in apparatus for cooling milk and other liquids. January 3.

219. F. Woodhead. Improvements in or relating to machinery or apparatus for the manufacture of saggars and quarries. January 3.

458. F. W. Eames and H. Cressy. *See* Class XVI.

617. J. Foster. Improvements in and relating to evaporating apparatus. January 10.

695. J. Pinfold. Improvements in or connected with filtering apparatus. January 11.

713. D. Rae. Improvements in topping pans for brewers' and others use. January 11.

736. R. W. Hill. Electric alarm detector and valve for chlorine gas. January 11.

803. G. Morris and H. L. Wethered. *See* Class XVII.

827. N. Yagn and S. Bessonoff. Improvements in distilling apparatus. January 12.

### Complete Specifications Accepted.*

1894.

58. A. W. T. Hulssner and F. W. P. Rohrig. Improvements relating to the process and means for clarifying and filtering liquids. January 9.

575. A. L. G. Dehne. Improvements in filter presses. December 26.

1135. B. G. Martin and M. J. M'Mullin. Improvements in filtering plant for the purification of water or other fluids. January 9.

1303. S. Trivick, C. J. A. Head, and P. A. J. Head. Improvements in reversing regenerative furnaces for metallurgical and other purposes. January 16.

1703. W. Ramsbottom. Improvement in filters specially designed for treating sewage or other fouled waters. December 26.

2944. R. A. Grosse. Improvements in toluol thermometers. December 31.

3799. W. Pinder and J. Willoughby. Improvements in the method of and apparatus for controlling the supply of air to furnaces. December 31.

4069. O. Hamilton. An improved heating apparatus more particularly applicable to chemical processes. January 9.

4350. A. Normandy. Improvements in apparatus for evaporating and condensing water. January 9.

5686. T. Lohnstein. An improved float for determining the absolute weight and specific gravity of solid and fluid bodies. January 16.

17,274. T. Craney. Improvements in apparatus for drying salt and other substances. January 9.

21,633. H. H. Lake.—From H. See. Improvements in evaporating apparatus. January 16.

23,031. H. J. Haddan.—From The Ferry Manufacturing Company. Improvements in apparatus for carbonating liquids. December 31.

23,032. H. J. Haddan.—From the Ferry Manufacturing Company. Improvements in the method of and means for carbonating liquids. December 31.

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## II.—FUEL, GAS, AND LIGHT.

### Applications.

24,620. C. W. Claybourne. Improvements in and relating to apparatus for and method of burning coal dust or other granulated or powdered fuel. Complete Specification. December 18.

24,624. J. L. Hastings and C. D. Hauk. Improvements in and relating to the method of and apparatus for manufacturing gas. Complete Specification. December 18.

24,944. F. Boocock. An improved firebrick or block for house fires. December 22.

25,001. E. Stauber. An improved process for the production of peat briquettes. Complete Specification. December 22.

25,367. F. Stroehmer and P. Fecht. Improved process and apparatus for the manufacture of gas. December 31.

1895.

16. S. Schofield. Improvements in the means of method of enriching coal gas. January 1.

135. A. Surry-Montant and F. J. Llohammer. A new and improved composition for the mantles and similar bodies used in incandescent lighting with gas and other flames. January 2.

179. W. J. Radford and A. H. Knipe. Improvements relating to candles. January 3.

209. J. L. O'Flyn and A. Beaugeois. Improvements in the manufacture of briquettes for use as fuel, and apparatus therefor. January 3.

283. G. Huttemann and G. Spiecker. Improvements in the manufacture of blocks or briquettes of fuel. Complete Specification. January 4.

748. M. Otto. Apparatus for transforming oxygen into ozone. January 11.

756. J. Blum. Improvements in the manufacture of producer and other combustible gas, and in apparatus therefor. January 11.

### Complete Specifications Accepted.

1893.

20,215. J. A. Wanklyn and W. J. Cooper. Improvements in the manufacture of gas for heating and illumination. December 5.

1894.

1833. H. G. Heid. Improvements in the manufacture of briquettes and patent fuel, and in means and apparatus employed therefor. December 26.

2937. M. Graham. Improvements in and apparatus for charging inclined gas retorts. December 26.

4376. H. Palmer and E. Spain. Improvements in night lights. January 9.

5656. A. Schneller and W. J. Wisse. Improvements in the production of ozone and in apparatus therefor. January 16.

20,998. J. Morrison and T. Booth. An improved apparatus for producing and saving gas. December 31.

22,036. W. H. Biggs and H. R. Greenhow. Improvements in the manufacture of artificial fuel. January 16.

23,996. C. Weygang and The Petroleum Products Syndicate, Lim. Manufacture of artificial fuel from petroleum. January 16.

24,005. A. G. Glasgow. Improvements in the method and apparatus for carburetting water-gas. January 16.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Application.

25,173. J. Meikle. Improvements in treating coal or carbonaceous minerals for the obtainment of ammonia and other products. December 28.

## IV.—COLOURING MATTERS and DYES.

### Applications.

24,999. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of new sulphonic acids deriving from naphthaline, and of colouring matters therefrom. December 22.

25,018. S. Pitt.—From L. Cassella and Co., Germany. New processes for producing polyazo dyestuffs from amidonaphthol-sulpho acids. December 22.

25,075. H. Loesner. Processes for the reduction of aromatic nitro bodies. December 24.

25,213. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of azo-colours on fibre. December 28.

25,214. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters and a new material therefor. December 28.

25,273. H. Imray.—From P. Monnet, France. Improvements in the manufacture of toluene sulpho-chlorides. December 29.

### 1895.

43. A. G. Brookes.—From E. Lauber and L. Caberti, Italy. A new or improved process for the production of insoluble azo-colours on cotton tissues by the use of naphthol solutions containing oxide of tin and oxide of antimony. January 1.

292. A. Liebmann. Process for the production of a new colouring matter. January 4.

306. H. D. B. Wall. *See* Class XIII.

667. G. W. Johnson.—From Glenck and Co., Germany. Improvements in the manufacture and production of dyestuffs of the induline series. January 10.

676. H. H. Lake.—From K. Oehler, Germany. Improvements in the manufacture of colouring matters. January 10.

### Complete Specifications Accepted.

### 1893.

18,908. O. Imray.—From The Farbwerke vormals Meister, Lucius and Brüning. Production of *o*-oxyanthraquinone. January 16.

### 1894.

1228. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of acid compounds derived from gallic acid and hydrides. January 16.

3828. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Improvements in the manufacture of naphthazarine and of new intermediate products related thereto. December 26.

3844. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of a new naphthylenediaminedisulpho acid and of colouring matters therefrom. December 26.

4373. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo-colouring matters. December 31.

4459. S. B. Boulton, T. B. Haywood, H. E. Boulton, and H. Fergusson. Processes for the production of certain salts of beta-sulphonaphthalene and for the separation of alpha- and beta-sulphonaphthalenes. January 9.

4542. R. E. Evans. Manufacture of a new colouring matter. January 9.

5056. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. January 16.

5148. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo-colouring matters and materials therefor. January 16.

5159. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Improvements in the manufacture of colouring matters. December 26.

5267. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo-dyestuffs and materials therefor. January 16.

5722. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Improvements in the manufacture of colouring matters of the alkylated induline series. January 16.

6197. B. Willcox.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new azo-colouring matters. January 16.

7046. C. D. Abel.—From A. Fischesser and Co. Manufacture of 1 naphthylamine, 3, 6, 8 trisulpho acid, from 1 nitronaphthalin, 3, 8 disulpho acid. January 9.

22,533. O. Imray.—From W. J. Matheson and Co. Manufacture of colouring matter from logwood. December 26.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Application.

21,693. W. V. Williams, T. H. Redwood, and A. J. de Hailes. A new and improved method for the treatment of fibres, especially relating to the urticaceae. December 19.

### Complete Specifications Accepted.

### 1893.

21,313. H. H. Boyle. Improved process and apparatus for the treatment of rhea grass and similar fibres for commercial purposes. January 16.

### 1894.

810. A. F. B. Gomess. An improvement in the treatment of textile vegetable fibres. January 9.

4605. E. de Pass.—From J. C. McLauchlin and A. A. Hand. Improvements in the manufacture of fabrics from fibre. December 31.

13,677. E. Richard-Lagerie. *See* Class XII.

22,366. E. Esser and P. Scheider. Machine for treating textile fabrics. December 26.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

### Applications.

25,128. L. Weldon. Improvements in dyeing-machines. Complete Specification. December 27.

1895.

119. L. Frotscher. An improved apparatus for treating spun or woven fibrous materials with dyeing, washing, bleaching, mordanting, and other liquids. Complete Specification. January 2.

256. J. Robb and J. Grime. Improvements in producing white and coloured patterns on cotton fabrics in combination with azo-dyes. January 4.

693. E. Heppenstall and E. Sykes. Improvements in machinery for dyeing loose cotton, wool, and other fibres. January 11.

## VII.—ACIDS, ALKALIS, AND SALTS.

### Applications.

24,651. J. S. Wallace and F. L. Ball. Improvement in or connected with the manufacture of carbon di-oxide. December 18.

24,652. J. S. Wallace and F. L. Ball. Improvements in or connected with the manufacture of carbon di-oxide. December 18.

24,814. J. Raschen, R. H. Davidson, and J. Brock. Improvements in the manufacture of cyanides or ferrocyanides from their corresponding sulpho-cyanides. December 20.

24,859. T. Parker. Improvements in the utilization of waste or spent acid pickle from galvanizing works or other works where iron is treated by acid and in the treatment (for the recovery or obtainment of chlorine) of other products containing chlorine. December 21.

25,860. T. Parker. Improvements in the manufacture of potassium chlorate. December 21.

25,073. R. O. Lorenz. Production of hydrochloric acid form chlorine and of hydrobromic acid from bromine. Complete Specification. December 24.

25,343. H. von Miller and C. Opl. Process for the manufacture of soda and potash respectively from sodium sulphate and potassium sulphate. December 31.

25,368. C. Kellner. Process and apparatus for the separation of salts from their solutions. December 31.

1895.

129. R. Tervet, jun. A new and improved method of and apparatus for extracting sulphur and other substances. January 2.

136. G. T. Beilby. The manufacture of cyanides. January 2.

199. C. Raspe. Improvements in the manufacture of pure ammonium carbonate. January 3.

429. H. Lane and J. Pullman. Improvements in the method of and apparatus for producing carbonic acid gas. January 7.

584. H. R. Lewis and C. Gelstharp. *See* Class X.

609. E. A. Parnell. Improvements in the extraction and production of muriate of ammonia from galvanizer's skimmings. January 10.

### Complete Specifications Accepted.

1894.

2373. J. Pedder. Improved process for effecting the desulphurisation of sodic sulphate. January 16.

4423. R. Wolffenstein. Improvements in the development or preparation of high percentage and of chemically pure super-oxide of hydrogen. December 31.

17,274. T. Craney. *See* Class I.

## VIII.—GLASS, POTTERY, AND EARTHENWARE.

### Applications.

25,067. C. E. Blue, jun. Improvements in moulds for the manufacture of glassware. Complete Specification. December 24.

25,169. E. J. Holmes. *See* Class X.

1895.

116. C. Pryce. Method of prevention of scum and other discoloration on terra-cotta and other clay goods. January 2.

585. T. Ennson. Improvements in and relating to the measuring and delivering of molten glass or other material, and means therefor. January 9.

586. T. Ennson. An improved press for moulding glass. January 9.

587. T. Ennson. Improvements in the process of manufacturing moulded glass. January 9.

### Complete Specifications Accepted.

1894.

3677. J. Hawthorn. Improvements in pottery kilns. December 5.

4081. C. Margot. An improved process for producing indelible ornamentations upon glass or glazed surfaces. January 9.

22,446. H. Guinard. Improved process of making hollow glassware. December 2.

23,974. T. Arrowsmith, H. T. Arrowsmith, and J. Arrowsmith. Improved construction of thimble pins for use in supporting pottery-ware whilst being fired. January 16.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

24,646. J. S. Gabriel. Improvements in the manufacture of cement. December 18.

24,994. J. Scheck. Improvements in building stones and bricks. December 22.

25,177. C. L. Lüders and G. C. M. Lüders. Improvements in cement tiles. Complete Specification. December 28.

1895.

324. J. Foster. Improvements in the construction of kilns for burning limestone, cement, and other similar material. Complete Specification. January 5.

416. The Adamant Co., Lim., and J. Wilkinson. A new or improved fireproof flooring and ceiling. January 7.

641. G. F. Thomson. Improvements in the manufacture of artificial stone roofing, and other tiles and enamel, and in apparatus therefor. January 10.

612. G. F. Thomson. Improvements in the method of treating stone. January 10.

798. C. S. Churton. A new and improved compound for the preservation of timber. January 12.

### Complete Specifications Accepted.

1894.

1370. A. Hooydonk and H. Hooydonk. A new or improved preparation or compound for decorating the interior of buildings. January 16.

4377. R. Astley. Improvements in the construction of fireproof floors. January 9.

5160. C. J. Potter. An improved material for paving and like purposes. January 16.

22,308. C. G. Picking. Improvements in bricks or blocks to be employed in the construction of the floors of fireproof and other buildings. December 26.

## X.—METALLURGY, MINING, Etc.

### Applications.

24,535. M. M. Marcus, G. Buffier, E. Marcellot, and G. Dardespinne. Improvements relating to the manufacture of ferro-zinc alloys with or without other metals. Complete Specification. December 17.

24,569. W. Fairweather.—From The Thomson Electric Welding Co., United States. Method of producing locally annealed steel plates. December 18.

24,782. W. H. Hyatt. A method for extracting gold without the use of water by means of a combined air blast and mercury, and apparatus for effecting same. December 20.

24,815. J. F. Allen and J. Brock. Improvements in alloys of manganese with other metals. December 20.

24,837. C. Dreyfus. Improvements in the utilisation of certain iron residues. December 21.

24,861. T. Parker. Improvements in the treatment of ores known as sulphide ores, for the separation and obtainment of the metals contained therein. December 21.

25,016. M. Crawford. Process of extracting precious metals from their ores. Complete Specification. December 22.

25,026. W. Bickley and J. E. Bickley. Improvements connected with stamping, rolling, forging, or drawing aluminium and its alloys. December 24.

25,169. E. J. Holmes. The application of a metal commonly known as aluminium alloy for engraving purposes, for use in the decoration of pottery ware, or for printing on fabrics and the like materials. December 28.

25,321. H. R. Angel. Improved method of abstracting metallic antimony and other metals from antimony ores and apparatus therefor. December 31.

25,322. A. Lencauchez. Improvements relating to the production of homogeneous cast-iron or steel and to apparatus therefor. Complete Specification. December 31.

1895.

73. E. Fischer, E. Klein, and F. Mahlstedt. Improved method and apparatus for extraction of precious metals from their ores. January 1.

465. T. Hydes. Improvements in the manipulation and treatment of blast-furnace slag and other slag, and in the apparatus therefor. January 8.

469. B. Moebius. Improvements in method of and apparatus for separating metals. Complete Specification. January 8.

568. N. Devisse. Process and apparatus for smelting manganese ores. January 9.

584. H. R. Lewis and C. Gelstharp. An improved method or process and apparatus for obtaining chlorine and zinc in the treatment of ores containing zinc or blende, and other metals and metalloids. January 9.

712. L. Munzing. Process for the electrolytic extraction of nickel and cobalt from ferruginous raw materials. January 11.

801. H. R. Angel. Improvements in the extraction of lead with silver, gold, or other metals from ores blended with sulphide of zinc or otherwise. January 12.

833. J. Mactear. Improvements in the obtainment of precious metals. January 12.

### Complete Specifications Accepted.

1894.

7854. W. A. Thoms and W. H. Burgum. An improvement in the coating of metals with a metallic alloy. January 16.

22,514. A. J. Hobson. An improved metallic alloy for use in the manufacture of pocket cutlery. December 31.

## XI.—ELECTRO-CHEMISTRY and ELECTRO-METALLURGY.

### Applications.

24,541. C. Kellner. Method of and apparatus for effecting electrolysis. December 17.

24,630. H. S. Blackmore. Process of and apparatus for dissociating soluble salts by electrolysis. Complete Specification. December 18.

24,639. J. T. Harris. Improvements in method and apparatus for purifying liquids magnetically, to which may be added electrolysis and aeration. Complete Specification. December 18.

24,714. L. Epstein. Improvements in secondary voltaic batteries. December 19.

25,074. R. O. Lorenz. Process and apparatus for the production of zinc and lead by electrolysis of the melted chlorides. December 24.

25,080. T. T. Oliver. Improvements in or relating to the separation of metals by electric action. Complete Specification. December 24.

25,132. J. C. Dagoneau. A method of and means for economically producing electricity. December 27.

25,145. J. C. Mewburn. From La Société L'Electrolyse, France. Improvements in the production of copper by electrolysis, and in apparatus employed therein. December 27.

25,197. G. Platner. Improvements relating to the charging-materials for primary and secondary galvanic elements. December 28.

25,264. J. B. Torres. Improvements in electric or galvanic batteries. December 29.

25,289. V. Ludvigsen. An improved primary battery. Complete Specification. December 29.

1895.

106. E. M. Levetus, H. Levetus, and W. Rowbotham. Improvements in primary batteries. January 2.

107. E. M. Levetus, H. Levetus, and W. Rowbotham. Improvements in primary batteries. January 2.

231. E. M. Levetus, H. Levetus, and W. Rowbotham. Improvements in primary batteries. January 4.

297. C. F. Claus, jun., and H. S. Sutton. Improvements in the electrolytic treatment of tin and its separation from alloys and mechanical mixtures. January 4.

358. J. Wershoven. Improvements electrodes for secondary batteries. January 5.

396. A. Slatter. An improved grid for secondary battery plates. January 7.

432. E. Ageron and A. Fournier. Improvements in electric accumulators or secondary batteries. January 7.

563. I. Klein. Process for compressing and moulding electrolytically obtained metallic precipitates. Complete Specification. January 9.

632. E. Ageron and A. Fournier. Improvements in galvanic or primary electric generators. January 10.

737. R. W. Hill. Production of aluminium and generator of electricity. January 11.

807. W. Siepermann and H. Riegermann. A process for the electrolytic decomposition of alkaline chlorides. January 12.

816. R. W. Hill. Production of gaseous ammonia by electricity. January 12.

817. R. W. Hill. Production of nitric acid by electricity. January 12.

### Complete Specifications Accepted.

1894.

669. C. J. Wollaston. Improvements in electric batteries. January 9.

2806. C. Kellner. Improvements in electrolytical decomposing apparatus. January 16.

3725. T. Blackhurst. Dry or semi-dry galvanic elements. January 16.

4113. H. T. Barnett. Improvements in electric batteries. December 31.

4325. A. H. Harris. Improvements in the electrodeposition of aluminium. January 9.

4721. O. March. Improvements in and relating to secondary batteries. January 16.

8808. R. McLauchlan McDonald and A. McDonald. Improvement in electric batteries. January 9.

9129. H. Blumenberg, jun. Improvements in electrolysis January 16.

23,441. J. C. Fuller and G. Fuller. Improvements in and connected with galvanic batteries. January 9.

23,553. L. Wagner and J. Marr. Improvements in apparatus for the electrical treatment of beer or other liquid or material. January 16.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

24,669. J. McLaren. Improvements in the cleansing powers of soap. December 19.

25,324. E. Andreoli. Treatment of drying oils. Filed December 31. Date applied for, July 20, 1894, being date of application in Belgium.

### Complete Specifications Accepted.

1894.

13,677. E. Richard-Lagerie. Improvements in furnaces for extracting potash from the grease contained in sheeps' wool. January 16.

16,040. S. Neumann. Improvements in or connected with the manufacture of fluorescent soaps. January 9.

19,968. H. Whitbread. An improved saponaceous compound. December 26.

1895.

23,054. H. Heaton. Improvements in dry soap. December 31.

23,995. C. Weygang and the Petroleum Products Syndicate, Limited. Manufacture of saponaceous products from petroleum. January 16.

24,080. D. H. McClelland and R. D. Jackson. Improvements in and connected with oil purifiers. January 16.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

24,673. R. Hutchison and J. Binnie. Improvements in treating gutta-percha. December 19.

24,799. G. Pommerhanz. Improvements in the manufacture of varnish. December 20.

24,830. W. Moody and M. N. d'Andria. Improvements in and connected with the manufacture of white-lead pigment. December 21.

1895.

306. H. D. B. Wall. Improvements in and connected with the manufacture of pigments or colours. January 5.

414. F. Crane. Improvements in or relating to paints or driers. January 7.

478. F. Ellershausen. Improvements in the manufacture of rubber. January 8.

622. W. P. Thompson.—From C. Reich, Germany. Improvements in the manufacture of liquid bronze and the like. January 10.

### Complete Specification Accepted.

1893.

24,695. C. U. King and R. V. Jellicoe. Improvements in materials or compounds adapted for use in varnishes as substitutes for india-rubber, gutta-percha, and like substances, and for other purposes, and the process for their production. December 26.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

24,735. O. Finsen. The preparation of hæmo-albumen. Complete Specification. December 19.

24,877. P. C. D. Castle. *See* Class XVI.

25,225. G. Feith. An improved manufacture of leather. December 28.

25,362. G. Bertin. Improved process for rendering hides and skins waterproof and impervious. December 31.

1895.

615. G. Seeligmann. A new or improved method and apparatus for testing the adhesiveness of glue and such like. Complete Specification. January 10.

### Complete Specifications Accepted.

1894.

2517. W. H. Jeansson. Improvements in the treatment of leather. January 9.

4696. A. Zimmermann.—From The Chemische Fabrik auf Actien vormals E. Schering. Improvements in the treatment and testing of gelatinous matter. January 16.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

24,511. R. C. Garton and C. H. Meyer. An improved method of manufacturing from starch or starchy substances a material suitable for use in brewing and for other purposes. December 17.

24,877. P. C. D. Castle. Improvements in or appertaining to the utilisation of a waste or nearly waste product, and the manufacture of a useful gum or gummy compound therefrom. December 21.

25,242. J. Hilton. Starch and linen gloss for laundry purposes. Complete Specification. December 29.

1895.

458. F. W. Eames and H. Cressy. A new apparatus for rapidly cooling sugar or analogous material in a liquid form. January 8.

603. T. W. T. Carran. Improvements in apparatus for the evaporation of saccharine solutions. January 10.

623. J. F. Nagel and Co. Process for manufacturing pure dextrose. January 10.

791. E. A. Loesch. Perfumed starch glosine. January 12.

### Complete Specifications Accepted.

1893.

24,718. S. Touyarou. Improvements in the manufacture of sugar and in machinery therefor. December 26.

1894.

17,744. L. I. N. Norman. Improvements in the manufacture of brewing syrup. December 26.

22,726. J. Y. Johnson.—From T. von Heyden. A new crystallised sweet compound called crystallose, and process for manufacturing the same. Jauuary 16.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

24,511. R. C. Garton and C. H. Meyer. *See* Class XVI.

24,672. G. Field. Improvements in or connected with mixing or blending apparatus for beer or other liquids.

25,078. A. M. Hofmann. Improvements in or relating to the carbonating of beer and other beverages. Complete Specification. December 24.

1895.

174. J. B. Howard.—From H. Rosel, Germany. Improved apparatus for purifying casks and cooling the air passing into casks. January 3.

713. D. Rae. *See* Class I.

803. G. Morris and H. L. Wethered. Improvements in stills or apparatus for distilling spirits and other liquids. Complete Specification. January 12.

### Complete Specifications Accepted.

1894.

3998. C. Rach. Apparatus for brewing. December 31.

4078. C. P. Hendy. Apparatus to prevent waste when fining beers and ales in casks. December 26.

17,309. C. W. Ramsteldt. A Pasteurising apparatus with rotating, heating, and cooling elements. December 26.

17,744. L. I. N. Norman. Improvements in the manufacture of brewing syrup. December 26.

23,553. L. Wagner and J. Marr. Improvements in apparatus for the electrical treatment of beer or other liquid or material. January 16.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

24,637. W. H. Beck.—From G. Christull, United States. Improvements in processes of manufacturing ice. December 15.

24,706. E. Fischer, H. Zedler and E. Klein. Improvements in preparing a substitute for coffee, and apparatus therefor. December 19.

24,997. G. S. Mackenzie.—From Gray, Mackenzie, and Co., Asia Minor. Improvements in the manufacture of food-stuffs from dates in combination with farinaceous and other substances. December 22.

25,123. W. P. Thompson.—From G. B. R. von Poschinger, Germany. An improved process and apparatus for preparing or producing a fodder material. Complete Specification. December 27.

1895.

23. T. B. Milner. Icing liquid. January 1.

146. J. Wetter. — From L. Hentzschel, Germany. Manuufacture of a new or improved milk product. January 2.

720. A. C. Granville. Improved cattle and poultry food. January 11.

#### *B.—Sanitary Chemistry.*

24,783. J. Briggs, D. Briggs, T. Briggs, and B. Briggs. Improvements in or connected with apparatus for filtering and purifying sewage and other impure liquids. December 20.

25,119. T. Craig and A. E. Raper. Improvements in the treatment of wash waters, sewage, and other fouled waters in order to purify the same. December 27.

1895.

166. F. P. Candy. Improvements in and in apparatus for use or in connection with the purification of sewage and impure waters. January 2.

370. A. Hanlon. An apparatus for the destruction by burning of the germs of disease contained in sewer gas. Complete Specification. January 7.

594. W. M. Williams. Improvements in or relating to the treatment of water. January 10.

#### *C.—Disinfectants.*

1895.

11. W. Brothers. Improved antiseptic agent or compound. January 1.

163. G. E. Heyl. An improved preparation for antiseptic and antifermentative purposes for medical and other use. January 2.

360. J. Y. Johnson.—From Lasmolles and Frechon, France. A composition for treating the diseases of the vine and other plants. January 5.

629. J. F. Davies. Improved distributor for insecticide, disinfectant, and other powders. Complete Specification. January 10.

788. S. A. Vasey. Improved compound forming an antiseptic, disinfectant, and deodorant. January 12.

834. M. A. Hicks. A curative or antiseptic compound, applicable for use as a salve or as a plaster or the like. January 12.

### Complete Specifications Accepted.

#### *A.—Chemistry of Foods.*

1894.

3413. R. C. Wilson. Improvements in or connected with the manufacture of salt. December 31.

4049. A. L. Lebret. An improved food compound having for its base milk. December 26.

4050. A. L. Lebret. An improved food compound having for its base milk. December 26

9626. H. E. Hansem. Method of producing condensed milk. January 9.

#### *B.—Sanitary Chemistry.*

1894.

3969. H. Lockwood. Improvements in the purification of sewage and other foul waters. December 26.

7992. R. Schneider. Improvements in and apparatus for the utilisation of refuse. December 26.

20,711. E. W. Ives. An improved system and apparatus for purifying sewage or other foul or waste waters. January 9.

### *C.—Disinfectants.*

1894.

5288. A. Kraus and A. Chevrier. An improved manufacture of an antiseptic and microbicide. January 16.

23,135. C. T. Gardner. An improved sterilizing, disinfecting, and deodorising fluid, applicable also for use as an insecticide. January 16.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

24,614. G. K. Littlefield. Improvements relating to the moulding of articles from vegetable fibrous material. Complete Specification. December 18.

24,826. H. Sweetapple. Improvements connected with the manufacture of vegetable parchment paper. December 21.

25,359. A. F. Spooner.—From P. Patois, France. Improvements in the manufacture of whalebone and the like in continuous strips. December 31.

### Complete Specification Accepted.

1894.

409. C. F. Cross. Treatment of wood for the manufacture of cellulose and other products. January 9.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

24,713. C. D. Abel.—From J. C. W. F. Tiemann. Process for the manufacture of pseudo-ionon. December 19.

24,901. O. Imray.—From the Farbwerke vormals Meister, Lucius and Brüning, Germany. Manufacture of new carbonic esters of acylamido-phenols and of their alkylised derivatives. December 21.

25,311. F. Sahlfeld. Improvements in the production of fish extracts. December 31.

1895.

154. G. Tobias. Improvements relating to the manufacture of salts of pyrocatechindisulpho-acid and of pyrocatechin therefrom. Complete Specification. January 2.

417. W. Mallmann. An improved manufacture of musk-like substances. Complete Specification. January 7.

### Complete Specifications Accepted.

1894.

4097. J. Y. Johnson.—From C. F. Boehringer and Söhne. The treatment of ergot of rye and the production therefrom of the substance which imparts to it its valuable properties. December 31.

22,902. F. Ludy. Manufacture of bismuthoxyiodidegallate. December 31.

## XXI.—PHOTOGRAPHIC PROCESSES and MATERIALS.

### Complete Specifications Accepted.

4606. C. E. Petitt. Improvements in the manufacture of sensitive plates and films for photographic purposes. January 9.

4689. J. R. C. Gale and J. W. T. Cadett. Improvements in the preparation, packing, and storing of photographic chemical compounds. January 16.

22,952. A. G. Adamson. Improvements in and connected with the developing of photographs. December 31.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

25,058. J. Watson. Improvements in the manufacture of igniferous fuses. December 24.

25,151. M. Reuland. Improvements in the method of and apparatus for the manufacture of explosives. December 27.

### Complete Specifications Accepted.

1894.

3743. E. Hesketh and A. Marcet. Improvements in or connected with the manufacture of gun-cotton or other manufactures in which cooling water liable to become acidulated is employed. January 9.

20,786. E. B. Beeches and J. P. Wright. Improvements in and relating to machines for making matches. January 9.

22,192. Siemens Bros. and Co., Lim., and A. S. Schloemer. An electric exploder. December 26.

## XXIII.—ANALYTICAL CHEMISTRY.

### Applications.

24,786. E. Hérissé. An improved composition for the production of moulded articles. December 20.

24,988. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of chemical compounds. December 22.

25,071. E. F. Okell. An improved solvent of oil, grease, and other fatty matters. December 24.

1895.

662. G. W. Peipers. A new or improved process for determining the carbonaceous value of iron. January 10.

## PATENT UNCLASSIFIABLE.

### Application.

138. H. Albert. An improved manufacture of a carbonaceous absorbent. January 2.

# THE JOURNAL
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## A MONTHLY RECORD
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## NOTICES.

The Annual General Meeting will be held in Leeds in the month of July next. Full particulars will appear in a subsequent issue.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l*., instead of 15*l*. as heretofore, after the 1st January 1895.

### BANKERS' ORDERS.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

## LIST OF MEMBERS ELECTED 22nd FEBRUARY 1895.

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Auchterlonie, Wm., jun., Canal Bank House, Paisley, N.B., Analytical Chemist.

Colchester, G. H., Burwell, near Cambridge, Chemical Manure Manufacturer.

Cooper, Bertwin, 9, North Street, Derby, Colour Manufacturer.

Dorsey, Grafton D., 135, Marshall Street, Brooklyn, N.Y., White Lead and Oil Works Superintendent.

Earle, Vavasour, Porchester Lodge, Streatham Common, S.W., Merchant.

Forbes, Paul R., 614, Sears Building, Boston, Mass., U.S.A., Chemist and Assayer.

Jamison, Alf. C., Junction Dyewood Mills, Hyde, Manchester, Dyewood Extract Manufacturer.

Lossen, Dr. C., 209, River Street, Hoboken, N.J., U.S.A., Mining Chemist.

McDougall, Isaac, Redhill, Wateringbury, Kent, Student.

McDougall, Isaac S., High Bank, Didsbury, Manchester, Manufacturing Chemist.

Stevenson, Jno., 14, Church Row, Limehouse, E., Analytical Chemist.

Taber, G. H., jun., 1531, South Broad Street, Philadelphia, Pa., U.S.A., Superintendent of Lubricating Department.

Thompson, Gustave W., c/o National Lead Co., Marshall Street, Brooklyn, N.Y., U.S.A., Chemist.

Waddington, Thomas W., 8, Albert Street, Padiham, Lancashire, River Inspector.

Wardman, G. B., c/o J. L. Elliot, Ahualulco, Estado de Jalisco, Mexico, Chemist.

## CHANGES OF ADDRESS.

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Dickinson, A. J.; Journals to 4, Shardeloes Road, New Cross, S.E.

Goodall, Reginald, l/o Highgate Road; (subs.) Camden Works, Camden Town, N.W.; and (Journals) The Grove, Pinner.

Habirshaw, W. M., l/o Front Street; 315, Madison Avenue, New York, U.S.A.

Hawkins, J. D., l/o Denver; The El Paso Reduction Co., Gillett, Colo., U.S.A.

Hecht, Jos., l/o Philadelphia; 2667, Commercial Street, Ravenswood, Ill., U.S.A.

Herriot, W. Scott; retain Journals until further notice.

Herzmann, Dr. M., l/o Maida Vale; 4, Woburn Place, W.C.

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Jennison, F. H., l/o Moscow; Hollywell House, Armley, Leeds.

Johnson, E. E., l/o Manchester; The Warren Hill, Loughton, Essex.

Jones, Prof. D. E., l/o Aberystwith; 4, Berthwyn Street, Cathedral Road, Cardiff.

Lewkowitsch, Dr. J., l/o Whitehall Soap Works; 24, Moorland Road, Leeds.

Lucas, B. R., l/o Borough Road; 32, Ayresome Street, Middlesbrough-on-Tees.

Macfarlane, Jas. A., l/o British Columbia; (Journals) Santa Rosalia, BajaCalifornia, viâ Guaymas, Mexico; and (subsn.) c/o N. McFarlane, 104, Bothwell Street, Glasgow.

Mansbridge, W., l/o Battersea; 9, The Green, Stratford, E.

Marshall, Jas., l/o Paisley; Willowbank, Girvan, N.B.

Neilson, Thos., l/o California; c/o Utah Furnace and Manufacturing Co., Ogden, Utah, U.S.A.

Parker, Gerald L., l/o Chester; Worsley, Manchester.

Passmore, Dr. F. W., l/o Kennington; 29, Wolfington Road, West Norwood.

Pittuck, F. W., l/o 15; 19, Stratford Grove, Newcastle-on-Tyne.

Rennoldson, W. L., l/o Jarrow; c/o United Alkali Co., Lim., Allhusen's Works, Gateshead.

Riley, Jas., l/o Hope Street; 168, St. Vincent Street, Glasgow.

Sanford, P. Gerald; l/o Streatham; Analytical Laboratory, 20, Cullum Street, E.C.

Schönzeler, J., l/o Mincing Lane; 27, Kyverdale Road, Stoke Newington, N.

Trechmann, Dr. C. O., l/o Cliff Terrace; Warren Cement Works, Hartlepool.

Usmar, J. H., l/o Palmerston Buildings; 22, Billiter Street, E.C.

Williams, W. J., l/o Wilmington; 635, Market Street, Camden, N.J., U.S.A.

## Deaths.

Burroughs, S. M., of Snow Hill Buildings, London, E.C., February 6th.

Johnson, Frank, Tharsis Mines, Huelva, Spain, January 13th.

Nason, Prof. H. B., Ph.D., M.D., LL.D., Troy, N.Y., U.S.A., January 18th.

# London Section.

THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

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74, North Side, Clapham Common, S.W.

## SESSION 1894–95.

March 4th:—
Mr. A. P. Laurie, F.I.C., F.C.S. "The Durability of Pigments derived from Coal-Tar Products."
Sir Henry Roscoe, F.R.S., and Mr. Joseph Lunt, B.Sc. "The Hermite System of Sewage Purification."

April 1st.—Dr. Carl Pieper, of Berlin. "The German Patent Laws and their Relation to Home and Foreign Inventions."

N.B.—The Election of Officers and Five Members to the Local Committee will take place at the Meeting on April 1st. Nominations must be signed by Ten Members and sent to the Hon. Local Secretary not later than Wednesday, March 20th. Members can only sign one Nomination. (*See Bye Laws of Section.*)

*Meeting held Monday, 4th February* 1895.

MR. B. E. R. NEWLANDS IN THE CHAIR.

## ON THE EFFICIENCY OF CARBON VAPOUR IN COAL GAS AND OTHER HYDROCARBON FLAMES, AND OTHER MATTERS OF INTEREST IN THE MANUFACTURE OF COAL GAS.

BY LEWIS T. WRIGHT, C.E.

FROM almost the earliest days in the history of gas-lighting many of the scientific men, who have occupied themselves with a study of the details of gas manufacture and the process of destructive distillation of coal and hydrocarbon gas-producing materials, have endeavoured to trace the existence of some relationship between the chemical composition of different qualities of illuminating gas and their effective luminosities as determined by ordinary photometrical methods; and many indeed have thought to have found in gas analysis a key to the solution of the problem.

It must be admitted that such efforts have not been awarded a very full meed of success; but any regrets that may be felt when we find ourselves compelled to witness the frustration of so much deserving ambition should be tempered with satisfaction now that our knowledge of the composition of coal and similar gases is considerably enriched by investigations that have been incited by the desire to find a relation between their luminosity and chemical composition, and also our methods of gasometric analysis improved by the continually increasing need of a more critical knowledge of the composition of such gases.

It is not my intention to enter into much historical detail concerning these matters, though I feel sure that a review of the subject would be interesting, and I will content myself with a brief explanation of why, in my opinion, a relation, if any, between the chemical composition of coal gas and its luminosity could not be brought to light, and how investigators often took a false route when a path perhaps more likely to lead to a successful issue was missed.

Firstly, there is a want of definition in the practice of photometry as applied to gases of widely different photometric value. The London Gas Referees may have reduced gas photometry, as applied to the particular quality of gas under their jurisdiction, to a system; but beyond the boundaries of that quality there is an Alsatia where the king's writ does not run.

Secondly, it was the practice to divide the hydrocarbons existing in coal gas into marsh gas, and some others that, unlike marsh gas, were capable of being absorbed by such reagents as bromine and fuming sulphuric acid.

Thirdly, it was generally considered, and indeed taught, by not the least distinguished of the chemists who had been attracted to this subject, that marsh gas, under the ordinary circumstances attending the combustion of gas, gave no light, and in that manner marsh gas became classed as a diluent that did not directly add any light to the coal gas flame.

For instance, I quote from Dr. E. Frankland, Journal of Gas Lighting, Vol. XVI., 327, 1867:—

"In addition to this function of taking up and carrying forward these volatile hydrocarbons, one of these diluents, viz., light carburetted hydrogen, is capable also, under very favourable circumstances, of producing a certain amount of light.

"We do not get any light from it under the ordinary circumstances surrounding the combustion of gas, but by taking advantage of an elevation of temperature in the air which supplies the gas flame, we may obtain a certain degree of luminosity, so that this marsh gas may be said to stand upon the line of demarcation between the diluents and the illuminants.

"If I employ the charcoal furnace which we used before for showing the increase of light, by heating the air and gas before combustion, and pass through the tube in the centre of it a stream of marsh gas, you perceive from the luminosity of the flame that we have converted our diluent into an illuminant of no inconsiderable power."

Dr. Percy F. Frankland (Jour. Chem. Soc., 1884, Vol. XLV.) observes in his paper on the illuminating power of ethylene when burnt with non-luminous combustible gases: "It is also most probable that at the high temperature of the flame obtained with the Argand burner, the marsh gas may possess a very appreciable illuminating power of its own. . . . I find, moreover, that marsh gas prepared from sodic acetate, and purified by bromine, as described, possesses a very decided illuminating power of its own, amounting to several candles, when burnt from a referee's burner, whilst from a fish-tail burner it emits but a very feeble light. I conclude from this that the increase in illuminating power which is observed when coal gas is burnt from a referee's burner is partly due to the light thereby obtained from marsh gas, which with a fish-tail burner produces practically no luminous effect."

However, the title of the paper containing these remarks is, "The Illuminating Power of Ethylene when Burnt with Non-Luminous Combustible Gases" of which pure marsh gas prepared from zinc methyl is one and in the calculation of the results obtained with mixtures of ethylene and marsh gas no luminosity is ascribed to the latter gas which is, therefore, treated in accordance with the title of the paper as a non-luminous combustible gas.

Both these gentlemen were aware that under some circumstances marsh gas gave a luminous flame, but it would appear that Dr. E. Frankland attributed this occasional luminosity to the heating of the air supply in his experiment and Dr. Percy F. Frankland partly to a higher temperature of the London Argand and partly to the impurity of marsh gas prepared from sodium acetate.

I can add to these remarks of other experimenters my own experiences with a sample of marsh gas prepared from sodium acetate. This gas gave in a batswing burner (Bray's market) a flame of beautiful brilliancy and in the London Argand when tested at the rate of 2·1 cubic feet per hour under control of the air supply to nearly smoking point an illuminating effect of 27·6 candles per five cubic feet per hour. I shall have occasion to refer later on to this gas prepared from sodium acetate and soda lime which though apparently consisting chiefly of methane is, as is well known, accompanied with other bodies.

That a gas properly called luminous, under certain circumstances, should yield a non-luminous flame, is not a matter that needs any remarks from me; but what is most prominent is the uncertainty that prevailed respecting the luminosity of marsh gas itself, and it is to that uncertainty that I wish to draw your attention.

Fourthly: It was held that coal gas when deprived of the $C_nH_m$ hydrocarbons was at the same time deprived of its luminosity and thus its luminous effect was held to depend upon the proportion of absorbable $C_nH_m$ hydrocarbons, and from the proportion and composition of these, together with the temperature conditions of the flame, it was sought to explain the lighting value of the gas.

There were, however, in these views, two fundamental errors.

In the first place, I showed (Journal of Gas Lighting, May 27th, 1884) that when the $C_nH_m$ hydrocarbons were removed from coal gas of from 14·8 to 18·5 candles that the residual gas instead of being disilluminated still possessed a very important lighting effect equal to 40 per cent. of the original, on the average of the six trials made, and I pointed out that there was no reason for supposing, as was commonly done, that the only member of the paraffin series occurring in coal gas was marsh gas, and alluded to Davis' researches on the distillation of coal (Jour. Soc. Chem. Ind. Dec. 1883) which indicated the presence of pentane hexane, &c. in the oils obtained by washing coal gas with heavy oils.

The author of the Chemistry of Gas Lighting was acquainted with the fact that coal gas was not disilluminated by treatment with fuming sulphuric acid, but I am not aware that anyone had determined the residual luminosity.

But if it were possible to reverse the operation and leave the $C_nH_m$ hydrocarbons in the gas, taking out only the so-called marsh gas, is it to be supposed that the residual luminosity would then be 60 per cent. of the original?

Not only does marsh gas possess a very appreciable, and in relation to coal gas, an important luminosity that cannot be neglected in investigations concerning the lighting power of such gas; but there can be little doubt that other members of the paraffin series are also present as Davis pointed out (*loc. cit.*).

Methane was but a convenient expression for the carbon of paraffins and other hydrocarbons that are not attacked by fuming sulphuric acid.

With this knowledge it is not now difficult to understand how it was impossible to explain the 16 candles of a gas containing perhaps only 3 per cent. of $C_nH_m$ hydrocarbons, whilst richer gases, say oil gas of 70 candles, contained as much as 50 per cent. That is to say over five candles for 1 per cent. in the one case and not quite one and a half candles per 1 per cent. of $C_nH_m$ hydrocarbons in the other case.

It cannot be said that the attempts made to explain the difference of supposed value of the $C_nH_m$ hydrocarbons in the one case or the other by differences of carbon density of these sulphuric acid absorbed bodies were more successful now that we know that the average carbon densities of these hydrocarbons are practically the same whether from 16 or 60 candle gas.

In 1884 (Journal of the Chemical Society, Vol. XLV., 103) I pointed out the existence of a simple relation between the total carbon vapour (including that of the carbon contained in the carbonic oxide), and the illuminating power of four samples of pure coal gas, ranging from 15·6 to 20·5 candles. Further investigations since that period have shown me that such relation did not apply to gases of widely different lighting effect and origin, but however led me to the belief, that within certain limits there is some simple relation between the composition and luminosity, if only that carbon vapour be regarded as effective, that exists, combined with hydrogen, a knowledge of which relation will have great practical value.

In 1892, Prof. W. Foster (Journal on Gas Lighting, Vol. LIX., 1174) repeated the same observation that I had been led to in 1884, and for gases of rather less range of lighting power, and he endeavoured, as I had done before, to explain the illuminating power of the gas by the total carbon vapour contained in it. He did not, however, go beyond what I had already done.

It appears to me that there is no such thing known to us as the intrinsic luminosity of coal or any other hydrocarbon gas.

If consumed with preadmixture of air or other diluents, coal gas can be disilluminated, and the same remark applies to other hydrocarbon gases since by admixture of air and other diluents, the lighting effect can generally be reduced to zero. If consumed, however, with graduated and superheated air supply as in the regenerative burners it is difficult to say how much light might not be obtained by a complete extension of this system of superheating since the luminosity of an incandescent body increases very much as its temperature rises as we know from the researches of Draper, Becquerel, and others. The luminosities of gases that may be properly called luminous rises then from zero to limits that have not been reached—according to the manner and method by which they are consumed. Also, if the gas flame be tested in great masses as in the triple and compound argands, &c., the exterior cooling influences are reduced, and the luminosity is in consequence increased.

On consuming such gases, however, in the ordinary flat flame or Argand burners, that are not designed to effect any superheating, either of the gas or of the air supply, and with flames of such magnitude as to yield a light not much exceeding 40 candles, it is found by selecting burners adapted to the quality of the gas to be tested, that a certain maximum lighting effect is produced which maximum is, I believe, by an unwritten convention, considered to be the illuminating power of the gas in question from the investigators point of view. This experimental maximum is not to be confounded with the lighting effect, to be obtained from any burner with a constant rate of consumption, irrespective of the quality of the gas, or with the intrinsic illuminating power, or any luminosity that might be obtained with burners in which the superheating of the gas and air supply is carried out to more or less perfection or from flames which by their size suffer less from exterior cooling influences than those ordinarily employed. It is in practice found that for the economical development of light in ordinary gas burners, the thickness of the flame must be proportioned to the quality of the gas intended to be consumed by that burner.

A gas, very rich in hydrocarbons, generally requires a relatively thin flame; on the other hand a poor gas requires a thicker flame.

Thus for any particular quality of gas ranging from say 10 to 80 candles will be found amongst those burners in use for ordinary illumination, one that develops a maximum lighting effect from that particular quality, and further for every quality of gas there will be found in any particular burner a rate of consumption that develops the maximum lighting effect from that gas in that particular burner.

The London Argand for example is not adapted for high qualities of gas, but for very low qualities I have used that burner fitted with an adjustable cap, in order to bring the air supply under control.

For low qualities, such as pure methane or so called disilluminated coal gas, there are perhaps no burners specially manufactured, and I can only suppose that those who have thought pure or even impure marsh gas and coal gas deprived of its $C_nH_m$ hydrocarbons to be devoid of luminosity have acquired that idea from trying them perhaps even in small quantities in burners very unsuited to the development of their luminosity.

Not only must the investigator seek the burner and the rate of consumption for that burner best adapted to develop the maximum I have referred to before as being the conventional illuminating power; but in order to make his results comparable with those of other investigators he must not seek that burner amongst those that superheat the air supply, &c.

The operation of photometry has not been like that of weighing, and has not been capable of the same high degree of accuracy. It is the comparison by means of a physiological effect of two lights, one being the standard and that standard may be variable.

Much also depends upon the manner of treating the gas to be tested, upon the choice of burner and rate of consumption.

Illuminating effect is not a fixed quality unless all the conditions are fixed. Change those conditions but slightly and the luminosity will be greatly modified.

I found in 1884 that for the four qualities of gas ranging as tested in the London Argand from 15·6 to 20·5 candles for every candle of the standard there were present in the gas from 3·51 to 3·62 volumes of total carbon vapour per 100 volumes of gas.

I have, however, since that period, had occasion to note the total carbon vapour of many qualities of gas of very much higher luminosity, and of other origin; and I found that my method of comparison, afterwards as before remarked, employed by Prof. Foster, was not of universal application.

It may be as well to explain what is meant by total carbon vapour. On making a combustion of the carbonic acid free gas with excess of oxygen a certain volume of carbonic acid is produced, and this per 100 vols. of gas is the total carbon vapour.

The carbon may have existed as methane or benzene or any other hydrocarbon or hydrocarbons or as carbonic oxide.

From the analysis of the gas, if the carbon density of the $C_nH_m$ hydrocarbons be given one can readily calculate the total carbon vapour.

For instance, a gas of the following composition—

| | |
|---|---|
| $C_nH_m$ hydrocarbons | 3·0 |
| Methane | 38·0 |
| Hydrogen | 49·0 |
| Carbonic oxide | 7·0 |
| Nitrogen | 3·0 |
| | 100·0 |

and with a carbon density of $C_nH_m$ hydrocarbons 3·0 would give on combustion 54 vols. of carbonic acid for every 100 vols. of gas and would contain 54 vols. of total carbon vapour per 100 vols. of coal gas or 0·54 cubic foot, per cubic foot of coal gas. This was what I meant by carbon vapour in 1884. Since then I have remarked in the course of experiments with cannel and oil and other gases that if we only regard as effective that carbon that is combined with hydrogen, there is a ready means of calculating with tolerable accuracy the illuminating power produced by coal or oil gases. My experiments are confined to carbonic acid and air free gases.

For simplicity sake the rule must be stated in a practical form and the carbon of the hydrocarbons must be calculated to a carbon density of one.

The gas of the composition cited contains 7 per cent. of carbonic oxide, and the effective carbon vapour is therefore only 48 vols or 0·48 of a cubic foot per cubic foot of coal gas.

For ordinary coal gas, such as is commonly supplied in England, I believe that the value in candles of a cubic foot of carbon vapour is very closely expressed by the factor 66 to 67. This is the value for instance I obtained in 1883 from London coal gas (Appendix A.). It must be recollected that a town supply often exceeds in quality that prescribed by the Act of Parliament.

The analyses are placed in an appendix in order not to encumber the paper with tables of analyses.

In the course of series of analyses of gas of the same origin, one finds variations in the value of the carbon vapour expressed as candles per cubic foot.

These variations may be due to radical differences in the carbon values, or to experimental errors, or imperfections in photometrical methods. The sample taken for gas analysis may not absolutely coincide with the gas tested photometrically but the deviations are not so large as might be expected. It will be noticed that the carbon vapour of low grade gases has sometimes a higher value than that of a richer gas in the same series.

This may be due to what may be termed burner effect. The effect of testing different qualities in the same burner.

For the series published in 1884 (J. Chem. Soc., Vol. XLV., 100) I found the following values:—

| Tested in London Argand. | Value of Effective Carbon Vapour. |
|---|---|
| 20·5 candles. | 6·47 candles per cub. ft. |
| 17·8 „ | 6·93 „ „ |
| 16·75 „ estimated. | 7·00 „ „ |
| 15·60 „ | 7·26 „ „ |

These samples were collected from an iron retort, and the carbonic oxide is very high.

### Appendix B.

A series from clay retorts:—

| —— | Value of Effective Carbon Vapour. |
|---|---|
| 28·3 candles tested with flat flame. | 6·71 |
| 19·1 „ „ Argand. | 6·66 |
| 14·9 „ „ „ | 6·53 |
| 12·7 „ „ „ | 6·83 |

### Appendix C.

Another from clay retorts:—

| —— | Value of Effective Carbon Vapour. |
|---|---|
| 17·5 candles tested with Argand. | 6·60 |
| 15·75 „ „ „ | 7·22 |
| 12·90 „ „ „ | 7·20 |

### Appendix A.

For London coal gas in 1883, value of carbon vapour. Average, 16–8 candles — 6–64 candles per cubic foot.

### Appendix D.

For cannel gas:—

(1.) 28·5 candles. Flat flame, 7·06.
(2.) 32·2 „ „ 6·92.

### Appendix F.

Oil gas from American petroleum:—

62·2 candles. Flat flame 6·93.
57·3 „ „ „ 6·8.

An analysis of some diluted oil gas of 28·4 candle power to be found in a very complete inquiry by Messrs. Nayes, Blinks, and Mory, Jour. Amer. Chem. Soc. 1894, **16**, 688—697, gives 6·8 candles per cubic foot of effective carbon vapour.

The average efficiency of a cubic foot of the effective carbon vapour of the gases analysed by Tocher (this Journal, March 1891) is 7·01 candles. (This able and exhaustive paper furnishes us with a most complete knowledge of oil gases.) Foster's analyses give an average of 6·66 candles per cubic foot of effective carbon vapour for qualities ranging from 16·30 to 20 candles, the carbon efficiency varying from 6·2 to 7 candles per cubic foot.

The trial I made on 50 tons of Derbyshire silkstone coal in order to study the distribution of the elements composing the coal amongst the various distillation products, some details of which appear in the article on "Coal Gas" in the "Dictionary of Applied Chemistry," gives an efficiency of 7·1.

Thus for every 100 of coal carbonised there were found in the purified gas 8·53 lbs. of carbon, and deducting the carbonic oxide, there were 6,805 lbs. as effective or 152·43 lbs. per ton of coal charged.

The gas production was 11,189 cubic feet (corrected) of 15·3 candle gas (per 5 cubic foot), or of 3·06 candles per cubic foot, or 34,238 candles per ton.

Thus, 152·43 lbs. carbon gave 34,238 candles, or 225 candles per lb. of effective carbon vapour. The equivalent of this in volume is 7·1 candles per cubic foot of effective carbon vapour.

In order not to multiply examples I do not give those of other similar cases.

In the course of experiments on the light afforded by petroleum oils, referred to in a paper that appears in this Journal, August 1888, the best results obtained was 1,520 candles for a gallon of petroleum oil of ·848 gravity. Assuming the oil to have contained 85 per cent. of carbon, there is a light obtained of 1,520 candles for 7·208 lbs. of carbon, or 211 candles per lb. of carbon, or an efficiency of 6·7 candles per cubic foot of carbon vapour. I have since obtained, with a "Duplex" lamp, a maximum of 1,680 candles, which would give 7·33 candles per cubic foot of carbon vapour.

A reference to the efficiency of the carbon of hydrocarbons burned in the pure state or in simple mixture would be interesting as some of the results do not differ from those obtained from coal gas, and similar mixtures of hydrocarbons. For instance, pure ethylene gives 6·85 candles per cubic foot of carbon vapour. (Dr. P. Frankland, J. Chem. Soc., Vol. XLV.); but I do not think it necessary to cite these values obtained from the pure hydrocarbons on this occasion since such results should not be confounded with those obtained from their combustion in complicated mixtures for which perhaps other burners than those employed in the determination may be required, and allowances must also be made for the photometrical methods employed.

There are two great factors ruling the production of light from hydrocarbon flames. One is the carbon precipitated, and the other is temperature.

Of intrinsic luminosity, as before remarked, we know nothing. That is, I believe, one of the false routes we have taken in order to explain the luminosity of coal and similar gases. From the luminosities of the constituents, as determined under special conditions, we cannot calculate the value afforded by a complicated mixture.

The property of luminosity is not a fixed property of hydrocarbons like mass, but is more of a fortuitous character, depending very largely upon the carbon that can be advantageously precipitated from them in their flames and the resultant temperature.

The carbon that can be advantageously precipitated from them in mixtures depends upon the burner that has to be employed for the mixture.

It is useless for our purposes that one constituent of a mixture of hydrocarbons should yield when burned in the pure state a very high efficiency per cubic foot of carbon vapour, if we cannot get it out in the burners we employ for the mixtures obtained in practice.

The burner in which we burn our mixtures of hydrocarbons must provide for the average and must burn without smoke.

There is no difficulty in precipitating carbon in the flame from even those hydrocarbons that appear to possess the least tendency to split off free carbon. If we have a mixture containing hydrocarbons of high carbon precipitating power together with others that have this power less developed, the most that those of high carbon precipitating power can do is to fill up the gaps which under the average conditions of the flame have been left by those hydrocarbons of low carbon precipitating power, burning in a burner that must provide for the average and not for any single constituent.

The best way of expressing this idea of mine in modern chemical language is by saying that the luminosity of hydrocarbons as determined in the pure state is not in mixtures an *additive* property, but rather a *colligative* one.

To burn, in a pure state, certain hydrocarbons that very readily split off free carbon one must employ burners with very fine orifices—burners in which gases of low carbon precipitating power would be almost non-luminous. To burn the latter class of hydrocarbons we must employ thicker flames in which, however, hydrocarbons of the former class would give torrents of smoke. For the mixtures employed in practical lighting a medium burner is required to bring out the practical maximum, a burner in which neither one class nor the other class of hydrocarbons could advantageously be dealt with.

Turning once again to practice, it is found on destructively distilling hydrocarbon oils that a certain amount of free carbon is left in the apparatus either suspended in tar or, if the destructive distillation be complete, as a mass of coke.

In my own experiments this has not been weighed as the apparatus did not lend itself to the ready collectors of this residue. It is stated by those who are facile princeps in this matter that the residue amounts to about 25 per cent. of the original oil.

If a gallon of the oil weighing 8·4 lbs. contained, say 7·2 lbs. of carbon, there is left on this basis 2·1 lbs. of carbon as coke and 5·1 lbs. go into the gas as effective carbon vapour.

Adopting as a constant seven candles per cubic foot or 221 candles per lb. of effective carbon vapour there would be 5·1 lbs. × 221 or 1,127 candles per gallon. In my experiments I have not quite reached this value. Tocher in his very complete study of gas from paraffin oils gives 1,094 candles for oil containing 86·68 per cent. carbon, and of ·888 gravity. (There must be a misprint in his paper, as the 81 cubic feet of gas of 61·1 candles only give 989·8 candles per gallon.)

It is claimed for this gas that its enriching value is much higher than its photometric value as determined when burned undiluted, and there is no reason why this should not be the case within certain limits that are, I believe, also dependent on our photometrical methods.

Common coal-gas with an efficiency of 6·7 when mixed with a gas of efficiency 7, may be brought up in the mixture to the latter efficiency. I would, however, like to see some of the statements that have been made respecting the enrichment value of oil-gas substantiated by the analysis of the gas and full particulars of the burners and rates of consumption employed, because it would be interesting to know whether a mixture of gas of efficiency 6·7 with another of 7 can be brought to 8, for example.

Turning to carburetted water gas it will be found that values of from 1,300 to nearly 1,500 candles per gallon of oil are given in various quarters; but information is required to enable us to judge whether this is due to the higher value of the effective carbon vapour in water gas or to the larger amount of effective carbon vapour brought into the gas by cracking the hydrocarbons in a medium of water gas instead of in their own vapour.

Dr. Hurter in one of his papers in which pure theory is so perfectly balanced with good practice that we realize an ideal of what is technical chemistry and what is a technical chemist, refers to the engineer with his pocket-book of constants. As an engineer, I offer this constant of seven candles per cubic foot or 221 candles per lb. of effective carbon vapour.

To apply it to ordinary coal-gas pure and uncontaminated we must deduct about 4 or 5 per cent. from the result.

In course of time constants will be formed for each class and quality of illuminating gases, and *suited to the manner of testing employed in each particular case.*

It is interesting in studying the analyses of illuminating gases to note how widely different can be the ratio of carbon to hydrogen without any remarkable alteration in the carbon efficiency of the effective carbon vapour. Thus, in 16-candle gas the carbon may be to the hydrogen, by volume, as

1 : 6·5, and in oil-gas as 1 : 2·5, and yet the carbon efficiency as formed by the ordinary burners for such qualities does not materially differ.

Amongst published results of analyses of coal and other illuminating gases where the illuminating power is at the same time given there are to be found carbon efficiencies much higher than I have met with. For instance, in the valuable study made by Dr. E. Frankland on White's hydrocarbon gas are the following :—

| | Candles per Cubic Feet of Carbon Vapour. |
|---|---|
| Wigan cannel | 6·41 |
| Boghead cannel | 8·70 |
| Lesmahago cannel | 8·10 |
| Met Hill cannel | 7·90 |
| Newcastle cannel | 6·64 |

The average of these is 7·55 candles.

There is not in practice much evidence of a trustworthy character that would lead one to believe such gases as have been hitherto manufactured from coal or cannel reach so high a value. The use of benzol as an enriching material is also advocated, and the various published results of its enriching values are so discrepant that I hardly like to add to the confusion by making public the maximum found in experiments on the enrichment of 16 to 20-candle coal-gas.

Dr. Knublauch ("Ber. Deuts. Chem. Ges., 1878") for a single experiment with coal-gas enriched from 15·7 candles to 17·2 candles gives a value calculated to 184 candles per cubic foot of benzol vapour or 29 candles per cubic foot of carbon vapour in the benzol.

It is dangerous to attach too much confidence to a single determination when the difference before and after enrichment of the coal-gas only amounts to 1·5 candle.

Dr. Percy Frankland (Jour. Chem. Soc., Vol. XLV.) has given results obtained by enriching London coal-gas, "disillumined" by treatment with bromine with benzol vapour.

He found that a mixture of 96·91 per cent. bromine treated London coal gas, and 3·09 per cent. benzol vapour gave a light of 22·92 candles calculated on 5 cubic feet of the bromine treated gas. But, allowing for the carbon in the bromine treated gas which might very well have been 39 vols. per 100 and adding thereto the 18·54 vols. due to the benzol, there would be 57·54 vols. of carbon vapour per 100 in the gas that gave 22·92 candles per 5 cubic feet, or 4·58 candles per cubic foot. Deducting 3 per cent. for the measurement having been effected on the gas before benzolisation, we have a value of about 7·5 candles per cubic foot of carbon vapour in the hydrocarbon mixture. The best average value I have obtained with benzol in coal-gas of 16 to 20 candles, is 41·5 candles per cubic foot of benzol, or 6·92 candles per cubic foot of carbon vapour.

As an instance of the influence of photometrical method upon results, I will refer to a case that has been much quoted and upon which conclusions have been built that are used to explain other results obtained in practice.

I refer to the "enrichment curve" for ethylene in hydrogen. The term "enrichment curve" is frequently used as though such things were perfectly understood.

In this series of experiments made by Dr. Percy F. Frankland (Jour. Chem. Soc. 1884, Vol. XLV. 36), it will be found that the efficiency of the carbon vapour reached its maximum when the percentage of ethylene in the mixture was 26·08 per cent., and that at 13·37 per cent. of ethylene the carbon efficiency fell to 5 candles per cubic foot of carbon vapour. On examining the table of results with attention it will be found that the candles observed, that is to say, the total value of the light observed in the London Argand irrespective of rate of consumption fell to 13·96 candles. All the other results had been taken with flames of from 25 to 32·76 candles. It can hardly be doubted by anyone acquainted with the London Argand burner that the efficiency of a gas tested with a flame of 13·96 candles cannot be compared with that of a gas tested with a flame value of 32·76 candles without some allowance or correction being made for the severity of this burner upon small flames as compared with large ones.

I quote the results obtained, with the carbon efficiencies added—

| Percentage. | | Candles observed. | Rate. | | Carbon efficiency Candles per cubic foot. |
|---|---|---|---|---|---|
| $C_2H_4$ | $H_2$ | | Gas in cubic feet per hour. | Candles in grains per hour. | |
| 77·55 | 22·45 | 28·04 | 2·50 | 116·8 | 7·0 |
| 68·39 | 31·61 | 27·86 | 2·65 | 112·5 | 7·2 |
| 53·58 | 46·42 | 25·00 | 3·56 | 133·8 | 7·3 |
| 35·47 | 64·53 | 32·76 | 5·38 | 121·6 | 8·7 |
| 26·08 | 73·92 | 29·00 | 5·82 | 110·0 | 8·75 |
| 13·37 | 86·63 | 13·96 | 10·00 | 115·7 | 5·0 |

On referring to the series with mixtures of ethylene and carbonic oxide to be found in the same memoir the effect of a sudden fail in the flame value observed will be found to have been far more prominent. Thus, a mixture containing 28·73 per cent. of ethylene with an observed flame value of 15·76 candles gave a carbon efficiency of 6·8 candles per cubic foot of carbon vapour. A mixture, however, of 23·89 per cent. ethylene only gave a carbon efficiency of 2·7. Can it be doubted that the reason of his sharp and rapid falling off of efficiency was not due to the flame value observed, viz., 7·16 candles ? The series is given below to illustrate the effect on the carbon efficiency of a sudden falling off in the flame value observed.

| Percentage. | | Candles observed. | Rate. | | Carbon efficiency Candles per Cubic Foot. |
|---|---|---|---|---|---|
| $C_2H_4$ | — | | Gas in Cubic Feet per hour. | Candles in Grains. per hour. | |
| 81·65 | 18·35 | 29·4 | 2·54 | 114·5 | 6.8 |
| 66·75 | 32·25 | 29·0 | 2·92 | 115·5 | 7·1 |
| 46·30 | 53·70 | 31·98 | 4·18 | 103·75 | 7·2 |
| 37·94 | 62·06 | 30·16 | 5·15 | 108·75 | 7·0 |
| 28·73 | 71·27 | 15·76 | 5·45 | 111·00 | 6·9 |
| 23·89 | 76·11 | 7·16 | 5·33 | 117·25 | 2·7 |

I make these remarks merely to call the attention of those who are acquainted with photometry and the London Argand to the difficulty of constructing "enrichment curves" from these results. I must apologize to the author of the memoir from which they are taken for the addition I have made, on my own responsibility of a table of illuminating power calculated in candles per cubic foot of carbon vapour in the place of the candles per 5 cubic feet per hour of the mixture.

A sample of marsh-gas from sodium acetate and soda lime gave me 24·4 candles, calculated to 5 cubic feet per hour when tested at the rate of 2·1 cubic feet per hour in the London Argand with air supply controlled. This sample contained 85·1 volumes per 100 of effective carbon vapour, and the carbon efficiency was therefore 5·73 candles per cubic foot. The quantity at my disposal was small and I had no opportunity of trying other burners in order to find a higher value if possible.

I have on several occasions been able to show that an increase of the distillation temperature of coal, up to the limits of gas works plant brings out more lighting value from the coal though the gas obtained is of a lower grade.

This increase is of course attended with the permanent gasification of more carbon and appears to be principally at the expense of the tar.

On taking charge of the Nottingham Corporation Gas Undertaking in 1883, I found that there was a coal mined on the outskirts of the town that had been refused as useless though the coal-owners were willing to deliver it at about 6*s*. 3*d*. per ton. The coal had been tested and found to yield but little gas and it was not considered to have an economical value. It had acquired the name of "Rattle-jack." I immediately submitted this coal to a complete examination* and found that with a temperature perfectly practicable on a gas works, it yielded remarkably good results and made use of it to such benefit that a saving at the rate of 10,000*l*. per annum was at once effected with other advantages such as increase of illuminating power.

To-day the price of petroleum and paraffin oils is so moderate that the cost of enrichment is not a serious matter and "high" heats will come more into vogue.

Of the selling price of gas in the metropolis about 80 per cent. is made up of charges that are independent of the quality of the gas supplied and would be the same if the gas were 14 or 18 candles.

On account of the large proportion of the selling price of gas consisting of charges which are independent of its lighting power it generally happens that the cheapest light is that supplied at the highest grade. Taking for example the three cases of London, Liverpool, and Glasgow, we have for cost per candle of the standard.

| Town. | Net Gas rental per Thousand. | Candle Power. | Cost per Candle of Standard Candle Power. |
|---|---|---|---|
| | Pence. | | |
| London | 34·04 | 16·3 | 2·08 |
| Glasgow | 32·83 | 21·3 | 1·54 |
| Liverpool | 35·72 | 21·6 | 1·66 |

The recent propaganda made in favour of low-grade gas has received much support from men eminent in the gas profession and has been brought to the attention of this society in the able address recently made by Mr. Forbes Carpenter to the Manchester Section.

Having had experience of the manufacture of coal gas in London, where the quality is 16 candles, in Nottingham where it was 18½ to 18¾, and in Buenos Ayres with gas of 25 candles, I must say I am at a loss to understand the arguments in favour of the reduction of the London standard.

In the first place it would be a serious step for those companies to take, that suffer from electric light competition.

It would be a highly retrogade measure, as it would lead to the depreciation of gas in the public mind, and generally to serious loss of prestige.

It is against economical principles, since gas light, within the limits discussed, can be sold cheaper at a higher than at a lower grade. It is not only by lowering the price that we can make coal gas more economical, but there is also another means, and that is by improving its quality if it be possible to do so. It is true that price appeals more to the agitator, but quality appeals to the consumer.

The increased attention now being given to enriching materials will perhaps bring about the development of a photometrical system equally fair to all qualities of gas that will be generally adopted, and I can only hope that now attention has been directed to the efficiency of carbon in hydrocarbon flames the analysis of gas may be employed in conjunction with the photometer and then we shall learn much more about the efficiency of carbon than I have been able to relate.

### Appendix A.

London Coal Gas, 1883 (Wright).

| | | |
|---|---|---|
| $H_2$ | 51·8 | 48·32 |
| CO | 9·1 | 4·63 |
| $CH_4$ | 31·8 | 39·55 |
| CnHm | 5·2 | 5·18 |
| $N_2$ | 2·1 | 2·32 |
| | 100·0 | 100·00 |
| Carbon density of CnHm hydrocarbons. | 2·86 | 2·92 |
| Effective carbon vapour | 46·67 | 54·69 |

Average ... 50·68 volumes carbon vapour.

Average candle power tested by Referee's system ... 16·8 per 5 cub. ft. 3·36 candles per cub. ft.

Value of 1 cub. ft. effective carbon vapour ... 6·64 candles.

### Appendix B.

Gas from clay retorts.

| | | | | |
|---|---|---|---|---|
| $H_2$ | 24·92 | 46·25 | 53·28 | 58·4 |
| CO | 5·95 | 5·06 | 5·52 | 6·1 |
| $CH_4$ | 56·39 | 41·53 | 35·61 | 31·7 |
| CnHm | 9·82 | 5·11 | 3·14 | 2·2 |
| $N_2$ | 2·92 | 2·05 | 2·45 | 1·6 |
| | 100·00 | 100·00 | 100·00 | 100·0 |
| Carbon density of CnHm hydrocarbons. | 2·85 | 3·1 | 3·2 | 2·5 |
| Effective carbon vapour. | 84·38 | 57·4 | 45·66 | 37·2 |
| Candle power per 5 cub. ft. | 28·3 | 19·1 | 14·9 | 12·7 |

### Appendix C.

Gas from clay retorts.

| | | | |
|---|---|---|---|
| $H_2$ | 48·70 | 59·80 | 54·91 |
| CO | 5·92 | 7·04 | 6·25 |
| $CH_4$ | 38·27 | 28·26 | 32·81 |
| CnHm | 4·58 | 2·92 | 3·82 |
| $N_2$ | 2·53 | 1·98 | 2·21 |
| | 100·00 | 100·00 | 100·00 |
| Carbon density of CnHm hydrocarbons. | 3·22 | 2·6 | 2·83 |
| Effective carbon vapour | 53·02 | 35·85 | 43·62 |
| Candle power per 5 cub. ft. | 17·5 | 12·90 | 15·75 |

### Appendix D.

Cannel gas from clay retorts.

| | | |
|---|---|---|
| $H_2$ | 36·1 | 30·5 |
| CO | 6·8 | 8·3 |
| $CH_4$ | 37·8 | 43·2 |
| CnHm | 16·4 | 17·8 |
| $N_2$ | 2·9 | 0·2 |
| | 100·0 | 100·0 |
| Carbon density of CnHm hydrocarbons. | 2·63 | 2·8 |
| Effective carbon vapour | 89·7 | 93·0 |
| Candle power per 5 cub. ft. | 28·5 | 32·2 |

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* Appendix E.

### Appendix E.

Lighting value of Nottingham cannel distilled at various temperatures, in clay retorts in usual manner.

| Cubic Feet. | Candle Power. | Candles. |
|---|---|---|
| Per Ton. | Per 5 Cubic Feet. | Per Ton. |
| 6,595 | 23·56 | 31,076 |
| 6,641 | 24·19 | 32,129 |
| 6,923 | 23·98 | 33,203 |
| 6,955 | 23·28 | 32,382 |
| 7,442 | 23·30 | 34,680 |
| 7,625 | 22·83 | 34,816 |
| 7,783 | 23·00 | 35,802 |
| 8,007 | 23·20 | 37,152 |
| 8,084 | 23·02 | 37,219 |
| 8,150 | 23·43 | 38,191 |
| 8,170 | 22·25 | 36,356 |
| 8,233 | 22·26 | 36,653 |
| 9,157 | 22·20 | 40,657 |
| 9,492 | 21·46 | 40,740 |
| 9,584 | 22·18 | 42,515 |
| 9,642 | 21·67 | 41,788 |
| 9,749 | 22·40 | 43,675 |
| 9,775 | 22·02 | 43,049 |
| 11,001 | 20·08 | 44,180 |

### Appendix F.

Oil gas from American petroleum.

| | |
|---|---|
| $H_2$ | 4·8 |
| CO | 0·2 |
| $CH_4$ | 53·7 |
| CnHm | 41·2 |
| $N_2$ | 0·1 |
| | 100·0 |
| Carbon density of CnHm | 2·81 |
| Effective carbon vapour | 169·5 |
| Candle power per 5 cub. ft. | 57·3 |

### Discussion.

The Chairman having invited discussion :

Dr. S. Rideal suggested that if members had an opportunity of seeing proofs of papers beforehand they would be in a better position to discuss them. In his concluding remarks the author had thrown down the gauntlet on behalf of a gas of high illuminating value, although many gas experts were in favour of employing a low standard gas. The arguments used in the paper appeared to be based on gas as an illuminant, and to ignore its value for heating or as a source of energy. He would like to know whether the author considered that gas in future would be mainly an illuminating agent, as in the past, or that it would be likely to have other uses ; and, if the latter, whether it would not be better to judge the value of the gas by its heating power, rather than by its value as measured by the photometer.

Mr. Westcott considered that greater benefit was obtained from marsh gas for heating than for illuminating purposes. In burning a cubic foot of marsh gas about 1,000 thermal heat units are obtained, whereas in coal gas only about 650 are obtained, thereby heating the other particles of carbon in a gas jet to a higher state of incandescence. Again the high illuminating power obtained from a gallon of oil in a carburetted water gas apparatus is due to the way in which it is cracked up in combination with the straight water gas. It depends also on the way in which the apparatus is handled ; for a man who manages his apparatus properly can obtain entirely different chemical results and different gases therefrom when subjected to the photometric test, will sometimes show that instead of 1,500 candle power, only 600 to 900 c.p. are being obtained per gallon of oil used.

Dr. Dvorkovitz said that everybody who had tested gas by the existing apparatus had often felt the necessity for having some other means of testing; and he was pleased to support the method now proposed, which was really a chemical method. With regard to the efficiency of the illuminating power, the author took the unsaturated hydrocarbons of ordinary coal gas—say, 3·5 per cent. by volume, representing 16 candles, which was equal to about 5 candles for every 1 per cent. of the unsaturated hydrocarbons. He could not find any special difference between the character of the unsaturated hydrocarbons in the coal gas and in the oil gas. There was a certain difference in the oil gas, so far as it consisted more of the benzol series than of the ethylene series. This difference was certainly in favour of the oil gas. He could not understand the figures that Mr. Wright had given as to the large variation in the yield of gas per ton of the same coal—6,595 cub. ft. of 23-candle gas in one case, and 11,000 cub. ft. of 20-candle gas in the other. It seemed rather strange that such a coal should be despised altogether; and he would like to be informed by Mr. Wright how he obtained these very high figures from such a poor coal. Was it a certain method of cracking? If so, the engineers of the London gas companies would be very glad to be informed what that method was. Mr. Wright had also spoken of benzol. It seemed rather strange, after all the work that had been done in connection with benzol—not only in the laboratory—by that great authority Dr. Bunte (whom he believed all scientific men in the world respected), that his figures were not given. Those figures referred to the enrichment of the gas at the Munich Gasworks; and they were quite opposed to what Mr. Wright had achieved with benzol—that was, as an enricher. At Munich they were using benzol as an enricher; and they realised, if he remembered rightly, about 22,000 candles per gallon—this meant 22,000 cub. ft. of coal gas by enriching with one gallon of benzol. He thought the author ought not to have passed over such facts. What they wanted were not experiments made in the laboratory eight years ago, but the experiments which had been made recently, and the results of many of which had been published in the gas journals; but, in his paper, the author had told them nothing of what was going on at present. He quite agreed with Mr. Wright that the question which had been taken up lately by gas companies with reference to the reduction of the illuminating power of gas was rather against their interests. But he did not think they seriously meant it ; and, in his opinion, it had only been taken up in order to frighten the suppliers of cannel and oil. The main point of the paper appeared to him to be that of introducing the chemical method of testing gas. In such an idea every chemist should be interested, as it had hitherto been rather despised in the gas world.

Mr. T. S. Lacey considered it impossible to criticise a paper like the one that had just been read, or even properly appreciate it in the short space of time available. Mr. Wright did not appear to attach much value to the combination of the carbon with the hydrogen which was formerly considered of much importance. He drew attention to this because liquid hydrocarbons were now largely used for enrichment, and asked if the nature of the combination of the carbon and hydrogen made any considerable difference, because if so there might be a great saving or loss in using hydrocarbons having the same number of atoms of carbon, but differing in the hydrogen, as in the case of hexane and benzene. He would like to know whether the author had made any experiments in that direction. The factor for expressing the value of the carbon in the gas was a very interesting one, but he was surprised that it varied so slightly in the large number of gases tested. He would like to know the possibilities of a gallon of oil, now that oil gas was coming so much into use. Mr. Wright seemed to have an opinion that there was a certain value to be got out of a gallon of oil, and that one could not get more by merely using a different apparatus. If that were so, it would be useful to know the possibilities, so as to be in a position to reject the doubtful schemes that were often brought to one's notice.

Mr. F. Wright thought that gas managers should try to make either a lighting or a heating gas. They could not make the two in one. His own experience with gas engines and cooking stoves did not support the theory that any quality of gas was suitable for the purpose.

Mr. W. Grafton referred to the difficulty of making exact comparisons in these experiments, and stated that if different qualities of gas were burned in a London Argand burner, having a fixed height of flame, very different results could be obtained from those shown by the author of the paper.

Mr. Lewis T. Wright, in reply, said that he was rather surprised at the question put by Dr. Rideal. Was it that he thought gas to be a heating gas must be a low grade and non-luminous gas? He knew it to be a belief in certain quarters that a lighting gas was not a good heating gas. He could not understand how that idea could ever have originated, because as the lighting power of gas was increased, its carbon density and hydrogen density were increased, and per cubic foot with that increase, a corresponding increase of heating power was obtained. In 1883 he had read before the Manchester section a paper combating that idea. The idea originated with Dr. Siemens that there should be two supplies of gas, whereas he should say that the most rational way would be to use but one supply, of the strongest gas practically obtainable. He felt sorry that anyone should have misunderstood him, as Dr. Dvorkovitch appeared to have done; and he in turn confessed to having been unable to comprehend Dr. Dvorkovitch. He did not consider it necessary to refer again to the figures, because he thought them perfectly intelligible to anyone acquainted with gas manufacture. Dr. Dvorkovitch had not on this occasion referred to experiments of his own, though in a recent issue of the *Gas World*, he did refer to results that he was obtaining. He (the speaker) did not wish to add to the confusion surrounding benzol value, nor did he think it necessary to refer to the values obtained by Dr. Bunte, since these were obtained with "disilluminêd" coal gas; and he had already referred to that manner of obtaining enrichment values. Nor did he wish to be drawn into expressing opinions on matters that were not properly within the scope of the paper. He confined himself strictly to fact, and went very little away from actual experience; but he wished to impress upon his hearers that the value of hydrocarbon volumes, whether taken from a low or high grade oil, if burned in a paraffin lamp, varied very little, say from 6·7 to 7·3 candles per cubic foot of effective carbon vapour, and some of this variation was probably due to variations of photometric methods. He thought he could say with very great exactitude that the value of ordinary pure coal gas was 6·7 candles per cubic foot of carbon vapour. If one had a gas yielding on combustion, 50 per cent. of carbonic acid, after deducting that due to the carbonic oxide, it would appear that that gas would give half a cublic foot of effective carbon vapour per cubic foot of gas, which would give very nearly 16·75 candles, and he believed that experienced gas engineers would confirm that statement. He considered that we have not sufficient information about oil gases to be able to fix a value with the same certainty that it could be fixed for ordinary coal gases. It would appear that the value was slightly higher, though it might not be so if a great number of experiments were made on the same photometric methods as were used for coal gas. The value of the carbon in petroleum and paraffin oils burned in ordinary lamps would be about the same as that obtained in coal gas. He would have liked to have heard from Mr. Westcott some more information about water gas. With regard to the question of coal tar, he objected to take up ground outside the scope of the paper and preferred to confine himself to his own experiences. Some years ago he had used the London Argand burner for experiments in the laboratory, and had shown that with such a burner at low rates the efficiency was very low indeed. Now, everybody in experimental work tried to get the maximum efficiency out of the gas, and to do that it was the practice to burn the gas with "a full chimney." He quite understood that it was impossible for members to discuss a matter that was suddenly brought before them. He would have preferred that the paper should have been put into circulation beforehand, as things would possibly appear in a different light, and when members read the paper and saw the analyses he had no doubt that they would see that there was something in this question of carbon efficiency.

The Chairman regretted that the meeting was not favoured with the attendance of more experts in gas manufacture, as the discussion would have greatly benefited thereby. He concluded by explaining the causes which would make it difficult to follow Dr Rideal's suggestion.

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# Liverpool Section.

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Dr. Lewis Bailey, University College, Liverpool.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1894–95.

*Meeting held Wednesday, January 9th, 1895.*

MR. EUSTACE CAREY IN THE CHAIR.

## SOME APPLICATIONS OF REFRIGERATION.

BY FRANK TATE.

*(Abstract.)*

In dealing with the subject of refrigeration, I am relieved of the duty of entering into a description of the various systems for producing artificial cold, as these have already been very fully dealt with by members of our Society, viz.: J. S. Coleman (this Journal, 1884–357), T. B. Lightfoot (1886–133), G. E. Davis (1887–252). More recently still by Prof. Linde in a paper read by him before the Society of Arts (Jour. Soc. Arts, 1894–322).

On reference to these papers you will find they contain records of the various machines and systems. I purpose, therefore, to assume that the production of artificial cold can be economically accomplished, and to deal with a few of the more recent applications of artificial cold.

In reviewing the application of refrigeration to the cold storage of foods, I will refer shortly to the general principles of such stores.

The spaces or rooms in which the goods are to be stored, are so arranged that whilst allowing free passage from room to room by corridors on the same floor, or deck, or by hoists and lifts, if on floors, or decks situated one above another, are so isolated from each other as to allow of each chamber being kept at such a temperature as is best suited for the foods stored therein. These temperatures vary considerably.

The rooms and their approaches are kept scrupulously cleared and are lighted by electricity. The rooms which vary in size are lined inside with tongued and grooved boards, all metal work such as nails, hangers, &c., being protected from rust by galvanizing or some other process. The insulation of the stores is attained by packing the walls of the stores themselves, of the rooms contained in them with a sufficient thickness of suitable material such as "vegetable-silica," flake charcoal, hair-felt, &c. The refrigeration is produced by engines and compressors situated in such a position as regards the stores as will allow of the most economical conveyance of the "cold" without interfering with the cleanliness of the building. The cold is conveyed in one of several ways.

1st. By direct expansion of cold air—as in cold air machines—the expanded air being withdrawn from the stores and compressed for further expansion.

2nd. By the conveyance of air which has been previously chilled by being drawn over the upper surface of discs which revolve in chilled brine, the circulation of the air being maintained by mechanical air-propellers.

3rd. The stores may be maintained at the requisite temperatures by coils of pipes arranged along the ceilings or upper portions of the walls of the Chambers, through which coils, brine (which is generally speaking chloride of calcium solution of about 48° Tw.), chilled to a low temperature is caused to circulate by means of pumps.

4th. A low temperature may be maintained by coils of pipes, similarly placed to the brine coils in which anhydrous ammonia is allowed to expand, the expanded gas being drawn off and liquefied by compression for use again in expanding in these coils.

In dealing shortly with the question of artificial ice-production, I do not intend to enter into a discussion of the methods used. The two chief systems are known as the "can" and the "plate" systems, and the working of these has, of course, been varied by numerous inventors.

The advantages of artificial ice prepared from water of known purity over ice collected from ponds, lakes, and similar sources, have been the subject of much discussion, but I think it is generally admitted that ice produced from water as found in nature, if such water is in itself unpolluted by sewage or other pollution, and satisfactory as a drinking water, should be as harmless from a sanitary point of view as the water from which it is produced. On the other hand, if the ice be formed from water containing dangerous amounts of pollution and disease producing bacteria, it is quite unsuitable for domestic use. This question has received much attention from Fraenkl, Heyroth, Prudden, Percy Frankland, and others. It has been shown by many experiments that in freezing, water is by no means freed from bacteria.

To pass on to some other recent applications of cold, I would mention the proposed "chilling" of metals. It has been shown that the tensile strength of certain metals is very much increased when they are cooled to a very low temperature. When cooled to 180° C., as is possible when using liquid air, the breaking strain of iron is nearly doubled. Liquid carbonic acid has also been used for a similar purpose, and extensive and very valuable experiments have been made in Russia and elsewhere is this direction.

But to the Liverpool section of the Society of Chemical Industry the great question is, can refrigeration do anything for the manufactures in which we are more directly interested? Its use in stearine works, breweries and distilleries, india-rubber and gutta percha works, sugar factories, &c , are well known to you. As regards the production of monohydrated sulphuric acid, and sulphuric acid of high strength, the facts will be fresh in your memories, as also the use of cold in connection with oils, dealt with by Mr. G. Beilby in the Journal of the Society (1884–321). Its adoption for increasing the crystallisation of the mother liquors of chlorate of potash was brought before this section by Messrs. Hammill and Wylde in 1889 (this Journal 1889–168), and since then its application for this purpose has been considerably cheapened and improved. Very suggestive was the paper of Mr. C. J. Ellis on the Recovery of Sulphate of Soda from the Waste Liquors of Copper Extractors (this Journal, 1884–613).

One of the recent applications of refrigeration to chemical manufacture is the process of Hirzel of Winterthur, Switzerland. An abstract appears on page 1031 of the 1893 volume of the Journal. You will see from this that "advantage is taken of the formation of a definite hydrate of sodium chloride ($NaCl.2H_2O$). At a temperature between − 15° C. and 22° C. to separate salt from brine. As at − 2° C. saturated brine congeals with formation of the deca-hydrate, the cooling is carried to about − 20° C., and the mother liquor left on separation of the crystals, is returned to the bore-hole leading to the brine or rock salt beds being caused, on its way, to cool fresh entering brine. The hydrated salt crystals are dessicated in a current of hot air or gases."

I am indebted to Mr. T. B. Lightfoot of the Linde British Refrigerating Company, Limited, for some information as regards the working of this process. It appears the process has been working in Germany on a fairly large scale for some months. The salt obtained by this process is extremely pure and may be used for table salt without further purification. Salt obtained from brine, which contains 0·51385 per cent. of sulphate of lime, contains only 0·012 per cent. of the sulphate, whilst by evaporating the same brine, the salt contained 1·5 per cent. of sulphate.

For a yearly production of say 15,000 tons of salt, it would require a plant with engines of about 150 horsepower. The exhaust steam from the engine is sufficient to dry the salt. The result would be an expenditure of something like 3½ cwt. of coal per ton of salt obtained. By this process, I understand, the wear and tear on pans is very slight, there being no such thing as scaling, and the crystals can be removed with the greatest ease.

### Discussion.

The Chairman said they should consider what refrigeration was capable of attaining in the extraction of salt from brine. They all knew that by the ordinary method of evaporation 10 cwt. of fuel is used to the ton of salt. He would be glad to hear the opinion of experts with regard to multiple effects by which a great economy of fuel is possible.

Professor Campbell Brown considered the removal of common salt from solution to be a bad example of the application of the refrigerating method, the solubility being much the same in cold as in hot water, and if it could be made to pay with common salt, much more would it be profitable to apply the process to some other substances. The process, from the theoretical point of view, would be most economical and advantageous in the removal of salts from solution by bringing about crystallisation at a low temperature without actually converting the water into ice, because the latent heat of water was high.

Dr. Hurter remarked that in discussing the question as to whether evaporation or refrigeration was the more efficient means of obtaining or separating a solid from a liquid, the first question that arose was, "What was the cost of either process?" Hitherto the cost of refrigeration had always been stated per ton of ice produced. For other purposes that mode of stating the cost was extremely vague, and for many calculations useless. In the first place, they should ask the question — how much refrigeration did it require to make a ton of ice? He had seen it put down in Prof. Zeuner's "Thermodynamik" that 1 lb. of ice meant the transfer of 100 calories from one liquid to another between the limits of + 15° C. and − 8° C. In such processes as Mr. Wylde had applied, they had to go further than $-8^\circ$ C. The number of calories that could be transferred from one liquid to another per horse-power depended upon the limits of temperature. If he had a condensing water at 15° C. or 10° C., in which during absorption the heat rose to 20° C., and a refrigerator to cool the liquid down to $-20^\circ$ C,, the number of calories transferred per horse-power-hour would be much less than in the manufacture of ice, and cost a good deal more. He would like in future to see the cost stated, instead of per ton of ice, per horse-power-hour, putting on the latter the whole of the interest on the machinery, the losses of ammonia, and the labour; they would then be able at once to apply the cost to any process of refrigeration as desired. From information at his disposal he found that one horse-power-hour calculated in this way was very expensive, and came to nearly twopence; that was including interest on the capital, &c. He believed it could ultimately be brought a great deal lower, and it ought to be done for a halfpenny per hour. If they wished to calculate any particular refrigerating process, they must know the highest and lowest temperature at which they worked. It was next to impossible to get the temperatures of the ammonia in the machines, but it was possible to get the temperature of the liquids which they had to cool, and of the condensing water, which they used for taking away the heat from the compressed gases. He had carefully studied the reports of the Polytechnic Society of Munich, on the Linde and Pictet's machine working with ammonia, and found that with ranges from $-20^\circ$ C., up to $+35^\circ$ C., the number of calories which could be transferred per horse-power-hour could be calculated almost accurately by means of Carnot's formula $L = \frac{Q(T_1 - T_0)}{T_0}$, provided it was considered that the actual amount of heat transferred would be 42 per cent. of the theoretical amount, so that they would see how far the freezing machine was then (1890) still from the theoretical yield which could be expected under the given conditions. The main reason why only 42 per cent. was got was that in order that heat may be transferred from the brine to the ammonia there must be a difference between the temperature of the brine and the ammonia, and there was bound to be such a difference between the ammonia gas and the condensing water. The limits of temperature between which the ammonia in the machines worked was greater than that registered by the thermometers in the refrigerator or condenser. That greater range of temperature was such that in an experiment in which the difference of temperature between condenser and refrigerator was only 15° C., the real difference between the ammoniacal vapours and liquid amounted to nearly 25° C., and as the power needed was proportional to the difference of temperatures, they would see at once what influence this greater range had; that was, if he took the observed 15° or the real 25° as the difference, that explained at once the great amount of power needed as compared with that calculated by Carnot's formula.

As to applying refrigeration to common salt, he thought, with Dr. Campbell Brown, that that was the worst example that could be chosen. When the temperature was lowered to $-15^\circ$ C. the salt separated as $NaCl + 2H_2O$, and at $-21^\circ$ C. it separated as $NaCl + 10H_2O$; they all knew that brine contained about 26 per cent. of salt, and if they calculated it out they found it constituted nearly as $NaCl + 10H_2O$; it would be necessary therefore to evaporate as much water from $NaCl + 10H_2O$ solid as from the original brine. Looking into the tables of solubility of common salt, he found that at ordinary temperatures 100 parts of water would dissolve 35 to 36 parts of common salt, whilst at $-15^\circ$ only 32 to 33 parts. Therefore refrigerating from $+15^\circ$ C. to $-15^\circ$ C. would mean the removal of about 3 lb. of salt per 100 lb. of water, and he did not think the refrigerating process could be made to pay under those conditions. He had for himself calculated at a very low figure what it would cost per horse-power-hour, including interest on the capital, loss of ammonia, &c., and had come to the conclusion that it would cost about 9*s.* per ton of salt to freeze it out, apart from labour. All that of course depended upon how much of the salt would crystallise out between the limits of temperature employed.

He did not believe that the refrigerating process could compare at all with multiple-effect evaporation; he knew that apparatus was made which would evaporate 36 lb. of water per lb. of fuel. Refrigeration was best applied to salts whose solubility rises at a rapid rate with increase of temperature, and which have no water of crystallisation. One salt to which the process might be applied was carbonate of soda, common soda crystals, but there a difficulty was encountered—the salt crystallised with 10 mols. of water, and the separation required as many calories per ton as ice.

Mr. Howell said he might confirm what Dr. Hurter had stated. By means of a boiler and quadruple effect his firm had evaporated 36 lb. of water per lb. of coal—equal to 36 tons of water per ton of coal. Last week they had a report with reference to a triple-effect distilling apparatus erected in South America, in which an evaporation of 25 lb. of water per lb. of coal had been maintained. It seemed to him that, judging from these and similar results, it would be impossible for refrigeration to compete with evaporation in producing salt, assuming that a proper multiple effect was designed for the purpose. In no machine as yet introduced for ice-making was there anything like the same quantity of heat transferred per lb. of coal as by a multiple-effect evaporator. Cold-air ice machines produce, on the average, about $2\frac{1}{2}$ tons of ice per ton of coal—the worst result. Other machines vary from $2\frac{1}{2}$ tons to $12\frac{1}{2}$ tons per ton of coal. According to the figures given by Mr. Tate, $3\frac{1}{2}$ cwts. of salt had been produced in a refrigerating machine per ton of coal, and it would not be difficult to design a double-effect evaporator to do more than this. The result would of course in either case depend on the strength of the brine used.

Mr. Tate, in reply, said that, with regard to the commercial side of the question, the communication he had had from Mr. Lightfoot in this respect was only given to him quite recently, and he had given it to the members present for what it was worth. Of course they would all recognise the fact that the cheaper they obtained salt the better it would be for chemical manufacturers. He quite agreed that salt was a very unfortunate example in comparing refrigeration with evaporation, so he thought that if any good results had been obtained from the process, which had been suggested from Switzerland, it should encourage them to have good hope indeed for refrigeration.

Dr. Hurter then remarked, with regard to the commercial success in Switzerland, that it struck him it was a local possibility. It was an advantage for saltworks in Switzerland that they had water-power near them. He remembered, years ago, an attempt being made to utilise water-power in evaporation of brine; that had now been abandoned. No doubt in Switzerland, with a compressor driven by cheap water-power, refrigeration might be a commercial success compared with evaporation, as coal there was expensive.

* * *

## THE INFLUENCE OF OXIDE OF IRON AND ALUMINA IN THE REVERSION OF SUPERPHOSPHATE.

BY ALFRED SMETHAM, F.I.C.

It has long been known to manufacturers of superphosphate that, in order to produce the maximum of solubility of phosphoric acid, it is necessary, before treatment with sulphuric acid, to grind the raw phosphate sufficiently finely to pass through a sieve of six to ten thousand meshes to the square inch. The reason for such fine grinding will be better understood by a consideration of the changes which take place during the manufacture of superphosphate.

When sulphuric acid is added to tribasic phosphate of lime, a variety of reactions may take place, the extent of the reactions depending on many conditions, but chiefly upon the relative proportions of phosphate to acid. If the sulphuric acid is in excess the whole of the lime combines with the sulphuric acid, while phosphoric acid is liberated in the free state, thus:—

$$Ca_3P_2O_8 + 3H_2SO_4 = 2H_3PO_4 + 3CaSO_4.$$

If, on the other hand, the sulphuric acid falls short of the quantity required to complete this reaction, and the mixing of the phosphate and acid is sufficiently intimate, then a portion of the lime remains in combination with the phosphoric acid in the form of acid phosphate of lime, thus:—

$$Ca_3P_2O_8 + 2H_2SO_4 = CaH_4P_2O_8 + 2CaSO_4.$$

In practice it is found convenient and economical to use sufficient acid to produce a reaction coming in between these two points, with the result that most of the samples of superphosphate in the market are found to contain free phosphoric acid as well as the soluble mono-calcic phosphate.

If less acid is used than is required to convert the whole of the tribasic phosphate into monobasic phosphate, or if the grinding has not been sufficiently fine, so that local reactions are likely to take place, the monobasic salt first produced reacts on the unattached phosphate, forming a dibasic salt which is insoluble in water, and, so far as the English market is concerned, of no value, thus:—

$$CaH_4P_2O_8 + Ca_3P_2O_8 = 2Ca_2H_2P_2O_8.$$

The extent to which such "reverting" action may take place in partially attached superphosphates is determined solely by the relative amounts of acid and phosphate, and by the length of time the mixture is kept. In some instances which have come under my observation, the soluble phosphate in bone superphosphates has been reduced in the course of a year from over 20 per cent. to almost *nil.* In the manufacture of mineral superphosphate, however, where fine-grinding is the rule, and where the mixing is complete, and the acid usually in excess of that required for the transforming of the tribasic phosphate to monobasic form, reversion due to the formation of a *bibasic* phosphate is seldom, if ever, met with, and may almost, for the purposes of the present discussion, be dismissed from our consideration. It is only where the grinding, either through accident or design, has not been sufficiently fine that such reversion takes place, the monobasic phosphate in direct contact with tribasic phosphate forming locally the dibasic salt, which is protected from the excess of acid by itself and by the gypsum found in the reaction.

The mineral phosphates of commerce are not, however, composed wholly of phosphate of lime, but invariably contain impurities, either as an integral part of their structure or by admixture. Such impurities are oxide of iron, alumina, carbonate of lime, fluoride of calcium, sand, &c., all of which, with the exception of the first two, have little effect upon the finished product, provided sufficient sulphuric acid has been used to ensure their complete decomposition. The first two, however, have long been believed to exercise a very prejudicial effect upon the keeping properties of superphosphates, as it was found that on keeping the soluble phosphate diminishes in some cases to a very appreciable extent. Hence, of late years it has been customary among the large manufacturers to stipulate in the contracts for a small minimum per-centage of oxide of iron and alumina, any quantity above that fixed amount to be considered as reverting double its weight of soluble phosphate, and a proportional amount deducted from the invoice.

How that particular factor became first to be used I do not know, but it is evidently based on the following supposed reactions:—

$$CaH_4P_2O_8 + Fe_23SO_4 = 2FePO_4 + CaSO_4 + 2H_2SO_4 \text{ and}$$
$$CaH_4P_2O_8 + Al_23SO_4 = 2AlPO_4 + CaSO_4 + 2H_2SO_4$$

from which it may be calculated that 160 parts of $Fe_2O_3$ will revert phosphate equal to 310 parts of tribasic phosphate of lime; while 103 parts of alumina will revert the same amount. Until of late years nearly all the mineral phosphates in the market contained proportionately more oxide of iron than alumina, and thus, doubtless, a sort of compromise was made, which has been accepted ever since by merchant and manufacturer alike without comment.

As my observations in the analysis of a very large number of samples of superphosphate from many different sources led me to suspect that the reversion was very unequal, I determined in 1893 to start a series of experiments with a view of ascertaining, if possible, the relative effects of oxide of iron and alumina in causing retrogression.

The problem, simple as it may seem at first glance, is really a very complicated one, because, as I found from some preliminary experiments, no reliance can be placed on purely laboratory tests. In the manufacture so much depends upon the temperature generated in the den, and the retention of the heat by the large bulk dealt with, that it would be impossible to adequately imitate the conditions on a small scale, and consequently the primary reactions are not to be relied upon. I, therefore, considered it better in approaching the subject to start with samples about the manufacture of which there could be no cavil.

Original Sample 771.

| —— | Soluble Phosphate. | Insoluble Phosphate. | Soluble. | | Insoluble. | |
|---|---|---|---|---|---|---|
| | | | Oxide of Iron. | Alumina. | $Fe_2O_3$ | $Al_2O_3$ |
| 28th October 1893 | 25·97 | 3·21 | .. | .. | .. | .. |
| 12th October 1894 | 25·48 | 3·63 | 0·41 | 0·85 | 0·45 | 0·03 |
| 17th December 1894 | 25·21 | 4·05 | 0·16 | 0·19 | 0·70 | 0·19 |
| Original sample + 1·36 per cent. $Fe_2O_3$ as sulphate | | | | | | |
| 11th November 1893 | 24·11 | 5·07 | .. | .. | .. | .. |
| 11th October 1894 | 23·09 | 6·02 | .. | .. | .. | .. |
| 12th December 1894 | 22·79 | 6·47 | 0·50 | 0·41 | 1·66 | 0·10 |
| Original sample + 1·1 per cent. $Al_2O_3$ as sulphate | | | | | | |
| 11th November 1893 | 25·80 | 3·38 | .. | .. | .. | .. |
| 11th October 1894 | 24·65 | 4·46 | .. | .. | .. | .. |
| 12th December 1894 | 24·19 | 5·07 | 0·20 | 1·14 | 0·75 | 0·37 |

When a superphosphate is manufactured from phosphate containing oxide of iron and alumina, and is analysed directly it leaves the den it is usually found to contain only a comparatively small amount of insoluble phosphate, but on keeping the percentage of insoluble phosphate increases and the soluble correspondingly decreases, the retrogression going on more slowly as the time progresses.

In the experiments which I desire to bring before your notice I have endeavoured to approach the subject in two ways; first, by determining the effect produced by known quantities of oxide of iron and alumina, and secondly, by ascertaining the solubility of these substances at various periods. By the adoption of the two methods I have, I believe, eliminated any errors that might be due to reversion other than that caused by the oxide of iron and alumina.

A sample of superphosphate (see previous page), testing 25·97 per cent. of soluble phosphate and 3·21 per cent. of insoluble phosphate, was mixed intimately with persulphate of iron containing oxide of iron equal to 1·36 of the superphosphate taken, and the soluble phosphate estimated at various periods.

From these results it will be seen that 1·36 per cent. of $Fe_2O_3$ reverted at once 1·86 per cent. of soluble phosphate, and on keeping nearly a year 2·39 per cent., and in 15 months 2·42 per cent., the theoretical quantity being, according to the reaction previously given, 2·63 per cent.

The results obtained after the addition of the alumina are by no means so marked. The amount reverted at once was exceedingly small, 0·17 per cent. At the end of a year the reversion due to the added sulphate of alumina was 0·83 per cent., and at the end of 15 months, 1·02 per cent. Had the reaction which is generally assumed to take place obtained in this instance, the reversion should have been 3·33 per cent. instead of less than one-third that amount.

The next superphosphate experimented with was prepared about a fortnight previously, and was manufactured from—

| | | | |
|---|---|---|---|
| Carolina phosphate | 7 | 0 | 0 |
| Belgian „ | 3 | 0 | 0 |
| Acid at 115° | 10 | 3 | 14 |
| | 20 | 3 | 14 |

The following were the results :—

| — | Soluble Phosphate. | Insoluble Phosphate. | Soluble. | | Insoluble. | |
|---|---|---|---|---|---|---|
| | | | $Fe_2O_3$ | $Al_2O_3$ | $Fe_2O_3$ | $Al_2O_3$ |
| 12th November 1894 | 27·37 | 3·28 | 0·42 | 0·16 | 0·72 | 0·12 |
| 13th December 1894 | 26·81 | 3·91 | 0·32 | 0·26 | 0·80 | 0·68 |

In this case, it will be seen, the bulk of the reversion seems to be due to the oxide of iron, although it is greater than can be accounted for by that alone.

The next superphosphate was different to the last, in so far as it was manufactured from materials containing more alumina than oxide of iron, and had been made for four months previous to analysing.

The results were :—

| — | Soluble Phosphate. | Insoluble Phosphate. | Soluble. | | Insoluble. | |
|---|---|---|---|---|---|---|
| | | | $Fe_2O_3$ | $Al_2O_3$ | $Fe_2O_3$ | $Al_2O_3$ |
| 12th November 1894 | 32·54 | 0·98 | 0·40 | 0·60 | 0·15 | 0·10 |
| 13th December 1894 | 32·54 | 1·05 | 0·38 | 0·68 | 0·18 | 0·11 |

From these results it will be seen that although the sample had been made for five months, nearly all the $Al_2O_3$ are in the soluble portion, and the total insoluble phosphate only amounted to 1 per cent.

Thinking that in the absence of an excess of sulphuric acid the alumina might cause reversion to a greater extent than when present in sufficient quantity to liberate free phosphoric acid, I experimented with a sample which had been kept over from November 1893. When originally tested it contained 36·50 per cent. of soluble phosphate, but in a year the soluble had increased to 38·19 per cent. The results, when analysed in November 1894, were :—

| Soluble Phosphate. | Insoluble Phosphate. | Soluble. | | Insoluble. | |
|---|---|---|---|---|---|
| | | $Fe_2O_3$ | $Al_2O_3$ | $Fe_2O_3$ | $Al_2O_3$ |
| 38·19 | 5·10 | 0·20 | 0·51 | 0·62 | 0·28 |

In this case it is quite evident that although the insoluble phosphate is high, it is caused neither by the oxide of iron nor the alumina, but by insufficient acid. In spite of this, however, nearly two-thirds of the alumina are soluble in water, while three-quarters of the oxide of iron remain insoluble.

A review of the facts already obtained makes it pretty certain that there is a wide difference in the behaviour of oxide of iron and alumina in the manufacture of superphosphate. The first, for practical purposes, seems to revert phosphate in what may be called theoretical proportions, viz., 160 : 310, or as nearly as possible 2 parts of phosphate to 1 of oxide of iron, while the alumina, which, if acting in the same manner as oxide of iron, would revert three times its weight of phosphate, at most seems to cause a retrogression of its own weight. It has long been known that superphosphate manufactured from Florida phosphate increases in the percentage of soluble phorphate instead of retrograding, and as this phosphate contains scarcely any oxide of iron, but 2—3 per cent. of alumina, it was difficult to understand this behaviour. The foregoing results, however, explain the matter.

Under these circumstances, and especially as many of the phosphates now coming into the market contain alumina in larger proportions than oxide of iron, it appears to me that there is pressing need for a revision of the terms of the contracts on which phosphates are usually sold, and for a differentiation of oxide of iron and alumina in the analysis upon which the sales are made. Probably the best method of approaching the matter would be for those interested to appoint a joint committee of merchants, manufacturers, and analysts to consider the subject, and to report upon the best way of dealing with it equitably.

# Manchester Section.

ROOMS OF THE CHEMICAL CLUB, VICTORIA HOTEL.

*Chairman:* R. Forbes Carpenter.
*Vice-Chairman:* Edw. Schunck.
*Committee:*

G. H. Bailey.
F. H. Bowman.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
P. Hart.
J. M. Irving.
E. Knecht.
I. Levinstein.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
W. Thomson.

*Hon. Local Secretary:*
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

SESSION 1894–95.

March 1st:—
Mr. G. J. Fowler, M.Sc., and Mr. P. J. Hartog, B.Sc. "Notes on certain Silver Alloys."
Mr. G. H. Hurst, F.C.S., &c. "Modern Developments in Colouring of Textile Fabrics, and a Note on Dog Fat."

* * *

*Meeting held Friday, February 1st, 1895.*

MR. R. FORBES CARPENTER IN THE CHAIR.

## NOTES ON ACETYLENE.

BY R. FORBES CARPENTER.

The CHAIRMAN explained to the meeting that in consequence of severe indisposition, Professor Wanklyn was unable to travel and to give to the meeting the paper which doubtless so many had come specially to hear, on "Fractional Distillation and its Results." Meanwhile, in the first half-hour devoted to matters of general interest, he desired to draw the attention of the Section to the commercial production of acetylene and its possible technical uses, a subject which had recently created a most marked sensation among gas engineers and chemists, especially through the brilliant lecture delivered at the Society of Arts last month by Professor Vivian Lewes. As he noticed that on the following Monday the London Section was to have the benefit of a paper by Mr. Lewis T. Wright, the Society would probably learn something of more value on this matter than anything he could put before them to-night. This section had reason to be grateful to Mr. L. T. Wright in past years for the extremely valuable paper he had read here on chemical points arising in gas manufacture, on which he was such an acknowledged authority. The Chairman then briefly noticed the production of calcium carbide, and the production of acetylene by its decomposition with water. As to whether acetylene at 6*s.* 4$\frac{1}{2}$*d.* per 1,000 feet could compete as an enricher of poor coal gas with carburine, or even benzol, was a moot point that only further experience could solve. The point that had struck him specially was the extreme whiteness of the flame of acetylene when burned in a small flat flame burner ($\frac{1}{2}$ foot an hour) as described by those who were present at the Society of Arts lecture. Professor Lewes stated that the temperature of the flame was under 1000° C. tested by the Chatelier couple, and 16-candle gas has a temperature of 1400° C. The whiteness therefore cannot be a function of temperature, as is the case with gas burned in regenerative (*e.g.* Wenham) burners; but the question suggested itself to his mind whether it was not attributable to the high carbon density of acetylene, a larger number of carbon atoms being liberated in a given area and raised to incandescence. Still he understood that a benzol flame of the same carbon density did not possess the marked whiteness, and that the acetylene flame was cooler than that of an albo-carbon or oil gas flame of the same size. He would much like to elicit information on this point.

The meeting would remember Professor Lewes' contributions to the elucidation of the chemical changes occurring in the combustion of complex hydrocarbon mixtures, that the first work done in the flame was to break down the higher moleculed hydrocarbons to simpler ones, and finally to acetylene, which then at 1200°—1400° C. became the source of light in itself, breaking up and undergoing subsequent complete combustion; this view would not accord with the laws enunciated as regards endothermic bodies by Professor Ostwald which, theoretically, increased in stability with rise of temperature; still, direct experiment had demonstrated that Professor Lewes had solid grounds for his theory, and when once an endothermic body began to break up it found its own heat to continue. As acetylene is, in this view, the end of all enrichers, is it likely, commercially, that a dear substance like specially prepared acetylene can compete? Professor Lewes has stated that he is now engaged in a series of tests of percentage enrichment values of acetylene, a research requiring the observance of great precautions even by trained experts. Its results would be awaited with great interest.

### DISCUSSION.

Mr. GRIMSHAW had not heard of this new discovery, but it had occurred to him that (from a commercial point of view) it had a very strong competitor in the field in the form of naphthalene as a gas enricher, and he was surprised that it had not come more into vogue. The only reason he could assign for this was the aversion people had to a little extra trouble. It gave double the illuminating power, and it could be produced at 9*l.* per ton. He strongly recommended the use of naphthalene as a gas enricher, and if brought more into general use would reduce the price of Manchester gas by something like one-half.

Mr. THOS. DUXBURY, gas manager, Darwen, said gas managers were looking forward to the production of an illuminant which would be cheaper than coal-gas, but he was doubtful whether acetylene could be produced on anything like a commercial scale at a sufficiently low price. With respect to the albo-carbon light he had made some experiments with 18-candle gas. He burned it 40 hours in succession, measured its photometric value as it was consumed, and he also weighed the amount of napthalene used. During the whole of that time he took a record of the illuminating power every half-hour and he found there was a slight saving, at the same time there was danger of smell if the plug of the containing vessel was not properly screwed down.

Mr. SCUDDER said that this subject had occupied his attention for some considerable time as he had been professionally consulted on it by a firm in North Carolina, and if it would be interesting to the meeting he would be glad to show a sample of carbide of calcium and the production of acetylene therefrom. Mr. Scudder having obtained a sample from his laboratory proceeded to say that the value of this material for enriching coal-gas depended entirely upon the cost price of production. If it could be satisfactorily proved that the material could be produced at a price not exceeding 4*l.* per ton there would no doubt be a future for it. If, on the other hand, the material was only a by-product produced in the manufacture of aluminium then he thought its future application could only be very limited. Carbide of calcium deteriorates on exposure to moist air, and consequently the yield of acetylene would depend upon the physical condition of the carbide. It was a hard substance of high specific gravity, and a ton of the material yielded about 12,000 cubic feet of acetylene-gas.

Dr. WEBER wished to know if Mr. Scudder could give any particulars as to the yield of calcium carbide per Ampère-hour or Watt-hour that would enable them to calculate the cost of the carbide independent of any other process, and further he would like to know if he (Mr. Scudder) was satisfied that the whole of the 12,000 cubic feet were really acetylene, because there was a likelihood of hydrogen being given off as well as acetylene, and in that case the lighting power would be very considerably reduced. He (Dr. Weber) was quite certain that in the decomposition of calcium carbide by water, there is a certain proportion of hydrogen mixed with the acetylene produced. Mr. Carpenter had suggested the superior candle power of the acetylene light to be a function of the carbon density of acetylene, by which term he (Dr. Weber) supposed he meant the ratio between the carbon and hydrogen; but in this respect he might perhaps point out that while the carbon density of benzene is identically the same as that of acetylene, the lighting power of the former was far inferior to that of the latter. This might be due to the energy which had to be expended in the process of splitting up the benzene molecule into three molecules of acetylene, but theoretical speculations of this kind were apt to mislead. Of course it is well known that the increase of the hydrogen in a hydrocarbon is accompanied by a decrease of its lighting power, so that *vice versâ* an increase of lighting power is to be expected to follow from the increase in carbon density, but the exact relation between hydrogen density on the one hand, and carbon density on the other hand, to the lighting power of the hydrocarbon is not known at the present time. As a matter of fact he was doubtful whether such a relation pure and simple existed at all, and whether on full investigation of the subject the lighting power of a hydrocarbon would not be found to be also a function of its final constitution.

Mr. Scudder.—With regard to Dr. Weber's remarks he could not say whether there existed traces of hydrogen gas in the acetylene or not. He would be very glad to test this more minutely and report the result. He might, however, say that he did not think there was any hydrogen in it because he had proved that the gas he had obtained from the decomposition of the carbide with water was completely absorbed by the copper solution forming the well-known compound, acetylide of copper. A very important use of acetylene would be for carburretting water gas, and it would also have the advantage of communicating a decided odour to water gas which they knew *per se* is odourless, and thus one of the greatest drawbacks to water gas as an illuminant would be removed. With regard to Mr. Grimshaw's remarks *re* the use of naphthalene, in the albocarbon light, it was clear that it could only be used at the point of ignition, and every gas manager is aware that naphthalene gives him trouble when it makes its appearance in the service pipes. In the albocarbon light the illuminating power is obtained almost entirely from the naphthalene; there is a loss of 70 per cent. of the illuminating power of the coal gas when burnt in a burner used for the albocarbon light; in other words the vehicle is too expensive, and it would be better to use non-luminous gases such as water gas or gases of low illuminating power such as are used for cooling and heating purposes.

Mr. G. Fowler remarked that acetylene was decomposed by a shock such as that produced by the explosion of a percussion cap, and it would therefore be dangerous to store it under pressure in bulk for such purposes as Prof. Lewes had suggested, *e.g.*, in the lighting of railway carriages.

Dr. Weber thought it more probable that the reaction mentioned by Mr. Fowler was due to sudden polymerisation and not to decomposition. He illustrated this by experience he had met with in the investigation of isoterpenes, the heat evolved in the sudden formation of these condensation products might produce partial decomposition with deposit of carbon.

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### Errata,

*January Issue*, 1895.

In the second line of the Chairman's remarks on Mr. Le Neve Foster's paper (p. 11, col. 1), for "him" read "the same author."

In the third line of Mr. Grimshaw's remarks on the same paper (p. 12, col. 1), after the word "Manchester" insert the word "Chemical."

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University College, Nottingham.

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.—Mr. Jas. O. Sullivan: "Note on the Estimation of Cane Sugar."

*Meeting held at University College, Nottingham, on Wednesday, December 12th, 1894.*

MR. J. M. C. PATON IN THE CHAIR.

## RECENT EXPERIENCES WHEN PUTTING UP A STEAM BOILER.

BY F. J. R. CARULLA.

That chemical knowledge may play an important part in the process of steam raising is now well recognised, after the numerous careful investigations conducted by some of our ablest members on the subject of preventing boiler incrustations. It is, however, on a different ground that your attention to the question of the use of steam is directed this evening. The gas engine is making such rapid advances, not only when employed for supplying motive power in the lighter trades, but also in relation to the heavier branches, that at no distant date, steam raising threatens to become a lost art for the mechanical engineer, but still needed by the industrial chemist. The installation of a new boiler is an event in store for some one who has no experience of such work. It is especially hoped that the present paper, and the discussion to follow, will afford some useful hints to any one placed in that position. Having decided to have a new boiler it is necessary to make up one's mind how to get the work done. Three courses are obviously open, viz: (1st), to do everything oneself, including the preparation of the specification; (2), to take the boiler maker's advice; or (3rd), to obtain the opinion of an independent expert. The first is not the safest way, even for anyone having some knowledge of the matter. The second course is hardly feasible if one wishes to obtain more than one tender. The only wise course, and the most economical in the end, is certainly the third, and who can be better experts than the engineers of the boiler insurance companies who make this subject their life study? We (the Sharon Chemical Company, Limited, Derby), gladly consulted with Mr. Crosland of the Boiler Insurance and Steam Power Company, and are pleased to acknowledge our indebtedness to his kindly aid.

It was decided to have a boiler of the Lancashire type. We were compelled to make the boiler shorter than we should have liked, and we were also obliged to send the products of combustion a round about way, having no alternative but to place the furnace end of the boiler close to the chimney, the shaft of which rises to a height of hardly 50 feet above the ground. This circumstance renders the plan of some interest, as it was at first feared that the draught would be interfered with and that possibly it might become necessary to use some arrangement for forcing it. Far from this being the case there is all the draught needed and in fact plenty to spare. It will be noticed that the flues are of ample dimensions and that the outermost is used for a drying hearth.

It was studied to have a sectional area of four square feet at least throughout the course of the flues.

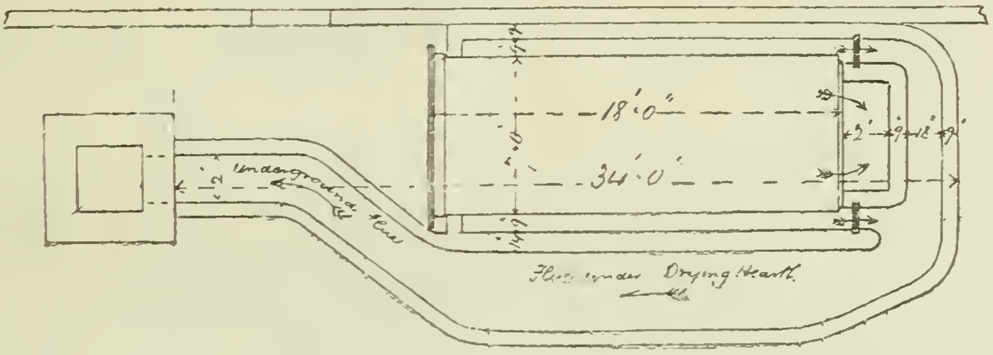
The leading dimensions of the boiler agreed upon were—

| | Ft. | in. |
|---|---|---|
| Length | 18 | 0 |
| Diameter of shell | 7 | 0 |
| " flues | 2 | 9 |
| Thickness of shell plates | 0 | $\frac{1}{2}$ |
| " end plates | 0 | $\frac{9}{16}$ |
| " flue plates | 0 | $\frac{13}{32}$ |

It was to be made of mild steel of an approved brand, and to be tested by hydraulic pressure to 180 lbs. per square inch. It was arranged that the new boiler should have only two holes on the top for the mountings besides the man-hole. We were at the very outset recommended to have a boiler capable of working at a pressure of 100 lbs. to the square inch. As our requirements did not exceed 45 lbs. it might not have occurred to us to more than double the pressure conditions, yet when it was considered that 20*l.* covered the difference in cost between a boiler capable of working at 80 lbs., and another to work at 100 lbs., in view of future possibilities it was obviously prudent to obtain a reserve of force purchased so cheaply. Having decided to have the stronger boiler, and that it was to be of steel, the specification was prepared. On going through it one might almost have thought that no boiler maker would be found to entertain the onerous conditions it contained. Nevertheless no difficulty was experienced in obtaining tenders and the very stringent conditions did not deter any of a considerable number of firms who tendered, a fact that shows plainly how well abreast of modern requirements the leaders of the boiler making industry in England have placed themselves.

The greater portion of the steel used in boiler construction is as yet the product of the Siemens' furnace, obtained by the acid process, but the basic process is also contributing plates destined to the same end. This fact is of special interest to us, as the basic process in its complete form, represents the solution of the most intricate chemical problem in the metallurgy of steel. When it is considered that the basic process, with the improvements recently introduced by Mr. Saniter, for the removal of sulphur by means of calcium chloride, produces steel equal to Swedish bar (Journal of the Iron & Steel Inst., 1–1894, 554), we may well rejoice to learn that the use of the material is extending, especially as everything needed for its manufacture is to be found in England. There can be no doubt that there is a great future at home for the basic process which has been so warmly taken up in Germany as to make the competition of that country keenly felt by us. The method that was successful in making general the use of Siemens' acid plates, is bound to succeed if applied to the material obtained from the same furnace with a basic lining. No plate is allowed to pass into a boiler without undergoing a series of severe mechanical tests that ensure the correct temper of the steel. Basic steel can be made that will stand all these tests, and so long as the steel makers are careful to supply plates that conform to such requirements there can be no doubt that their use for boilers will rapidly increase. It was only by the exercise of extreme care that mild steel from the acid furnace, succeeded in taking the place of the best qualities of iron, with enormous benefit to the steam user, who was at first very shy of the new material. With equal precautions to prevent the introduction in any particular case of plates unfit for the purpose intended, it is certain that basic steel will receive the same share of confidence. The opinion of some engineers, that steel that will not stand punching is unfit to be put into a boiler is a perfectly true one, for the process of punching affords a complete test of the quality of the plate. Unfortunately holes are not always punched exactly in the place intended so that this danger neutralises what would otherwise be a decided gain. How very little the operation of punching need injure the steel may readily be seen from one of the specimens that Mr. C. J. Stoddart of the Park Gate Iron & Steel Company has been good enough to furnish for purposes of illustration. This specimen, originally a square plate, has first been dished in the centre showing its perfect ductility, then it was punched with holes all round the edges, and finally the corners have been bent over. The turned corners thoroughly distort the punched holes in those localities without showing the minutest indication of a crack. The remaining specimens also give evidence of the high quality of the plates that are made from open hearth basic steel, and from their appearance one can safely say that they are well adapted for any purpose where plates are used.

Fig. 1.



Plan of Boiler Setting.

It will have been noticed that the steel for the furnaces and flues is softer than that for the shell plates. This was rendered necessary because the flues are welded, but the softer character of the material in no way militates against their strength. The flues are stiffened by the well known Adamson rings placed at distances of about 2 ft. 9 ins. from each other. The British Association is so often accused of being engaged in the pursuit of mere holiday science, that it may be well to remember that it was at the joint request of that body and the Royal Society that William Fairbairn conducted those experiments that first gave the engineer correct information on the strength of boiler flues. Adamson doubtless made very considerable improvements in the shape of the flue rings, and by his arrangement that invaluable property of elasticity in the tube is conferred that no rigid angle-iron ring could provide.

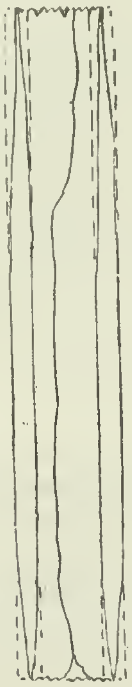
Before leaving the subject of the internal flues, mention may be made of the firebars. The name of these appliances is legion, and it is a puzzle not of easy solution to make a choice. After a long experience of many forms we adopted the hollow bars made by Mr. J. Shaw of Chesterfield. For the prevention of black smoke, we have found nothing to equal hollow bars of almost any shape, as the unburnt gases become intimately mixed with the warm air that passes through the hot bars, and complete combustion is effected. Shaw's bars have a great advantage over some others in that the tubes being straight can be seen into, and can be easily cleaned with a rod or hook, whilst this does not prevent the use of the "steam-brush" if desired. Those shapes in which the tube of the fire bar is bent can only be cleaned by blowing steam through. We have found this limitation to be a disadvantage in some cases.

Leaving the boiler itself we first come to the various valves, cocks and gauges that are necessary to admit the water, control the steam, and indicate what is going on within the boiler. These formerly were very simple appliances, but they have gradually become somewhat complicated and expensive. As much care is bestowed in a specification in particularising these attachments as in describing the boiler itself.

The blow-off cock is so constructed that the spanner cannot be taken off until the tap has been closed. As the importance of frequent blowing off is well known whilst a boiler under pressure may be emptied in a few minutes, the security that such a provision affords against the accident of leaving the cock open will be appreciated.

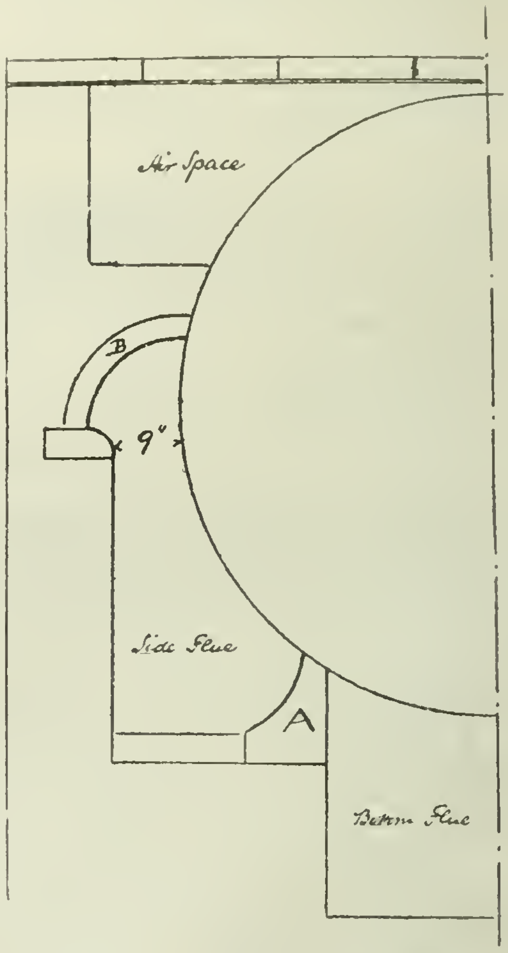
Another provision against accident that we have adopted is Fletcher's automatic "Positive safety water-gauge" by which in the event of the glass breaking, ball valves instantly close the openings, and prevent the rush of water and steam that would otherwise occur. That such an appliance is desirable, at least in our case, will be perceived from an inspection of the split gauge glass submitted to the meeting which was one of the last to break in our old boiler (Fig. 2). This glass tube has both ends worn down to a knife edge by the solvent action of the fluids in which these ends were immersed. It will be seen that not only the bottom end which was in the water has been so dissolved, but also the upper one in the steam space. This shows that the action cannot be due to any substances held in solution by the water, as were this the case only the lower part of the glass tube would be eaten away, and not also the upper part that was in contact with the steam alone. It certainly does at first sight appear as if the phenomenon were due to the solvent action of water pure and simple, whether in the liquid form or as vapour. If this be not so, the agent must evidently volatilise with the steam. But look at the matter as we may, there seems to be something puzzling, for the glass does not appear to have been worn away inside, at the middle, where the outside was exposed to the air. It is true that this part of the tube was in contact with the water and steam only on one side of the glass, but all the same, one would expect a certain amount of solvent action to be evident if this were brought about solely by the fluids. There would appear, therefore, to be in this some indication, either of an action on the glass induced by the proximity of the gunmetal by which the ends of the glass tube were surrounded, or of the presence of some agent capable of corroding glass in the india-rubber rings used for the packing. Again, it may be that the glass is soluble at the higher temperature to which the ends of the tube have been exposed, and insoluble at the presumably lower temperature of the middle of the tube where it was cooled by the surrounding air. But whatever the true explanation of the incident may be, the immediate practical value of the observation is to warn us that these glass tubes should be changed at regular intervals without waiting for them to break.

Fig. 2.



The external flues have already been referred to but there is one more point that may be noticed. Ordinary bricks are 3 ins. thick, whereas common fire bricks are only 2½ ins., therefore the two sorts of bricks will not "bond" or work together. Special 3 in. fire-bricks can of course be ordered for the purpose, but there appears to be no reason why the standard thickness of the two kinds of bricks should not be the same. Doutless where fire-bricks alone are used, as for some kinds of heating furnaces in forges, it matters nothing that they are only 2½ ins. thick, but where, as in setting boilers and similar work fire-bricks and ordinary red bricks require to be worked together, side by side, the adoption of a different standard of thicknes for each class of brick is a trouble. Special blocks are obtainable for the seating of the boiler (A, Fig. 3) and covers (B) can be had to suit any width of flue. In this connection it may be mentioned, how what promised to be a trouble, was turned to a decided advantage. By some misunderstanding 12 in. covers were supplied for the side flues instead of the 9 in. size that we required. The mistake was not found out until it was too late to change the covers, so the covers were placed on a row of round nosed bricks set on edge (Fig. 3) thus making a spacious recess for inspecting purposes. It seems to us that this accident has improved the flues rather than otherwise.

Fig. 3.



Sectional Sketch showing arrangement of Side Flues.

Special bricks are also made for covering in the boiler instead of using non-conducting composition. These bricks or tiles are made with studs so that they stand off the plates and enclose an air space that acts as a non-conductor. In this case the brick covers just described were not adopted. The reason for this was that the plan recommended by Mr. Crosland, ("The Engineer," February 9th, 1894, 121), of flooring in the boiler, appeared very practical and best suited for the purpose providing a floor or platform that facilitates access to the top fittings of the boiler and to the steam valves. All that was necessary for this arrangement has been to raise the side wall to the level of the top of the boiler; put ⊥ irons across of section $2\frac{1}{2}$ ins. × $1\frac{1}{2}$ ins. × $\frac{3}{8}$ in., and lay down tiles 18 ins. × 18 ins. × $2\frac{1}{2}$ ins. in the angles formed by each pair of adjacent bars. A very large closed-in air-chamber is thus obtained that, so far as can be seen, acts most efficiently as a non-conductor (Fig. 3). The only objection raised against this arrangement is that a leak is not readily perceived, but the removal of one or more of the tiles when there is cause for suspicion is a very easy matter, in fact the entire floor might be taken up and put down again at a very trifling expense.

The steam mains must also be covered over, especially if long and exposed to the weather. The steam user will have no difficulty in finding suitable compositions, and in this as in most other things it will generally be found the cheapest in the end to contract for the work with someone who makes it his business; nevertheless, the writer has known the following "home made" composition to have been used with advantage and economy where a large surface had to be covered.

| | |
|---|---|
| Clay | 80 parts by weight. |
| Cow dung | 8 " " |
| Chop | 2 " " |
| Cowhair | 1 " " |

This requires grinding in a mortar mill, the necessary amount of water being added. One ton will cover about 100 sq. ft. 2 ins. thick.

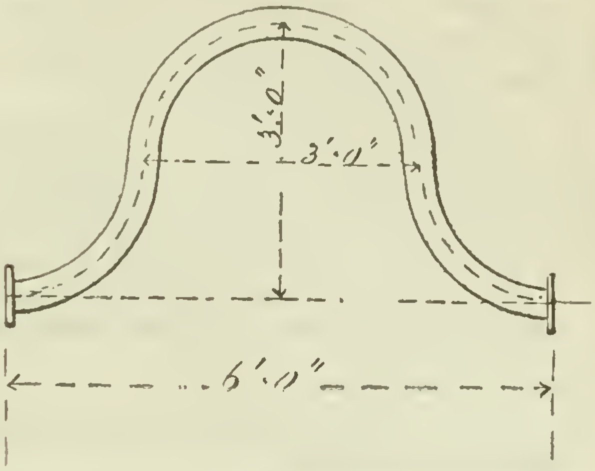
Whether economy would result in any case from the employment of such a composition will mainly depend on whether the clay can be had cheap. Where, as in the case referred to, the clay costs nothing, it is clear that no bought composition can compete with that made at the works.

It frequently happens, however, that one wants to cover some short length of pipe for which it is impossible to send for composition, and for a man to put it on without great extravagance. It will occur to everybody that to cover such a pipe with felt would be the cheapest plan. A patent hair felt adopted in the present case is supplied in rolls 4 ins. wide that any handy man with ordinary intelligence can easily apply. First a layer of roofing-felt is put on the pipe, this being also supplied in rolls 4 ins. wide. Then the patent hair-felt is laid on, and, lastly, another layer of roofing-felt, that forms the outer covering. A good coat of tar is given to the last layer, and a most efficient non-conducting cover is obtained which compares favourably in cost with the better class of compositions. The operation of pipe covering when damp compositions are used is performed whilst the pipes are hot and under steam. If felt be used the pipes might be covered when cold if desired, but even with felt the work will be better done when the pipes are hot, as it will bend better.

Another provision that long stretches of steam pipe require is that for expansion. As cast iron when heated to 212° F. expands 0·0011094 of its length at 32° F. or, say, $\frac{1}{1000}$, it is clear that when under steam a length such as we had to deal with, of about 150 ft., required attention in this respect. The expansion of such a length is nearly 2 ins. between the freezing and boiling temperatures alone. As it was desirable to fix the two ends some provision to take up the expansion was indispensable, and the most obvious was a plain sliding telescopic joint with a stuffing-box for packing. We had seen, however, the arrangement of a copper-syphon joint adopted by neighbours of ours who spoke so well of their experience with the syphon joint that one similar was adopted (Fig. 4). It promises well, having so far given us no trouble. The only improvement and one which would make this syphon-joint perfect is that it should lie flat. At present it is placed upright, and consequently provision has to be made for draining the condensed water when starting, so that it may not be forced over the syphon in a heavy mass and do damage.

Had the writer seen Mr. Driffield's paper (this Journal, Vol. VI. 183) in time he questions whether the present boiler would have been furnished with six Galloway tubes. The difficulty of getting about, not only within the internal flues, but also on the crowns with the mouths of the tubes forming regular traps, is a point that should be well compensated for by some advantage of an undisputed nature.

Fig. 4.



Copper Expansion Joint, Bore 3-in. Diameter.

Another point upon which opinions vary is the advantage of the exhaust steam injector. The objections are generally based on the idea that the return into the boiler of condensed water from steam that has been used in a greasy cylinder will damage the boiler, but the writer has not yet found anybody who had met with the accident. What decided the matter was the statement of the representative of the makers that an auxiliary supply of live steam passing through a half-inch pipe was necessary if the exhaust injector were required to lift the water two or three feet. On learning this, it was decided to continue the arrangement that had answered very well for many years of raising the temperature of the feed water through a plain heater into which the exhaust is turned, no condensed water being returned into the boiler.

In connection with the feeding of boilers it must often be desired by steam users that there were some automatic arrangement so that, without any care on the part of the attendant, the water in the boiler should retain its proper working level. It appeared so easy to apply an automatic valve to any of the low-water safety-valves that are worked by a lever that the writer suggested a design to one of the makers in the hope that so desirable an appliance might be put in the market. You will be interested in the account of what stands in the way of its success. They say: "We experimented some time ago with a similar arrangement, and we perfected a plan for automatically opening a valve for starting a feed apparatus, but our great difficulty was in obtaining a feed apparatus that would start without any coaxing, such as is the case with all injectors without exception. If, at the same time, a thoroughly reliable arrangement could be designed that would be positive in its starting, then such a combination would be of value; but so long as it is an injector, or the ordinary feed pump, we fear steam users and insurance companies would not take it up."

As the great thing is to know what to invent, the hint here given may be of service towards the realisation of the idea.

About a week was allowed before attempting to have high steam in the boiler from the time of first having a fire in it, but this has avoided any important cracking of the brickwork.

### Correspondence.

Mr. E. H. Saniter writes :—During the discussion on a paper by Mr. B. Dawson before the Cleveland Institution of Engineers at Middlesborough, Mr. Panton of Dorman, Long, & Co., and Mr. Bagley of the the Moor Steel Works, Stockton, both acid open hearth works, spoke most highly of the steel. In fact, Mr. Bagley is reported to have said : "He had recently been working some of the steel made from Cleveland white iron, and found it very satisfactory. It stood more severe tests for their plates than they had been able to get with their own acid steel. The quality was very regular. It had been made from ordinary white pig treated by the Saniter process, worked on a basic hearth." I think after this that there is no question as to its suitability for making boiler plates.

Mr. J. M. Gibson (of Buckley) writes :—Fire-bricks, $2\frac{1}{2}$ in. thick, called London bricks, are principally used there, and at the cement works on the Medway and in Ireland. These we stock, and are $8\frac{3}{4}$ in. × $4\frac{1}{4}$ in. × $2\frac{1}{2}$ in. Another size is 9 in. × $4\frac{3}{8}$ in. × $2\frac{1}{2}$ in. used by iron works, gas works, chemical works, &c. The 3 in. bricks are 9 in. × $4\frac{3}{8}$ in. × 3 in. also used by the works named and by contractors, and they are in all cases superseding the $2\frac{1}{2}$ in. for three reasons :—

1st. Because they make fewer joints.

2nd. Because they work or bond with common bricks.

3rd. Because a bricklayer will do more work with them in same time than with $2\frac{1}{2}$ in.

The following analyses of our bricks may be thought of interest :—

| Marks. | B.H.B. Brookhill Blue. | Flintshire White. | Metalline. |
|---|---|---|---|
| Silica...................... | 73·25 | 60·04 | 63·01 |
| Alumina...................... | 17·89 | 32·10 | 25·95 |
| Peroxide of iron............ | 5·91 | 4·71 | 6·49 |
| Manganese tetroxide ....... | ·40 | — | ·75 |
| Lime ...................... | ·41 | ·48 | ·83 |
| Magnesia .................. | ·36 | ·24 | ·40 |
| Soda ...................... | ·86 | ·95 | Trace |
| Potash .................... | ·83 | 1·46 | 2·57 |
| Organic matter and water .. | ·11 | ·10 | ·00 |
| | 100·02 | 100·08 | 100·00 |

B.H.B. are the best for boiler setting, although some people prefer the Flintshire White simply because they have been used to the idea that a fire-brick *must be white*, which is an error.

We have adopted grooves in the seating-blocks to allow for the rivet heads, also in order that if a leak takes place it can be easily located, and until it is the water can get away, and so prevent corrosion of plate.

Mr. C. J. Stoddart (Managing Director of The Park Gate Works), accompanied the specimens of basic steel exhibited with the following letter :—

"In accordance with your wish we have sent you a few samples of our basic steel, made by the Siemens-Martin process from which you will see that it is well adapted for plates of every description.

"The samples sent have all been bent and worked cold, not hot.

"As you are no doubt aware we also make plates by the Siemens-Martin acid process. Our plant consists of four 25 tons, and one 30 tons furnace, with a weekly output of about 900 tons.

"We are sending you also two pieces of $\frac{7}{8}$-in. plate, which have been welded and bent through weld *cold*."

Mr. Frederick Siemens wrote :—I quite endorse your remarks in reference to the application of basic open-hearth steel for such particular purposes as boiler plates, &c. Certainly, in Germany and other continental countries, this steel has largely been adopted in the manufacture of such plates, which has in many cases replaced the celebrated Lowmoor, Bowling, and other Yorkshire brands of iron. If the proper skill and care be exercised, I see no reason why the open-hearth steel melting furnace, having a bed composed of basic material, should not turn out quite as good steel from pig-iron made from phosphoric, or inferior English iron ores, as the sand lined open hearth furnace makes from pig-iron made from good hematite ores; for it still has the special advantage of giving sufficient time near the end of the operation to test the metal, both hot and cold, and also chemically if desired ; there being no difficulty in maintaining the required heat for tapping *during any length of time*.

In the future there is no doubt the Cleveland, Lincolnshire, Northampton, Scotch, and other such ores will be much more largely employed for making steel by the basic process than is the case at present.

The following samples of open-hearth basic steel made at the Park Gate Works, Rotherham, were exhibited.

(1.) One inch round bar with two holes $1\frac{5}{8}$ ins. diameter drifted in it, the steel at the sides of the holes being reduced to $\frac{1}{8}$ in. thickness. One end of the bar was bent over cold, nearly closed up. The perfect solidity and freedom from blow-holes of the material could be seen where the bar had been skimmed over in the lathe to a diameter of $\frac{15}{16}$ in.

(2.) A dish, worked cold, from plate $\frac{7}{16}$ in. thick, having an internal diameter of $4\frac{1}{4}$ ins. and a depth of $2\frac{3}{8}$ in.

(3, and 4.) Two specimens of plate $\frac{3}{8}$ in. thick, bent over cold twice, one bend being at right angles to the other, so that the corner where the two bends meet is most severely tested.

(5.) A piece of plate, 1 in. thick, bent to a radius of $\frac{7}{16}$ in.

(6.) A piece of plate, 1 in. thick, which having been welded was bent at the weld, cold, to a radius of $\frac{5}{8}$ in.

(7.) A similar piece, 1 in. thick, also welded, and bent over cold to a radius of $\frac{3}{8}$ in.

(8.) Fancy specimen, comparable in shape to a lady's hat. This was made from a plate $9\frac{1}{2}$ ins. × $9\frac{1}{2}$ ins. × $\frac{1}{2}$ in. Dished in the middle 4 ins. diameter by $1\frac{3}{4}$ deep. Sixteen $\frac{11}{16}$ holes were punched in a circle right round the specimen near the edges, and four similar holes were punched, one at each corner. The corners of the plate having been bent over to a radius of about $\frac{1}{2}$ in. the corner holes are completely distorted and opened out, forming on the outer side of the bend an oval of which the greater diameter is 1 in., but without the steel having cracked.

(9.) A tensile test, orignally $\frac{5}{16}$ in. plate × $1\frac{1}{2}$ in. × 10 ins. tensile resistance 28·8 tons per sq. in. Elongation 23 per cent.

(10.) A tensile test, originally $\frac{5}{8}$ in. plate × $1\frac{1}{2}$ in. × 10 ins., tensile resistance 28·2 tons per sq. in. Elongation 25·5 per cent.

(11.) A tensile test, originally $\frac{7}{8}$ in. plate × $1\frac{1}{2}$ × 10 in. tensile resistance 26·3 tons per sq. in. Elongation 30·0 per cent.

### Discussion.

Dr. Clowes said he would like to know the nature of the glass used for the steam gauge shown, which was seriously corroded by use. Chemists knew that different kinds of glass were differently acted upon by water and solutions. The glass bottles used for the storage of chemical liquids required to be carefully selected. It had been long known that water acted at a high temperature upon glass; he was surprised that there had been no action noticeable in the central part of the steam-gauge.

Mr. Stirk asked if in the construction of the boiler it had a double-riveted flue, and whether in the manufacture of a boiler, in the drilling of holes, they had taken precaution to clear away the "burr." If any accumulation of the "burr" occurred it was always necessary to take the boiler to pieces to rid it of a small quantity of "burr." Then, with regard to the glass, he quite agreed with Dr. Clowes that it required some explanation as to whether it seemed to waste only in connection with the water or steam. He thought that, as a rule, if a glass broke, it was at the top that it occurred.

Had the reader of the paper paid any regard to the heat of the escaped gases, because the boiler was so short that it could hardly absorb all the heat. Had Mr. Carulla taken the temperature of the waste gases? It seemed to him that in using the boiler he would lose a great deal of heat, and the boiler would be a rather expensive one, owing to its short length.

The Chairman remarked that in his experience this corrosion was most erratic. The water inside the glass was practically always distilled water as condensation went on in the steam space. The Jena glasses now being introduced into this country were of a double thickness and for some purposes were safer than the ordinary ones. There appears to be no entirely satisfactory explanation of this glass corrosion yet put forward.

Mr. Berridge said his experience of glasses was that they did not corrode much. He had seen them after two years' use almost as good as new. With regard to the oils in the water, he had found them to have a very bad effect indeed. It was not a steel boiler, however, but an iron one, and he would like to ask whether it would not deteriorate a steel boiler. Speaking from an economical point of view, they had to lay down a boiler like this in Staffordshire. They selected two makers of repute and sent them approximate sizes, asking each of them to send in a quotation. He considered he got his boiler 25 per cent. cheaper than Mr. Carulla, and the reputation of the maker was sufficient to ensure a good boiler being supplied. Of course, it was well to have everything perfect, but if they got the proper sizes and supplied full particulars they could not do much better.

Mr. Ross said that the boiler seemed altogether of special proportions to meet special conditions, which somewhat limited the range of criticism. In his opinion a boiler of the proportions shown could not be an economical one. Owing to its extreme shortness the gases would probably escape at much too high a temperature. The number of Galloway tubes crowded into the flues was excessive, and would probably do more harm than good. The author had been well advised in allowing the makers to provide the fittings. Plain fittings of good construction as a rule gave good results and little trouble; while those of delicate construction and undue complication of parts were to be avoided where a boiler was under the care of an ordinary stoker. The side flues in the setting had no doubt gained something by the error in the curved blocks as the author had pointed out.

Mr. Ward said that upon analysing the gas from their flues they found a tremendous proportion of free oxygen. He would like to ask a question with regard to the steam injector. They had three boilers with the steam injector and others with the ordinary feed pump. The three with the live steam injector had very seldom any hard scale upon them. In the other boilers with the feed pumps they were very much troubled with the hard scale, could anyone suggest an explanation? With regard to the expansion of steam pipes, the conclusion they had come to was that the simplest plan was to arrange the steam pipes with one or two right angle bends.

Mr. R. H. Hewitt said that with regard to the punching of the plates he was not a practical boiler-maker, but he thought the punching of the holes in the steel plates would be detrimental to the surrounding steel whether done by hand or steam. He preferred the spaces to be drilled and he thought the drilled ones were very much to be preferred.

Mr. Pentecost asked in the case of covering the boiler with non-conducting bricks and forming a level platform, whether Mr. Carulla would recommend utilizing the room over the boiler for purposes where the heat would be useful. He had been variously advised as to using the space over the boilers for drying purposes. Possibly Mr. Carulla or the Chairman would say whether such use was desirable or not.

Mr. Lancaster asked what quantity of steam or coal Mr. Carulla had found of most advantage in getting rid of the smoke.

Dr. Clowes said that Mr. Ward had suggested that the action on the glass surface might be due to leakage of steam. That particles of glass could probably be removed had been shown by Professor Dewar, who found that in a glass vessel in which a very perfect vacuum had been produced, matter gradually collected which was apparently composed of particles of glass. This matter was deposited from the vacuum when the glass was cooled by liquid oxygen. He thought that particles of glass might therefore be removed by the friction caused by the steam leaking over the glass surface. He wished also to know what was the nature of the packing used as a non-conductor for covering the boiler. He had understood that slag wool was frequently used, because it was incombustible and imperishable; but this seems to have been replaced by the hair coating of which Mr. Carulla had brought a specimen. Was the slag wool inferior as a non-conductor to this latter form of material?

The Chairman said the title of Mr. Carulla's paper did not enable one to know what to expect, and its drift appeared to be rather in the direction of mechanical engineering. Up till now the use of electrical power had largely increased, instead of decreasing, the number of steam boilers. Gas-engines used a fuel more perfect than coal, and by avoiding one cycle or conversion should give more economical results than steam-engines. It was now 22 years since Mr. Daniel Adamson made his first steel boiler. There was no doubt that by consulting the engineer of a respectable boiler insurance company a satisfactory boiler specification could always be obtained. The size of Mr. Carulla's boiler had apparently been fixed by the space available. The usual method was to decide how much water was to be evaporated per hour, then, assuming one pound of coal to evaporate 8 or 10 lbs. of water, the coal consumption was determined. Varying with the draught, the consumption of coal might be from 15 to 20 lbs. per square foot of grate per hour, and this fixed the area of the grate. As a stoker could not conveniently work a grate more than 6 feet long, the area of the grate practically determined its breadth, and the breadth of the grate is an equivalent to the diameter of the flue; then in Lancashire and Cornish boilers the diameter of the boiler became fixed. The only other dimension was then the length of the boiler, and this was deduced from the heating surface, which usually need not be more than 1½ square feet per pound of coal burnt per hour, and in most cases it was not necessary to allow more than 2 square feet. This was the only practical way of determining general dimensions of a boiler. Exhaust injectors had caused trouble in the London district, where the water was heavily charged with carbonate of lime, but where pipes were judiciously arranged the trouble disappeared. Fairbairn's rule was admirable in this way, but modern practice required certain modifications which made it more practical. Boiler plates would no doubt be eventually rolled in continuous rings, thus abolishing riveted longitudinal seams. Hollow fire-bars had been referred to, but, in his experience, more work could be got out of a boiler with plain bars. He had exported large numbers of blue fire-bricks, and believed his clients had got better value than if white ones had been sent. They had always been reported on favourably. He had found slag-wool, when used as a non-conducting covering, disintegrate or become powdery after a somewhat short period of use. If hair-felt became wet when on a hot steam-pipe the smell was frequently very offensive. Automatic feeding arrangements had been tried by the dozen; but even supposing one to work perfectly without repairs or sticking for 10 years, it did not relieve the man in charge from looking to his water-level every 10 minutes. The horseshoe expansion pipe, when placed vertically, was distinctly a source of danger owing to the possibility of water hammer.

Mr. Carulla expressed his thanks to the Chairman for having answered so many of the questions in a manner so much more able than he could have done, and also for so kindly supplementing the subject matter of the paper with a valuable record from actual personal experience. Answering first the question put by Dr. Clowes, he regretted he could not state the composition of the glass that had been shown with the corroded ends. He should think that various kinds of glass were in use for water gauges, judging by the different experience of so many of the speakers in regard to corrosion. Each end of the gauge glass would of course be a certain short distance beyond the packing when in place, and this was formed of the ordinary india-rubber rings used generally for the purpose. Unless this rubber contained fluoric acid he could hardly regard the action to have proceeded from that source.

Dr. Clowes here stated that india-rubber covered copper wire would sometimes show corrosion, but this was due to the presence of HCl in the rubber.

Mr. Carulla, replying to the other questions, said that the specification had the following clause regarding what had to be done to the rivet holes after drilling, viz.:—"The holes are to be afterwards slightly countersunk under the rivet heads, and the burr cleaned off between the plates. If from any cause they are at all unfair when the plates are drawn up together for riveting, they are to be rimered perfectly true before riveting." The boiler was inspected four times during construction at the maker's works, and certificates had been received from the insurance company stating that the work was being done according to agreement.

In regard to the escaping gases he had not actually tested the temperature at the chimney, but he would say they were certainly hot. It was in anticipation of this state of things that a drying hearth had been constructed over the outermost flue. This enabled a great part of the heat to be utilised that would otherwise go to waste. In some trades a room over the boiler, on the level floor, would no doubt, as had been suggested, be very useful, but in this case it was not of easy application. In reply to Mr. Berridge he would say that the boiler that had been fed with oily and greasy water would certainly be an iron one, as it was put down in 1860.

The Chairman: And would be worked at a low pressure?

Mr. Carulla: Presumably so. He regretted he could not give the name of the engineers from whom he received that interesting information, as he had not yet had a reply to the question whether they would permit their name to be used. In regard to the remarks of one of the speakers, he wished to say that after hearing them he had become quite reconciled to the presence of the Galloway tubes in the boiler. It was clear that if the gases went through the boiler too rapidly, because of its short length, and the Galloway tubes on the other hand retarded the draught, they were just the thing needed, and the one evil was the antidote to the other. He quite agreed with Mr. Hewett that drilled holes were preferable to punched holes, his contention being simply that punching afforded a test that drilling could not provide. He was unable to give any explanation of the interesting experience related by one of the speakers, that no scale was formed in a boiler fed by a live steam injector, whereas another, under exactly similar conditions, but fed by a pump, formed scale.

In answer to the Chairman, he would say that what had fixed the dimensions of the boiler was really the size of the space at command. Every inch that it had been possible to give had been devoted to it. They might notice that the back flue was shown 24 inches wide on the original drawing. Mr. Edwin Danks was asked whether he would allow this flue to be made 12 inches, and he strongly objected. He allowed it, however, to be made 18 inches wide, and they gladly took this six inches, insignificant though it might seem. As regards the price of mountings and fittings he would not say that one did not get value for money, only that they were costly by comparison with the simple appliances that were made to do duty in former times.

Since the date of the meeting Mr. Carulla has had a reply from Messrs. Walker, Eaton, & Co., of Sheffield, whose remarkable experience with feed water containing grease and oil, was given in the paper. They add, however, that although no damage occurred in the case related, they consider it advisable to keep the grease out of the boiler whenever possible, and only give the instance referred to as purely their own personal experience. Mr. Carulla would also add, in reply to one of the questions which escaped him at the time, that the circular seams of the new steel boiler described in the papers are single riveted and the longitudinal seams are butt jointed and double riveted.

## Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
J. Cohen.
T. Fairley.
W. Leach.
W. Mc'D. Mackey.
A. G. Perkin.
C. Rawson.
F. W. Richardson.
G. W. Slatter.
Thorp Whitaker.

*Hon. Local Secretary:*
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1894-95.

March 4th:—
Mr. Carlton B. Heal and Mr. H. R. Procter, F.I.C. "The Examination of used Chrome Tanning Liquors."

April 1st:—
Prof. Hummel and Mr. W. M. Gardner, F.C.S. "The Chroming of Wool. Part IV."
Mr. A. G. Perkin, F.R.S.E., and Prof. Hummel. "The Tinctorial Properties of some Indian Dyestuffs."

*Meeting held on 4th February, 1895, at the Queen's Hotel, Leeds.*

MR. C. F. TETLEY IN THE CHAIR.

## ON A MODIFIED FORM OF TINTOMETER OR COLORIMETER.

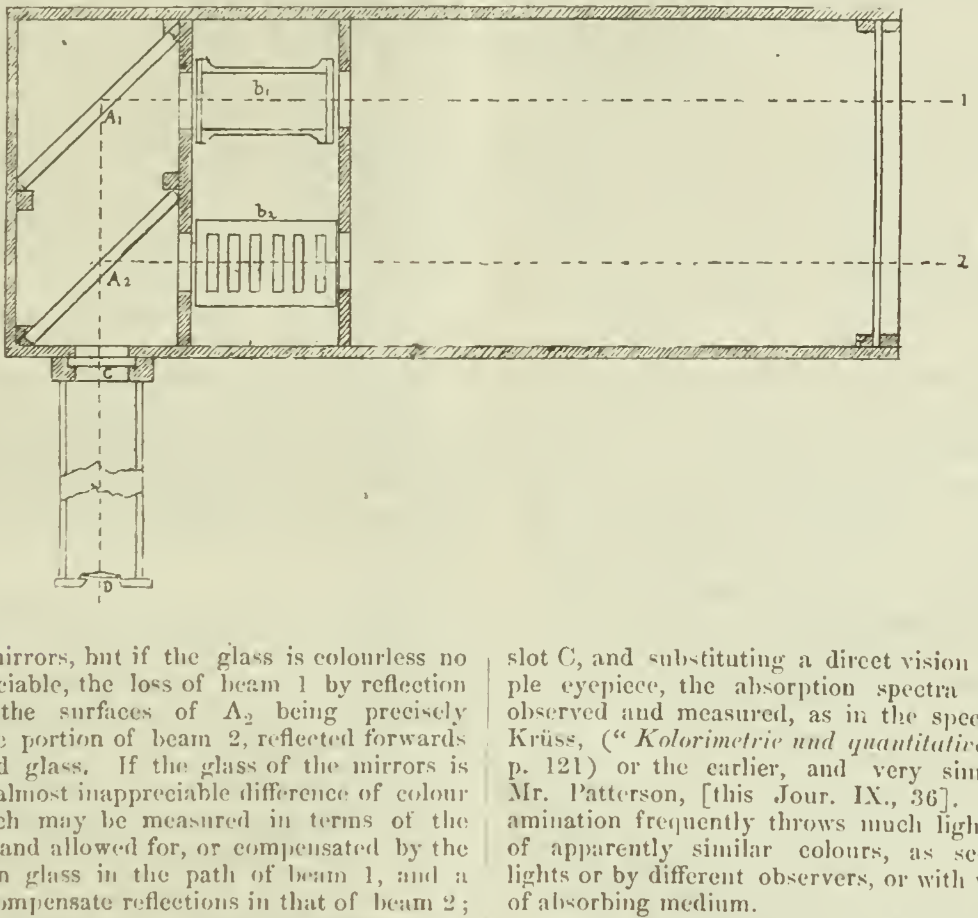
BY H. R. PROCTER, F.I.C.

While the tintometer of Lovibond must be recognised as a most valuable instrument for the estimation of colour for technical and even for some scientific purposes, and, indeed is as yet the only instrument by which it is practicable in ordinary laboratories to measure colour numerically, and to reproduce it at any future time, it must be admitted that there are many points about it which are unsatisfactory, both from the scientific and the practical side, as indeed is inevitable from the intrinsic difficulty of the problem which its inventor has set himself to solve; and, therefore, even small suggestions of improvement like the present may claim their justification.

The modification which I bring before you to-night is the outcome of experiments of which the practical results are detailed in another paper, and merely aims at making the matching of the colours easier and more exact, without attempting to touch the difficulties which are involved in the principles of the instrument, and on which I purpose to allow myself a few words of comment in the concluding portion of the paper.

In the original instrument of Mr. Lovibond, no optical means are employed to bring the two colour-patches which are to be compared into juxtaposition, and they are therefore separated by a broad black band. It may be argued that this separation lessens the danger of interference from physiological effects of complementary colours, but as the two colours should be exactly similar at the conclusion of the experiment, this need hardly be provided against, while it can scarcely be argued that comparison by the eye of rather widely separated fields of colour is so exact a test of equality, as the complete disappearance of division between them after the manner of the grease-spot photometer. Even with a trained eye, and the utmost colour-sensitiveness, it may be pointed out that the different sensitiveness of different portions of the retina, which is pointed out by Abney (Colour Measurement and Mixture, page 117) is much more likely to interfere when the colours are separated than when they are in actual contact, or one is surrounded by the other.

The construction of the apparatus is obvious from the diagram, where $A_1$ and $A_2$ are silvered glass reflectors placed diagonally to the beams of light to be compared. From the back of $A_2$ a portion of the silvering is removed in any appropriate form, as for instance that of a small disc, star, or parallel bands, through which the second beam of light reflected from $A_1$ is visible. When the two beams are accurately of the same intensity and colour, the unsilvered spot disappears, the light reflected being precisely equal to that transmitted. It might be supposed that the light from A would be somewhat lessened by having to pass through the glass of both mirrors, but if the glass is colourless no difference is appreciable, the loss of beam 1 by reflection backwards from the surfaces of $A_2$ being precisely compensated by the portion of beam 2, reflected forwards from the unsilvered glass. If the glass of the mirrors is green, a slight and almost inappreciable difference of colour is introduced, which may be measured in terms of the tintometer glasses and allowed for, or compensated by the addition of a green glass in the path of beam 1, and a colourless one to compensate reflections in that of beam 2; $b_1$ is a cell for liquids, and $b_2$ a rack to hold glasses as in the ordinary tintometer (*see* this Journal, VII., 424).



The experimental apparatus is so constructed that it can either be used like the tintometer, horizontally, or slightly inclined downwards, with glass-sided cells for liquids, or vertically with Nessler cylinders and standard colour solutions. In the latter case it is convenient to have one or both the cylinders tubulated and connected by india-rubber tubes with moveable reservoirs, so that the level of the liquid can be varied in the cylinders at will, as in Wolff's colorimeter. In this way any known colour existing in solution in a state of purity can be at once quantitively determined by comparing it with a similar standard solution of known strength. It may also be possible to standardise colour solutions by comparison with Lovibond's glasses, so that results can be expressed in terms of the tintometer scale, and slight differences in tint can be compensated and measured by the use of glasses.

At C in the diagram is a slot which is intended for the reception of coloured glasses, which sometimes facilitate matching, or serve to distinguish colours which though similar in resultant tint, are made up of different components. At D, a convex lens of about 12 inches focal length is conveniently used as an eyepiece, but is not strictly necessary. By placing an adjustable slit in the slot C, and substituting a direct vision prism for the simple eyepiece, the absorption spectra of liquids can be observed and measured, as in the spectum colorimeter of Krüss, ("*Kolorimetrie und quantitative Spectralanalyse,*" p. 121) or the earlier, and very similar instrument of Mr. Patterson, [this Jour. IX., 36]. Spectroscopic examination frequently throws much light on the variations of apparently similar colours, as seen under different lights or by different observers, or with varying thicknesses of absorbing medium.

The source of light found most convenient and reliable for general purposes is that indicated by Mr. Lovibond for use with the tintometer, viz., a sheet of uniform opal glass, evenly illuminated by good daylight. The direct light of a white cloudy sky will also give correct results, but is somewhat uncertain; and no satisfactory results are to be obtained in general colour matching by any artificial light except the electric; though no doubt those obtained by other lights would be comparable with others got under similar conditions.

It is obvious that the difficulties I have attempted to overcome in the instrument just described are rather those of detail than of general principle, and it may perhaps help the discussion of the subject if I point out others which, in my opinion, will have to be met in working out a really satisfactory system of colour measurement adapted to laboratory use.

That the Lovibond scale is an artificial one is a matter of little moment, if from its nature it can be expressed in terms of natural constants by calculation, but from the impurity of the colours employed as standards this would necessarily be very difficult. The grading and adjustment of the glasses themselves has been carried to a degree of perfection by the inventor which leaves little to be desired, and there seems no reason to doubt their permanency or the possibility of at any time reproducing them, which are both matters of prime importance. The principle of measuring the absortive power of bodies by standards of absorption, in place of deducing it from measurements of luminosity seems a sound one, since in by far the larger number of cases, it is the absorptive power of colouring matters which we wish to know, and its direct measurement in terms of absorption greatly simplifies the calculation. Thus while the percentage of colouring matter varies in direct proportion to the thickness of the absorbing layer, and (with certain limitations), to the concentration of the solution, and to the number of tintometer glasses employed to match it, it is proportional to the – logarithm of the transmitted light, which is certainly a less convenient quantity for arithmetical purposes.

The great inherent difficulty of all forms of colour measurement lies in the fact that colour is not a simple physical quantity like weight or temperature, but a physiological effect which varies with individual peculiarities; and bears no very simple relation to the physical causes which produce it. While to the physicist, all ordinary coloured light is a mixture of light-waves of every imaginable wave-length in very varied proportions, it is believed that the eye has only three primary colour sensations, and estimates all colour in terms of varying proportions of the three. Hence the physiological form of statement (if I may use the expression) is much simpler than the physical, since it can be expressed by three numbers, while the physical facts are so complex that they might perhaps be graphically, but not numerically expressed in any practicable form. On the other hand the difficulty arises that the physiological summation is in some sense an arbitrary one; and that, though to the eye, a perfect match can be made between a mixture of yellow and white light, and one of green and red, the constituents of the two matched colours are physically different, and are affected differently by differences in the light, or in the eye. Thus it happens that two colours may match perfectly by daylight, and appear quite different by gaslight, or may be indistinguishable by one observer and distinct to another.

To these difficulties, not only the tintometer, but Captain Abney's method of referring colours to their dominant ray in the spectrum are equally liable, but in the case of the tintometer, they are considerably increased by the low degree of purity of the standard colours employed. Theoretically, the standard colours should be (1) a pure yellow, which would absorb the blue and violet rays only, passing red, yellow, and green; (2) a red absorbing green blue, and yellow, and passing red and violet; and (3) pure blue, absorbing red and orange, and passing green, blue, and violet. These would approximately absorb the same rays as affect the three sets of colour sensations of the eye. It is further important they should uniformly absorb the whole of the centre of the spectral region they stop out, shading off gradually to each side of it, as does the perceptive power of the eye. The yellow glass of the tintometer fairly fulfils these conditions, but the blue and red glasses fail, not so much by being wrong in their average tint, as because their absorbtion is very selective, the blue glass transmitting bands of red, and the red glass bands of green, as will be at once seen on examination with a spectroscope. This not only diminishes the brightness of the colours produced by mixture, but alters the whole character of the light as it varies in intensity and source. Thus, by lamplight which is rich in red rays, strong shades of the cobalt blue become deep red, and this is one of the sources of difficulty in matching by varying light. On the other hand it may probably be urged that these difficulties cannot be wholly overcome, that the glasses are the best attainable, and that glass has great advantages over any other medium in permanency and convenience. From what Mr. Lovibond tells me it is certain that he has taken great pains in this direction.

One practical point to which I would direct attention is the advantage in matching which the use of actual neutral tint glasses to measure black would afford in place of that of the complementary colour. The final match would be equally accurate in either case, but whereas the introduction of the complementary colour alters the relation of both the other components, that of black would dull the colour merely. It is, however, very difficult, if not impossible to prepare a neutral tint glass which will correspond at varying intensities with the black produced by the combination of equal values of the three coloured glasses, and it would be perhaps easier to introduce simultaneously equal quantities of the three colours. I would suggest as a means of accomplishing this, the arrangement of the decimal divisions of the colour units round three discs rotating on a common centre. By rotating these singly, successive decimals of colour would be added or substracted, while their simultaneous rotation would vary black only. A rough match would first be obtained by the unit glasses in the ordinary way.

### Discussion.

Mr. Lovibond said that he objected to the use of any arrangement for reflecting the light which has passed through the solution or coloured glasses, because the reflection apparently altered the colour to some extent, and a match made with the use of reflectors would not be a match without their use. It was also more difficult to judge of the similarity of two colours unless they occupied spaces of the same form and size. Though it was undoubtedly an advantage that the two things to be matched should be brought into close juxtaposition, yet he thought that much of this advantage was sacrificed by the necessity of using some kind of reflector. Discs for holding the coloured glasses would require to be inconveniently large if they were to contain all the different glasses.

Mr. Rawson asked what degree of accuracy could be obtained with Mr. Procter's instrument.

Mr. Richardson asked whether the instrument avoided a difficulty which occurred with Lovibond's instrument, namely, if one took a layer 1 inch thick of a solution of potassium dichromate, and then a layer 2 inches thick of the same concentration, the colour measured in Lovibond glasses was not necessarily twice as deep, as Mr. Lovibond showed that every colour had specific curves of density in solution.

Mr. Procter, in reply, said that there was a certain amount of force in Mr. Lovibond's objection to reflectors, because if the light passing through one of the two things the colours of which were being compared, were polarised in a different plane from the light passing through the other, their intensities would be differently affected by the reflection. With regard to the discs for holding the coloured glasses he only proposed to use them to facilitate the accurate matching after a rough match had been obtained, as in his experience it was the final accurate adjustment which took so much time. In reply to Mr. Rawson he found it somewhat easier to make a match with the instrument described than with the Lovibond instrument. The difficulty mentioned by Mr. Richardson was in the nature of the thing, and could not be avoided by any colour-measuring instrument, however perfect.

## THE ESTIMATION AND NUMERICAL EXPRESSION OF COLOUR IN TANNING MATERIALS.

BY J. GORDON PARKER, PH.D., AND H. R. PROCTER, F.I.C.

There has been a long-felt want in the leather industry for a simple and accurate method of measuring the amount of colouring matter contained in tanning materials and extracts.

The only method which up to the present has been applied is that devised by Dr. Hellon, of Whitehaven, who makes up a sample liquor, containing exactly $\frac{1}{2}$ per cent. of tannin in bottles of uniform size. By placing two such examples side by side towards the light, it is therefore easy roughly to see the colour and to determine which contained the least coloring matter, but hitherto no method has been used for measuring and registering the colour numerically.

The importance of this was recently forcibly brought home to the authors, by a dispute which arose between a large firm of tanners and a manufacturer of Oakwood Extract. A contract was drawn up, by which the extract manufacturer was to deliver a certain number of barrels of extract at fixed intervals, equal in strength and colour to the sample received by the tanner and analysed by a competent chemist. All went well for some months, until the tanner noticed that his leather was not so good a colour as formerly, he therefore suspected the extract, and sent a sample to the same chemist for analysis. It was found to be approximately up to sample as regards strength, but the chemist reported that the colour was much darker. A claim was therefore made by the tanner, and two specialists on tanning materials were called in to settle matters. They both found that the extract had gone down very slightly in strength, and declared the colour to be dark, but as no method was known for measuring the same and no register was kept of that of the original sample other than the bottle of the $\frac{1}{2}$ per cent. liquor, which in the interval had probably changed, the tanner got but little satisfaction from the manufacturer, though the injury of colour to his liquors and the resulting leather caused him a loss of several hundreds of pounds.

It was therefore with the object of devising some method *as simple as possible* to measure the colour contained in solutions of different tanning materials of a uniform strength, and register the same, that the authors undertook this work. At the same time it was proposed to tan a small piece of some skin in as short a time as possible, and to devise a laboratory method of preserving the skin to be used, and of freeing it from all foreign substances which might affect the colour, leaving it in a definite and uniform condition. It was intended at the outset also to measure the colour imparted to the leather thus tanned, but by reason of the unevenness of the surface of the leather this was abandoned.

In order to accomplish the first part of our task, viz., that of measuring the amount of colouring matter contained in solutions of tannin of a uniform strength, it was decided to use Lovibond's tintometer. This instrument commends itself on account of its simplicity, and though the shades of the standard glasses are purely arbitrary, they still afford an easy and accurate method of matching any solution of tanning matter and of expressing its colour numerically. Experiments were therefore made with solutions of various tanning extracts of different strengths, and it was found that these could be accurately matched by a combination of the three standard coloured glasses—red, yellow, and blue in varying proportions. It was further found that the colour varied as the strength of the solution and the thickness of the cell in which it was measured. Thus, whether a $\frac{1}{2}$ per cent. solution was measured in a 1-in. cell, or a 1 per cent. solution in a $\frac{1}{2}$-in. cell, the results were practically the same.

The most convenient strength for working with was found to be usually $\frac{1}{2}$ per cent. solution, measured in a $\frac{1}{2}$-in. cell, but for solutions of sumac this was found to be too weak, and for hemlock extracts and materials rich in colour, on the other hand, a weaker solution was preferable. In most cases, the solution used in an analysis for tanning, usually containing about $\frac{1}{2}$ per cent. of tanning matter, may be used, and the results calculated as $\frac{1}{2}$ per cent. or 1 per cent. solution at will.

The following method is adopted in the case of a tanning extract. The proper quantity of the extract is weighed into a 500 cc. flask (the quantity calculated according to analyses) and made up to 500 cc. with distilled water as near boiling as possible (about a grm. of phenol having been previously added to prevent fermentation and consequent change of colour). The solution is allowed to cool and is then carefully filtered; the filtrate must be perfectly clear or accurate measurements cannot be made. If this cannot be accomplished by ordinary means the addition of a small quantity of kaolin is often beneficial and has no appreciable effect on the colour.

The measurements are now made in good day light, the light being reflected by means of a piece of opal glass. It was found that the chance of error was greatly reduced by making three or more measurements, using in each case different strengths or larger cells, *i.e.*, measuring a $\frac{1}{4}$ per cent. and $\frac{1}{2}$ per cent. solution first in a $\frac{1}{2}$-in. cell, and afterwards in a 1-in. cell and reducing the mean of the results to one strength. By this means it is possible to match any material to within $\frac{1}{10}$ of a Lovibond degree.

The method for tanning materials is practically the same. The liquid extracted must first be analysed and then diluted to the strength required.

It was found that in liquids of a fluorescent nature and also those which neither repeated filtering nor the addition of kaolin would completely clarify, it was necessary when making measurements to cover the sides and top of the cells with cloth or other suitable material, thus allowing only the direct rays of light to pass up, and shutting out the diffused light from the top and sides.

The next part of our work was the tanning of a piece of some skin; and the first question to be solved was, what skin was most suitable for our purpose. We decided to try sheep grains (which are thin splits from the outer side of the sheep skin), because they could be procured by all chemists with comparative ease, and by reason of their thinness they would tan quickly. It was also necessary to delime the skins and preserve them for any length of time until required for use.

Our first experiment was therefore made with a sheep grain, fresh from the tanyard, where it had been limed to rid it of the hair and split to suitable thickness.

This was divided into four pieces, one of which was put into each of the following solutions:—

(1.) $\frac{1}{2}$ per cent. solution of cresotinic acid.
(2.) 2 per cent. solution of boric acid.
(3.) 2 per cent. solution of boric acid, with 1 per cent. of phenol.
(4.) Distilled water.

The pieces were left in these solutions for 24 hours and frequently stirred.

At the end of this time they were each cut up into five strips, and one strip of each was suspended in each of the following tanning solutions of oakwood extract, containing:—

(1.) $\frac{1}{4}$ per cent. of tanning matter.
(2.) $\frac{1}{2}$ per cent. of tanning matter.
(3.) 1 per cent. solution of tanning matter (previously coloured in $\frac{1}{2}$ per cent.).
(4.) 2 per cent. solution of tanning matter (previously coloured in $\frac{1}{2}$ per cent.).
(5.) 5 per cent. solution of tanning matter (previously coloured in $\frac{1}{2}$ per cent.).

The results were as follows:—

*Experiment I. (1).—Strips tanned in $\frac{1}{4}$ per cent. solution of tanning matter.*

I. From cresotinic acid—colour dull and streaky.
II. From boric acid—colour bad.
III. From boric and phenol—colour clear and regular.
IV. From distilled water—very bad, all stained.

These pieces were tanned for three days.

*Experiment I. (2).—Strips tanned in $\frac{1}{2}$ per cent. solution of tanning matter.*

The results were exactly as above, the stains being even more marked and the colour less regular. No. III. from the boric acid and phenol solution was far the best. These required 36 hours to tan.

*Experiment I. (3).—Strips suspended in 1 per cent. solution of tanning matter, after having been coloured in $\frac{1}{2}$ per cent. solution.*

The results were the same as in the previous experiments, and it was also noticed that no difference was visible in the depth of colour imparted to the leather, whether tanned in 1 per cent. or $\frac{1}{4}$ per cent. solutions.

Numbers I. (3) and I. (4) tanned in 2 per cent. or 5 per cent. solutions gave similar results.

From these experiments it was evident that the mixture of boric acid and phenol was the best of the four deliming agents tried. It may here be mentioned that the strips of leather, on being taken from their liquors, were slicked out on a glass plate and dried between blotting paper, and that all strips marked III. delimed in boric acid and phenol dried a bright even colour, mostly free from stain or flaw.

We therefore decided to try some more deliming agents, repeating the experiments with boric acid and phenol, and to try two utterly different tanning materials.

To this end another sheep grain was divided into five pieces, and one piece put into each of the following solutions :—

I. 2 per cent. boric acid, and 1 per cent. of phenol.
II. 1 per cent. phenol.
III. 1 per cent. phenol with 1 per cent. glycerine.
IV. 1 per cent. phenol with 1 per cent. sugar.
V. 1 per cent. boric acid with 1 per cent. glycerine.

The pieces were left in the solutions for 40 hours, being frequently stirred and handled.

### *Experiment II., A. and B.*

Each piece was divided into two strips, one of which was tanned in a solution of oakwood extract, containing 1 per cent. of tanning matter, the other in a solution of Hemlock extract of equal strength.

The strips were tanned this time by agitation in an American "milk shaker" which has already been described by one of us before this Society. (This Journal, Vol. XXIII., 464.) As raw pelt cannot at once be brought into a strong tanning solution without damaging it, the strips were first shaken for 20 minutes in a $\frac{1}{4}$ per cent. solution, after which the solutions were strengthened up to $\frac{1}{2}$ per cent., and at the end of another 20 minutes the full strength of 1 per cent. was made up and shaken for $1\frac{1}{3}$ hours. The whole time of tannage was therefore only two hours as comparing with 36 hours in our last experiment by suspension.

The results were as follows :—

| Deliming Agent. | Oakwood A. | Hemlock B. |
|---|---|---|
| I. 2 per cent. boric acid and 1 per cent. phenol. | Colour A. and B. good and fairly clear. | |
| II. 1 per cent. phenol ......... | Both bad and stained. | |
| III. 1 per cent. phenol and 1 per cent. glycerine. | A. and B. both fair. | |
| IV. 1 per cent. phenol and 1 per cent. sugar. | Both bad and much stained. | |
| V. 1 per cent. boric acid and 1 per cent. glycerine. | Both very bad. | |

As in Experiment I., boric acid and phenol therefore again gave the best results, followed up as a bad second by phenol and glycerine; the rest of the pieces were all very unsatisfactory. It was also apparent that neither boric acid nor phenol would act satisfactorily alone, but appear to act in conjunction.

### *Experiment III.*

The above experiments were now repeated, the only differences being that No. II. the strength was increased to 2 per cent. of phenol, and that No. IV., with phenol and sugar, was omitted.

The resulting leather in this case was precisely the same, and we decided to adopt the 1 per cent. phenol with 2 per cent. boric acid as preservative and deliming agent, and 1 per cent. strength of the tanning solution with mechanical agitation, as being the most convenient and best fulfilling the requirement of getting speedy results.

Further experiments were made in the hope of improving our results and making them more concordant each time. The details of the last of these only need be given.

### *Experiment IV.*

A limed sheep grain was first washed in distilled water in a "tumbler" or churn, and slicked out to remove as much of the adhesive lime salts as possible; it was then cut into three pieces, and one of which was put in each of the following solutions for 30 hours :—

I. 2 per cent. boric acid and 1 per cent. phenol.
II. 1 per cent. phenol and 1 per cent. glycerine.
III. $\frac{1}{20}$ per cent. normal acetic acid, which was neutralised before tanning by shaking with $Na_2CO_3$ and well washing in distilled water.

Each piece was divided into three strips, which were shaken well in distilled water, and a strip of each was put into the following 1 per cent. solutions of tanning from oakwood, hemlock, and chestnut extracts:—

I. Colour in each case, clear, even, and good.
II. ,, ,, , only fair, streaked and dull in places.
III. ,, ,, , very dull and stained, dried dark.

From the results of these experiments and others we were decided to adopt this boro-phenol solution as our deliming agent, and this choice has since given great satisfaction. The grains remain unaltered in it for an unlimited time, and in no case was the resulting leather in any way stained, showing the absence of all lime salts or foreign matter which would influence the colour produced. It seems quite possible that in some cases the method may prove useful in actual leather manufacture.

The final method was as follows :—The sheep grains as received from the tanyard were washed with water in a churn, then in a second water containing our boro-phenol solution; they were then slicked out and put into a jar containing a fresh boro-phenol solution. Some sheep grains were preserved in this way for over two months, and the resulting leather samples were as good in every way as from freshly-delimed pelt.

The following method of tannage was finally adopted as giving the best and most unvarying results :—

Strips of delimed sheep grains, about 8 ins. by 4 ins., were cut, and to remove the boric and phenol solution were washed in the milk churn twice by shaking with distilled water, and lightly pressed out with the slicker. They were then put into the churn with the solution containing $\frac{1}{4}$ per cent. of tanning from the material to be used, and agitated for 20 minutes, after which the solution was strengthened to $\frac{1}{2}$ per cent., and at the end of another 20 minutes put into a solution of 1 per cent. strength, and shaken for $1\frac{1}{3}$ hour, the tanning process thus lasting two hours. The leather is then shaken for a few minutes in distilled water, slicked out on a glass plate with a glass slicker, pressed tightly in a letter-press between blotting paper, stretched by hand and tacked out on a board, and put into a dark place until partially dry. The leather is now given a further stretching to secure its drying a bright even colour, and in this stretched condition again tacked down and thoroughly dried out.

This method we find gives satisfactory results, the leather drying a nice even colour, and repeated tests of the same material giving concordant results.

Having adopted the above plan, our next experiment was to find whether the strength of the tanning solution, or the time of tannage had any effect on the colour produced. With this object in view, pieces of sheep grain prepared by the afore-mentioned method, were tanned by agitation in the milk shaker, in solutions of the same tanning material containing $\frac{1}{4}$ per cent., $\frac{1}{2}$ per cent., 1 per cent., 2 per cent., 3 per cent., and 5 per cent. of tanning matter, the pelt was agitated for three hours in order that those in the weaker solutions should be thoroughly tanned. The result obtained showed that the strength of the solutions had very little influence on the colour, thus confirming under the new conditions the results of experiment I. (3). A similar experiment with a 1 per cent. solution tanned for different lengths of time, showed that when once the pelt was coloured through, however long it was left in the solution the colour was not intensified.

We find by comparing some of our tintometer results with the samples of leather tanned in solutions of the tanning material, that the results are only proportional when the same material is used. For instance, a $\frac{1}{2}$ per cent. of Myrabolan liquor might register the same amount of colouring matter as a solution of sumac of corresponding strength, but the resulting leather tanned in these solutions would not necessarily be the same, because animal pelt does not take up all colouring matters with equal avidity, and the colouring matter of sumac is different from that of Myrabolanes. This method will however be of use for comparing different samples of one and the same material, especially in the case of tanning extracts, where the tanner makes a contract at the beginning of his year for so many hundred casks to be delivered in say four deliveries, since he will now be able, not only to ascertain that each delivery is up to strength as regards tanning, but that the extract has been properly decolorised.

We take this opportunity of expressing our thanks to Messrs. M. C. Lamb and W. Towse for their ready assistance in verifying both our analysis and tintometer observations. It is our intention to continue this work, applying our method to measuring the ratio in which colouring matter and tannin are extracted and effected by different temperatures of leaching; and also the effect of light on the liquors and leather, and the effect of "assistants" on the colour.

### Discussion.

Mr. C. E. Parker said that further investigation of the colour produced by different extracts on hides which had not been so carefully delimed were needed, as the tanner worked practically with skins containing lime and other impurities. On one occasion he had a contract for a certain extract, a ½ per cent. colour sample of which was preserved. The later deliveries were of inferior quality as regards colour, but on attempting to prove this by comparison with the sample it was found to have decomposed. The method described by Dr. Parker and Mr. Procter would be extremely useful to the tanner in such cases, as it would enable him to preserve a record of the colour given to leather by an extract, and so control this property as well as the strength of the extract. It was of interest that the depth of colour taken on by the pelt was so far independent of the strength of the extract. He wished to enquire whether this would also hold good if a skin to which a good colour had been imparted were treated with another extract of a different kind.

Mr. Fairley asked whether the kind of skin used had any selective action in absorbing the colouring matter from an extract.

Mr. Lovibond said that different strengths of the same dye often gave the same colour on fabrics, but the colours had different degrees of fastness to light. Attempting to build up a colour by different dyes generally diminished its purity.

Dr. J. Gordon Parker, in reply, said that the object of the work was more to find what colour an extract would give under the most favourable circumstances, than to find what colour it gave in average practical conditions. Different skins would probably give slightly different colours with the same extract. With the same extract the colour was within considerable limits independent of the strength, but treating the same skin with different extracts successively would probably alter the colour.

Mr. Procter said that ordinary tanning experience showed that the same extract gave somewhat different colours with different skins, but that the difference was not large. Sheep skin was used because it was easily procured and cheap, two indispensable conditions in a method which was to be generally used for analysis. The strength of the extract and also the time of its action had some influence on the colour. Referring to Mr. C. E. Parker's remarks he said that in tanning it was important to obtain a good colour in the first instance as it was not very much influenced by the subsequent treatment. This was not, however, always so; the colour of a skin tanned with hemlock bark is not much changed by treatment with valonia, whereas the colour obtained with valonia is greatly influenced by subsequent treatment with hemlock.

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# New York Section.

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Dr. H. Schweitzer, 159 Front Street, New York, U.S.A.

*Meeting held at the College of Pharmacy,*
*Monday, 7th January* 1895.

MR. A. H. MASON IN THE CHAIR.

## ON THE UTILISATION OF MAGNESIA OBTAINED AS A BY-PRODUCT IN THE MANUFACTURE OF CARBONIC ACID FROM MAGNESITE.

BY H. ENDEMANN, PH.D.

While magnesia was a product of manufacture it commanded a high price, and therefore its application was limited. After, however, Grecian magnesite had been introduced for the purpose of manufacturing therefrom carbonic acid gas on a large scale, and thus magnesia was obtained as a by-product, the circumstances became changed—magnesia went begging for applications. Not, however, that there were no wants directly to be filled. Magnesia was used or should be used especially in the iron industry for basic linings, and this industry should call for considerable quantities of the product either loose or in the shape of bricks. Yet it was found that even the bricks found not such a ready market as was expected, when it was considered that those produced here were the product of the purest magnesite yet used for this purpose; while the imported bricks were known to contain considerable impurities.

The anomalies here presented are evidently due to the unwillingness of the iron men to assume any risks. A real or valid cause for such timidity is not evident. Magnesia bricks are also used in litharge furnaces. Magnesia had also been used for the manufacture of artificial stones by combining it with chloride of magnesium. The disadvantages of this material, though long known, became more diffused when the manufacture of masses having this cement as a basis had made some progress. The sweating of such stones, produced by the liberation of some chloride of magnesium, as also the fact that such stones in contact with water will continually give off chloride, are decided disadvantages. The loss of the chloride is not followed by a complete disintegration, for the reason that the magnesia remains set as a hydrate, but it leaves naturally a more porous material.

Many patents have been taken to overcome these difficulties, and many more have been taken for special mixtures, with real or fancied advantages over the simple one of magnesia and magnesium chloride, which forms the basis for all. The last volume of Wagner's "Jahresbericht" (1893) enumerates four new patents of this kind. In 1891 and 1892 a series of new experiments were published, showing that silica as produced from silicates by acids was able in this very finely-divided state to aid the setting of the magnesia.

Magnesia was also in another form extensively used, namely, as basic or light carbonate of magnesia, notably in connection with asbestos for the manufacture of steam-pipe coverings to prevent radiation of the heat. Two methods were known and used for the manufacture of light carbonate of magnesia. 1. Precipitation of a solution of a magnesium salt by an alkaline carbonate. 2. Separation of the basic carbonate from its bicarbonate solution by boiling. The first method requires costly chemicals, the second requires an immense plant and much fuel; hence both can furnish the product, the light carbonate of magnesia, only for a comparatively high price.

My own experiments, made for the utilisation of magnesia such as is produced by the incineration of magnesite of great purity, are the following:—

1. Experiments for utilisation for artificial stones.
2. Preparation of light carbonate of magnesia.

1. *Use of Magnesia for the Production of Artificial Stones.*—Before going into the details, I wish to state that I found invariably the magnesia to produce a better stone when it was freshly heated than when it had been kept neglectfully for some time. Absorption of water and carbonic acid from the air before magnesia is utilised have a deteriorating influence. This influence in some combinations results to such an extent that certain substances seem to have no influence upon the proper setting of magnesia when the magnesia is not quite fresh, while when freshly ignited magnesia is employed such influence becomes at once evident. Substances which aid the setting of magnesia pre-eminently may give a quite satisfactory stone even with magnesia neglectfully kept.

I will not enumerate my experiments, which were made upon the old line of magnesia and magnesium chloride, and which were repeated by partially substituting magnesium by other bases, or the hydrochloric acid by other acids. Suffice it to say that none of these experiments gave results which in a practical way could be utilised. I then struck out into a new line. This was the study of the action of acid salts or neutral and acid ammonia salts upon magnesia. Of such substances tried and passed over I mention acid phosphates, boric acid and its salts. None gave results encouraging me to continue with either phosphoric or boric acid.

Silica had been employed already (Weber, this Journal, 1891, 111). A few experiments in this direction were made confirmative of results published. I was never able to obtain masses which could compete with the magnesia-magnesium chloride stones which I had produced previously.

My next experiments were with oxalate of ammonia. Using concentrated solutions, masses were obtained which crumbled when dry. By gradually reducing the strength of the solution, and thereby very likely the intensity of the reaction between magnesium and ammonium oxalate, better and better results were obtained. To test the correctness of this interpretation I used neutral ammonium oxalate in 10 per cent. solution, and obtained over night a well-set and hard mass, not in colour but in hardness more equal to the magnesia-magnesium chloride mass than any yet produced. The results were still more improved by using the magnesia recently calcined.

From the use of neutral oxalate I passed to the use of acid oxalate without changing the ultimate result, and finally to the use of oxalic acid.

With these setting agents I combined the use of silica, also with beneficial results. For practical application I use from 80 to 160 parts of sand for 20 parts of magnesia, together with the requisite quantity of oxalic acid or oxalate of ammonia.

The advantages of the oxalic acid over magnesium chloride are the following:—

1. The oxalate of magnesia formed is insoluble in water.

2. The small amount of setting agent required.

For 3 parts by weight of calcined magnesia 2 parts by weight of a concentrated cold solution of acid ammonium oxalate, which contain about 7½ per cent. of this salt, are used. If other substances are added to the magnesia—as, for instance, ground quartz or sand—the liquid must be increased, but not the quantity of the concentrated solution, which in this case can be diluted with water, so that the mixture for the purpose of forming can be brought to the desired consistency. From the above, it is evident that for 20 grms. magnesia but 1 grm. of acid ammonium oxalate is required. The magnesia is therefore not all converted into an oxalate, but only a small fraction thereof. Inasmuch as 107 acid ammonium oxalate engage only 40 magnesia, of the 20 grms. of magnesia only 0·37 is engaged for the formation of neutral oxalate, while 19·63 remain for the formation of either basic salt or hydration.

I look therefore upon the formation of the stone or the setting as a process of hydration accelerated by the presence of ammonia and ammonium salt. Some of the many compositions made are represented to-night by a few specimens, which were prepared in the following manner:—The solids are first mixed thoroughly dry, and then the solution of oxalate is added until the mass has the desired consistency for forming. So, for instance, I made the following compositions:—

| | Parts. |
|---|---|
| Magnesia | 60 |
| Ground quartz | 60 |
| Sand | 180 |
| Oxalate | 54 |
| Magnesia | 60 |
| Quartz ground fine | 60 |
| Sand | 180 |
| Silica precipitated from silicates | 10 |
| Oxalate and water | 70 |

But, as mentioned before, the magnesia can bear the double quantity of sand used in these prescriptions.

The stones show a fine polish, when cast into well-polished moulds or upon glass.

The ammonium oxalate salt I prepare as follows:—

50 lb. commercial oxalic acid are dissolved in 20 gallons of water; thereto ammonia water is added to complete neutralisation. Water is then added to make 170 gallons of liquid, and therein 50 lb. of oxalic acid are dissolved. The whole will then measure about 180 gallons.

If polish is not considered, but great hardness of surface is desired, the stones may be immersed into a solution of aluminium oxalate, prepared as follows:—

50 lb. of oxalic acid are dissolved in 40 gallons of water, and this solution is then saturated with aluminium hydrate. When finished the solution is diluted to 240 gallons. Cement stones immersed into this solution react with it by the formation of an oxalate and deposition of alumina in the pores.

The price of a cubic foot of stone for material is, according to prescription 1,—

| | Cents. |
|---|---|
| 20 lb. magnesia | 12 |
| 20 lb. ground quartz | 8 |
| ¾ lb. sand | 2 |
| Oxalic acid | 11 |
| Ammonia | 8 |
| | 41 |

This would give about one dozen flooring slabs 1″ × 12″ × 12″, at 3½ cents each. In the manufacture of these the bulk of the ammonia can be recovered. Using the double quantity of sand, the price per cubic foot would come to 22 cents.

2. *Preparation of Light Magnesium Carbonate.*—If the magnesia obtained as a residue from the manufacture of carbonic acid is finely ground and then treated with a quantity of carbonate of ammonia, which contains only sufficient carbonic acid to produce any of the basic salts, which we call light carbonate of magnesia, we obtain—in the presence of a large quantity of water, when the temperature is gradually raised to about 60° or 70° C., agitating constantly—light carbonate of magnesia. The other product is ammonia, which remains in water solution. If the quantity of water is not sufficient we obtain a mixture of hydrated crystallised carbonate of magnesia ($MgCO_3 + 5H_2O$) and magnesia or magnesium hydrate in part.

If we use, in the place of ammonium carbonate, bicarbonate of soda, the latter is reduced only to monocarbonate, and the quantity of its excessive carbonic acid must be equivalent to the quantity required for the basic carbonate to be prepared. The time for the conversion is about one hour, but it is well to let the liquor rest for some time, inasmuch as I found frequently that after this time the reaction was not yet quite finished. However, it is not necessary to keep up either heat or agitation after this time.

The quantity of water required is about 25 times the weight of the magnesia to be converted. In the case of bicarbonate of soda the following proportions were used :—

10 magnesia.
32 bicarbonate of soda.
250 water.

The bicarbonate of soda is dissolved in the water and temperature raised to 35° C. ; then the magnesia is added, and now, under agitation, the temperature is raised to 65° C. and kept there until the milky liquid appears to become solid. After resting, the precipitate, which fills the liquid completely, is filtered and washed.

I have measured the light carbonate of magnesia thus obtained, and found that, after drying, 1 cubic inch weighed 3·2 grms., while some light carbonate of magnesia from a drug shop, and presumably produced by one of the old methods, weighed 3·5 grms. It is needless to say that the carbonate of soda obtained by this reaction is re-converted into bicarbonate, to be applied in subsequent operations.

### Discussion.

Dr. Woodman said that the material gave him the impression of expanding upon hardening and setting.

Dr. Endemann replied that its form was the same.

Mr. Schleicher said, as the result of practical experience, that the masses might hold perfectly under cover, but when exposed to the inclemencies of the weather they disintegrated in 10 or 11 months. He believed that the same matter had been discussed in the Journal of the Chemical Society about a year ago, where the very same results were recorded.

Dr. Endemann said that compositions containing magnesium chloride were undoubtedly unsatisfactory, being all more or less influenced by water, so that they became porous ; and generally the next winter destroyed them entirely.

Mr. Toch asked what was the exact composition of the bricks used for basic linings in the iron industry.

Dr. Endemann replied that the brick shown was mainly magnesia, but contained a trace of clay. They were in use, amongst others, by the Balbach Smelting Company, in Newark, and gave entire satisfaction. The magnesia was heated to a very high temperature, and lost considerably in its volume, so that it became dense enough to be formed into bricks, which were then calcined.

Mr. Toch asked how the bricks lasted under exposure.

Dr. Endemann replied that they were not used for outdoor purposes, but only for furnace linings.

Dr. Vandenberg asked what was the life of such a brick in a furnace under ordinary conditions.

Dr. Endemann replied that they lasted in litharge furnaces for about two months.

The Chairman mentioned that there was a room at the disposal of the Section, furnished with apparatus and chemicals, and should any author give timely notice that he wished to illustrate a paper by experiments, every provision would be made for him.

## NOTES ON THE ANALYSIS OF LARD OIL.

BY H. SCHWEITZER AND E. LUNGWITZ.

Since lard oil is the oily part of lard, separated from the more or less chilled lard by pressure, it is evident that the oil must, under all circumstances, conform to the purity tests applied to genuine hogs' lard. According to the raw materials used for pressing and the process of manufacturing, different grades of lard oil are in the market, from the prime lard oil of clear, pale-yellow, sometimes greenish colour, of sweet taste and smell, containing almost no free fatty acids, to the rancid and offensive-smelling lard oils of deep brown colour called "Extra No. 1," "Extra No. 2," and "Extra No. 3."

While it is easy to test the better grades of lard oil for vegetable oils and for other adulterations, it is quite difficult and complicated in the case of the lower grade.

The Milliau test with silver nitrate, for example, which gives such excellent results with lard and prime lard oil, is of much less value for the low-grade oils, owing to the deep brown colour of their fatty acids. We have tried to remove this deep colour, but did not succeed to do so in a practical manner.

The phosphomolybdic acid test—which has been lately described "to be of slight analytical value, and certainly does not fill that long-felt want of a simple test which will reliably indicate small percentages of cotton-seed oil or other vegetable oils in lard" (George F. Tennille, Journ. of the Amer. Chem. Soc. 1895, p. 41)—does not, as we readily admit, compare in accuracy with such tests as those applied for the detection of lime, chlorine, or ammonia, but is nevertheless of great practical value. Among all the samples analysed we found about 20 per cent. giving the phosphomolybdic acid test, and only 5 per cent. of these samples proved to be pure lard oils.

The specific gravity of lard oil should not be lower than 0·9130 and not higher than 0·9190 at 15·5° C., and it is easily seen that we can detect larger additions of cotton-seed oil and maize oil by the determination of this constant. As the iodine number of genuine hogs' lard shows such great variations it is but natural that the same observation should be made with lard oil. But this variability of the iodine absorption is in close accordance with the congealing point of the oil which must necessarily be inversely proportional to the iodine number. Whereas we determine the iodine number after the old Huebl process with 30 per cent. of excess of iodine, we have adopted the following method for ascertaining the congealing point of lard oil.

The oil is put into a 4 oz. wide mouth bottle, standing in a mixture of ice and salt. Under vigorous stirring with a thermometer, the oil is cooled very quickly. We note carefully the temperature at which the oil shows the first sign of becoming cloudy. If the cooling is not done very rapidly the figures for the congealing point become irregular.

From the analysis of many samples we draw the following conclusions:

Any lard oil with higher iodine number than 70 should not show signs of cloudiness above 40° F.

Generally the lard oils from 60—64 iodine number are pasty at 40° F.

The following figures are cited from our notes:—

| Specific Gravity at 15° C. (water at 15° = 1), or, at $\frac{15^\circ\text{ C.}}{4^\circ}$ | Iodine Number. | Congealing Point. |
|---|---|---|
| 0·9136 | 78·8 | 25° F. |
| 0·9146 | 76·4 | 28° F. |
| 0·9174 | 76·0 | 28° F. |
| 0·9151 | 71·5 | 35° F. |
| 0·9159 | 67·8 | 40° F. |
| 0·9160 | 63·9 | 42° F. |
| 0·9186 | 62·8 | Solid at 40° F. |

## NOTES ON THE ANALYSIS OF WHALE OIL.

BY H. SCHWEITZER AND E. LUNGWITZ.

Of all the animal and vegetable oils, formerly used for lubricating and burning purposes, but lard oil, tallow and whale oil are still employed in the United States. Although petroleum products have been proved by practical experiments to be much superior to all the saponifiable oils for lubrication, yet the use of the above animal oils cannot be dispensed with, as it becomes necessary, in special cases, to improve the viscosity of the mineral oils by a certain addition of those oils. The importance of tallow and lard oil as trade products is a very well known fact, and they are often subjected to examination on the part of the analytical chemist, whereas whale oil is more rarely met with in commerce. When therefore the latter oil came first to our attention, we searched the literature in order to find out what constants and characteristic indications had been determined for establishing the purity of whale oil. We learnt that almost nothing had been published in this regard and that the figures given in the different publications did not apply to pure whale oil as refined and sold in the United States.

Nor did the study of the most modern literature prove more satisfactory. Alder Wright, for example, gives, in his recently published work on "oils, fat, waxes," only a general description of the origin of the oil, and some colour reactions with sulphuric acid after Schaedler which, according to Lewkowitsch's investigations (this Journal, 1894, 616) are valueless for determining the purity of whale oil.

R. Benedikt states in his book "The Analysis of Fats and Waxes" that "very few reliable figures are known for the determination of the purity of whale oil," and then he quotes from A. H. Allen's book, "Commercial Organic Analysis," the following datas :—

Specific gravity at 15·5° C. = 0·9307 at 98°—99° C. = 0·8725.
Saponification value : Northern whale oil 188·5—224·4.
„ „ Southern „ 193·1.
„ „ Iodine number 80·9.
Reichert value = 2·5 gr. = 3·7—12·5.

For curiosity's sake we give the figures contained in Künkler's book "On Lubricants," published in the last year 1894.

Specific gravity at 15° C. = 0·915—0·930.
Low temperature test from 5° C.—3° C.
Iodine number 30—152.

Since the figures given in the above references are so very indefinite, we decided to determine the analytical data of whale oil ourselves, by examining commercial products which we positively knew to be pure.

For commercial reasons we think that only mineral oil, resin oil, cotton-seed oil, maize oil, fish oil could be used as adulterants of whale oil. We therefore made it our object to find out those constants of pure whale oil by which the absence or presence of the above adulterants could be ascertained.

With this end in view we examined a great number of samples of pure whale oil. We give below, in tabulated form, the results which we obtained for some samples differing in colour, and therefore most likely of different origin.

We add that we selected among all the determined constants only those for publication which seem to us of special interest for our object :—

| —— | I. | II. | III. | IV. |
|---|---|---|---|---|
| Specific gravity at 15·5° C. ... | 0·9225 | 0·9223 | 0·9225 | 0·9221 |
| Iodine number of oil ......... | 127·7 | 126·4 | 122·7 | 121·3 |
| Iodine number of fatty acids.. | 132·0 | 131·0 | 130·8 | 130·3 |
| Saponification value.......... | 194·2 | 187·9 | 193·6 | 191·1 |
| Melting point of fatty acids .. | 16° C. | 14°—15° C. | 16·2° C. | 18·0° C. |

The melting point of the fatty acids was determined in a capillary tube, and the temperature noted at which the mass was completely transparent.

The fatty acids of all the samples of whale oil were liquid at ordinary temperature, and of light brownish colour which was not deepened by the silver nitrate test after Milliau.

On comparing the above data with the corresponding figures for cotton-seed oil, maize oil, fish oil, we find the following differences :—

| —— | Cotton-seed Oil. | Maize Oil. | Fish Oil. |
|---|---|---|---|
| Specific gravity at 15·5° C. | 0·923—0·925 | 0·9215—0·9244 | 0·9256 |
| Iodine number of oil. | 108—110 | 111—123 | 148—153 |
| Iodine number of fatty acids. | 112 | 129 | 158—166 |
| Melting-point of fatty acids: | | | |
| (*a*) begins to melt at....... | ° C.<br>30 | ° C.<br>18 | ° C.<br>28·0 |
| (*b*) completely transparent at | 40 | 30 | 36·4 |
| Silver nitrate test after Milliau. | Black | A little browner than original acid. | Brown colour of acid not deepened. |

The fatty acids of these three oils are solid at ordinary temperature, whereas the fatty acids of the pure whale oil are perfectly transparent under 20° C., and do not show, at ordinary temperature, the least traces of crystallisation. Slight percentages of the fatty acids of maize oil, cotton-seed oil, or fish oil added to the fatty acids from pure whale oil caused the appearance of crystals in the liquid fatty acids.

Reviewing the results of our experiments, we conclude by stating that a refined whale oil should possess the following qualities: It must be clear, and of pale yellow colour; its specific gravity must be between 0·921—0·923 at 15·5° C. The iodine number, determined with 30 per cent. excess of iodine, and titrated, after at least 12 hours' standing, must be between 120—130.

The melting-point of the fatty acids, ascertained as above, must not be higher than 20° C., and the Milliau test must leave the colour of the fatty acids unaltered. The saponification-value should be between 190—200.

* * *

## THE CORRECT IODINE NUMBER.

BY H. SCHWEITZER AND E. LUNGWITZ.

As has been proven by the investigations of Holde and other chemists, the iodine number is influenced by the amount of Huebl reagent used for the determination of the iodine absorption number of oils and fats. The irregularities observed in the execution of the reaction are assumed to be largely caused by a varying substitution of iodine taking place simultaneously with the addition of iodine. But this supposition has never been positively confirmed, and it is our object to prove the occurring substitution as an absolute fact, and to determine quantitatively the amount of iodine taken up in the course of the reaction by substitution, and thus to determine the correct iodine absorption number.

We started from the idea that if actually substitution of iodine should take place, for each atom of iodine substituted one molecule of hydriodic acid should be formed. It is, therefore, evident that the whole problem of substitution would have been solved if we were able to determine the amount of hydriodic acid in the liquid of the Huebl reaction. But this determination is much complicated by the following circumstances:—

At first we add with the alcoholic solution of mercuric chloride and iodine a certain amount of hydriodic acid, produced by the action of iodine on the alcohol. This continuous formation of hydriodic acid is certainly the reason of the steadily decreasing strength of the Huebl solution. We shall refer to this subject again at the end of this paper.

Furthermore, the commercial alcohol used for the preparation of the Huebl reagent always contains organic compounds showing acid reaction with phenolphthaleïn and other indicators.

Again, we add with the oil to be examined a certain amount of free fatty acids.

Then there is a great probability that the total amount of mineral acid in the Huebl liquid may be increased, owing to the following reaction:—The mercuric chloride appears to be converted into iodide of mercury with formation of chloride of iodine, which produces hydrochloric acid on the addition of water. The hydrochloric acid and iodide of potash react under the formation of hydriodic acid.

The last greatest difficulty is the presence of salts in the liquid, the base of which is precipitated by sulphuretted hydrogen in acid solution.

Thus it is obvious that the quantity of the hydriodic acid produced by substitution could only be determined as the difference between the acid added in the reagents and the total amount of acid found in the test.

The determination of the hydroiodic acid by titration with standardised alkaline solutions was excluded owing to the presence of the organic substances of acid reaction contained in the alcohol and in the oil.

After many unsuccessful experiments we finally found that the following method, which is easily and quickly carried out, gives good comparable results:—

We prepare a solution of one equivalent of iodate of potash and five equivalents of iodide of potash. In the presence of free mineral acid, for example, hydrochloric acid, the following reaction takes place:—

$$5KI + KIO_3 + 6HCl = 6I + 6KCl + 3H_2O.$$

From which it follows that for six molecules of acid present six atoms of iodine are titrated.

This reaction has already been recommended by Mohr (Lehrbuch der Chem. analyt. Titrirmethoden, 6th edition, p. 358) for distinguishing qualitatively between neutral and acid salts, but its importance for the quantitative determination of free acid in the majority of metallic salts of commerce has not been recognised by Mohr.

In order to find out if the above method was applicable to the titration of the mineral acid in the Huebl liquid we determined the separation of iodine, effected by known quantities of mineral acid under the approximate conditions of dilution, &c. prevailing in the Huebl reagent.

Half-normal hydrochloric acid, exactly standardised with carbonate of soda, using litmus as indicator, was precipitated by silver nitrate, and the amount of HCl determined by weight. We found that 2 litres contained 36·4361 grms. HCl = 100·18 per cent. Then we dissolved 100 grms. of iodide of potash and 25·8 grms. of iodate of potash in 1,000 cc., and since the iodide of potash usually shows slightly alkaline reaction, we added a drop of hydrochloric acid. After violent shaking and allowing to stand for some time, we added sodium hyposulphite solution, just enough to remove the separated iodine. Having once repeated this treatment, we obtained a liquid which, after six weeks' standing in a loosely-stoppered bottle, did not show any change in its composition under the action of the carbonic acid in the air. This liquid was used for titration in all the experiments, and is shortly called "mixture" hereafter.

If we add 30 cc. of the mixture to 10 cc. of half-normal HCl in 150 cc. $H_2O$, iodine is separated, which requires—

(1.) 63·1 cc. of hyposulphite solution.
(2.) 63·0 cc. of „

Since 1 cc. of this sodium hyposulphite solution is equal to 0·01005 grms. of iodine, we found by this titration 100 per cent. of the acid taken into reaction. Again we titrated half-normal nitrous sulphuric acid with our mixture, with the following results:—

(1.) 10 cc. half-normal $HNO_3$ + 150 cc. $H_2O$ + 30 cc. mixture requires 62·7 cc. hyposulphite, corresponding to 99·3 per cent. of acid used.

(2.) 10 cc. half-normal $H_2SO_4$ + 150 cc. $H_2O$ + 30 cc. mixture, require 62·5 cc. hyposulphite, corresponding to 99·03 per cent.

Finally, we titrated these three half-normal acids with a dilute solution of barium hydrate, and found—

(3.) 20 cc. half-normal $H_2SO_4$ = 78·2 cc. $Ba(OH)_2$ solution = 99·49 per cent. acid.

(4.) 20 cc. half-normal HCl = 78·6 cc. $Ba(OH)_2$ solution = 100·0 per cent. acid.

(5.) 20 cc. half-normal $HNO_3$ = 78·0 cc. $Ba(OH)_2$ solution = 99·21 per cent. acid.

These figures prove that our iodo-metric method for the titration of mineral acids gives very exact results.

The next question to be settled was whether the mercuric chloride of the Huebl reagent had any injurious influence on the exactness of the method.

Since 25 cc. of Huebl liquid contain 1·5 grms. of $HgCl_2$, we started the following experiments:—

(1.) 1·5 grms. $HgCl_2$ in 150 cc. $H_2O$ were treated with 20 cc. mixture, and no separation of iodine was observed.

(2.) 1·5 grms. $HgCl_2$ + 150 cc. $H_2O$ + 10 cc. half-normal HCl + 20 cc. mixture. The separated iodine required 62·5 cc. of hyposulphite, which means that 99·1 per cent. of the acid taken into reaction were found by titration.

(3.) 1·5 grms. $HgCl_2$ + 150 cc. $H_2O$ + 10 cc. half-normal $HNO_3$ + 20 cc. mixture. To remove the separated iodine 62·4 cc. of hyposulphite were necessary, which is equal to 99·8 per cent. of acid.

If the mercuric chloride used as reagent should be contaminated with mercurous chloride, then a portion of the iodine separated by the mineral acid is used for the oxidation of $Hg_2Cl_2$ to $HgCl_2$, and this reaction furnishes excellent means for the quantitative determination of $Hg_2Cl_2$ in the neutral salt $HgCl_2$. The same method of titration may be further employed for the quantitative determination of free acid in the salts of Hg, Ag, Pb, Cd, Zn, Mn, Co, and Ni.

If salts of copper are to be analysed, we must first determine the amount of iodine due to the formation of $Cu_2I_2$, before we can add iodate of potash. Thus we have a very convenient method for ascertaining in the same liquid the amount of copper and free acid which is of special importance in the liquors obtained in the electrolytic refining processes of copper.

The salts of aluminium and tin, however, give off their total amount of acid with precipitation of $Al_2(OH)_3$ and $Sn(OH)_4$, when subjected to this new iodometric method.

The quantitative progress of the reaction between compounds of Fe, Sb, As, Au, Pb, Bi, and the new mixture has not yet been definitely ascertained. (Meanwhile getting this paper, delivered January 7th, ready for publication, we received Chemiker Zeit., No. 1 of January 2nd, in which C. Meineke describes practically the same method for titration. This investigation disposes of a good deal of material gathered by us referring to the same subject.)

Having ascertained that our method was applicable to the Huebl liquid as far as the influences of mineral acid and mercuric chloride are concerned, we then convinced ourselves that also the fatty acids in any form and the organic compounds of acid reaction contained in the commercial alcohol, did not affect our liquid at all.

Therefore, to determine the mineral acid, contained in the Huebl liquid and the amount of substitution, one must proceed as follows:

After the usual titration of the free iodine with hyposulphite of sodium solution, we add about 5 cc. of a 2 per cent. solution of iodate of potash and titrate the new liberated iodine with the same hyposulphite solution. The addition of iodide of potash is unnecessary, as it has been previously put in the solution.

| No. | Name of Oil. | Per Cent. Free Fatty Acid. | Duration of Test. | Weight of Oil taken. | Amount of Iodine taken. | Amount of Iodine absorbed. | Original Iodine Number. | Iodine liberated by Hydriodic Acid, contained in 25 cc. Huebl Reagent. | Iodine liberated by Total Hydriodic Acid in the Real Test. | Amount of Iodine substituted. | Amount of Iodine substituted in Per Cent. from Oil taken. | Correct Iodine Number. | Amount of Iodine substituted in Per Cent. of original Iodine Number. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Olive oil | 10·67 | 14 hours | 0·2323 | 0·46029 | 0·19849 | 85·44 | 0·15628 | 0·17487 | 0·0372 | 16·00 | 69·44 | 18·72 | |
| | | 10·67 | 14 hours | 0·4885 | 0·46029 | 0·41506 | 84·96 | 0·15628 | 0·19246 | 0·07236 | 14·80 | 70·16 | .. | |
| 2 | Olive oil | 3·2 | 3 hours | 0·2810 | 0·48642 | 0·23216 | 82·61 | 0·12764 | 0·149745 | 0·04422 | 15·72 | 66·89 | 19·0 | |
| | | 3·2 | 3 minutes | 0·8760 | 0·48642 | 0·48542 | 55·4 | 0·12764 | 0·16784 | 0·0804 | 9·17 | 46·23 | .. | Gantter solution of T in $CCl_4$. |
| | | 3·2 | 3 × 24 hours | 0·2576 | 0·39748 | 0·14221 | 55·20 | .. | .. | .. | .. | 55·20 | .. | |
| 3 | Olive oil foots | 26·1 | 12 hours | 0·3685 | 0·51858 | 0·31055 | 84·27 | 0·08241 | 0·12864 | 0·09246 | 25·09 | 59·18 | 29·8 | |
| | | 26·1 | 12 hours | 0·3580 | 0·51858 | 0·30251 | 84·49 | 0·08241 | 0·12563 | 0·08644 | 24·15 | 60·34 | .. | |
| 4 | Lard | .. | 12 hours | 0·2143 | 0·57889 | 0·12965 | 60·49 | 0·022044 | 0·04221 | 0·04034 | 18·82 | 41·67 | 31·1 | |
| | | | 12 hours | 0·3700 | 0·57889 | 0·22613 | 61·11 | 0·022044 | 0·05829 | 0·07250 | 19·60 | 41·51 | 32·1 | |
| 5 | Lard oil | 0·68 | 12 hours | 0·3065 | 0·46934 | 0·24221 | 79·02 | 0·13970 | 0·16482 | 0·05024 | 16·39 | 62·63 | 20·7 | |
| | | | | 0·2260 | 0·46934 | 0·17788 | 78·71 | 0·13970 | 0·15778 | 0·03617 | 16·00 | 62·71 | 20·3 | |
| 6 | Lard oil | 11·3 | 12 hours | 0·2234 | 0·55778 | 0·16482 | 73·77 | 0·04724 | 0·07035 | 0·04622 | 20·69 | 53·08 | 28·04 | |
| | | | | 0·6730 | 0·55778 | 0·48140 | 71·53 | 0·04724 | 0·10754 | 0·1206 | 17·92 | 53·61 | 25·0 | |
| 7 | Lard oil | 12·1 | .. | 0·2648 | 0·55778 | 0·18894 | 71·35 | 0·04724 | 0·07437 | 0·05426 | 20·49 | 50·86 | 28·7 | |
| | | | | 0·6317 | 0·55778 | 0·44421 | 70·32 | 0·04724 | 0·10553 | 0·11658 | 18·45 | 51·87 | 26·2 | |
| 8 | Lard oil | 14·6 | 3 hours | 0·2629 | 0·45526 | 0·18191 | 69·19 | 0·15678 | 0·17638 | 0·03920 | 14·91 | 54·28 | 21·5 | |
| | | | | 0·424 | 0·45526 | 0·28442 | 67·07 | 0·15678 | 0·18593 | 0·05830 | 13·75 | 53·32 | 20·5 | |
| 9 | Cotton-seed stearine | .. | 12 hours | 0·388 | 0·47989 | 0·40049 | 103·22 | 0·13065 | 0·16884 | 0·07638 | 19·68 | 83·54 | 19·6 | |
| | | | | 0·3965 | 0·47989 | 0·41155 | 103·79 | 0·13065 | 0·17085 | 0·0804 | 20·27 | 83·52 | 19·5 | |
| 10 | Cotton-seed stearine | .. | 12 hours | 0·2808 | 0·47989 | 0·27989 | 99·67 | 0·13065 | 0·15778 | 0·05427 | 19·33 | 80·34 | 19·4 | |
| | | | | 0·2942 | 0·47989 | 0·29195 | 99·23 | 0·13065 | 0·15778 | 0·05427 | 18·45 | 80·78 | 18·5 | |
| 11 | Arachis oil | 13·84 | 14 hours | 0·265 | 0·46029 | 0·26231 | 98·98 | 0·15628 | 0·17989 | 0·04722 | 17·81 | 81·17 | 18·0 | |
| | | 13·84 | 14 hours | 0·4128 | 0·46029 | 0·40552 | 98·23 | 0·15628 | 0·19698 | 0·08140 | 19·72 | 78·51 | 20·0 | |
| | | | | 0·4736 | 0·46029 | 0·45728 | 96·55 | 0·15628 | 0·19648 | 0·0804 | 16·96 | 79·59 | 17·6 | |
| 12 | Whale oil | 0·56 | 12 hours | 0·283 | 0·49195 | 0·37085 | 131·04 | 0·11658 | 0·16130 | 0·08944 | 31·60 | 99·44 | 24·0 | |
| | | | | 0·2408 | 0·49195 | 0·3211 | 133·34 | 0·11658 | 0·15427 | 0·07538 | 31·30 | 102·04 | 23·4 | |
| 13 | Stearic acid | .. | 12 hours | 1·2000 | 0·46934 | 0·02513 | 2·09 | 0·14573 | 0·15075 | 0·01004 | 0·84 | 1·25 | 40·2 | |
| | | | | 1·0321 | 0·46934 | 0·02111 | 2·04 | 0·14513 | 0·15075 | 0·01004 | 0·97 | 1·07 | 47·5 | |
| 14 | Menhaden fish oil | 0·24 | 12 hours | 0·1991 | 0·47537 | 0·30653 | 153·9 | 0·12764 | 0·16683 | 0·07840 | 39·3 | 114·6 | 25·5 | |
| | | 0·24 | 3 hours | 0·1400 | 0·47537 | 0·21005 | 150·03 | 0·13795 | 0·16080 | 0·04570 | 32·63 | 117·4 | 21·7 | |
| | | 0·24 | 1 hour at 45° C. | 0·2023 | 0·47034 | 0·30552 | 151·02 | 0·13568 | 0·16985 | 0·06834 | 33·78 | 117·24 | 22·3 | |
| | | 0·24 | 1 hour at 45° C. | 0·1421 | 0·47034 | 0·22613 | 159·11 | 0·13568 | 0·16583 | 0·0603 | 42·73 | 116·68 | 26·9 | |
| 15 | Spirits of turpentine | .. | 12 hours | 0·0988 | 0·61355 | 0·3623 | 366·7 | 0·00653 | 0·24974 | 0·48672 | 492·3 | .. | .. | |
| | | | 12 hours | 0·1083 | 0·61355 | 0·3884 | 358·6 | 0·00653 | 0·26883 | 0·4846 | 447·4 | .. | .. | |

The real test is then subjected to exactly the same process, and the difference between this titration and the previous one multiplied by two, according to the formula—

$$6HI + KIO_3 = 5HI + HIO_3 + KI = 6I + 3H_2O + KO,$$

gives the amount of substituted iodine. Everybody determining the iodine number after Huebl has undoubtedly made the observation that the liquids standing for some time after the tiration has been finished, become blue again in consequence of separation of iodine. This separation is irregular, according to the nature of the tested oil. On the other hand, the mixture of iodide of potash, iodate of potash, and mineral acid in greater dilution, continuously separates small quantities of iodine. Therefore the titration for ascertaining the substitution, as described above, must be carried out immediately and brought to an end within 5 minutes after the addition of the mixture.

Following this course we obtained the results given in tabulated form.

From these tables it appears that when a larger excess of Huebl liquid is used, as, for example, in the two tests of oil No. 1—

0·46029 grm. iodine for 0·2323 grm. oil, and
0·46029 grm. iodine for 0·4885 grm. oil,

we obtain indeed a higher iodine number, namely, 85·44, as against 84·96. But this increase in the iodine absorption is not due to the addition of iodine, but to substitution, as seen from the following figures, which show that in the first case 16·0 per cent. of iodine have been substituted, and in the latter only 14·92 per cent. This proves clearly that Holde (Mitth. Königl. techn. Versuchs. Anstalten, Berlin, 1891, p. 81) is mistaken, when he thinks that a larger excess of iodine causes a more complete addition of iodine. A larger excess simply increases the substitution of iodine.

We further see that substitution takes place simultaneously with addition and not subsequently to the latter reaction, even if the amount of iodine used is very small and insufficient for complete addition. With oil No. 2 we found, after three minutes' standing, a substitution of 9·16 per cent., and after three hours 15·72 per cent., and with oil No. 14 we see that after three hours 32·63 per cent. of iodine are substituted, and after 12 hours 39·3 per cent.

This shows that the time of reaction increases the substitution. The same is the case with higher temperatures, as seen from oil No. 14. After one hour at 45° C. we have a substitution of 33·78 per cent.; after three hours at ordinary temperature, 32·63 per cent. At the same time it appears that the results obtained at higher temperature run very irregular. Repeating the test with oil No. 14 at 45° C. we get a substitution of 42·73 per cent. The correct iodine number, however, is almost constant in both tests, viz. :—

117·24 and 116·68.

The percentage of iodine substituted does not stand in direct relation to the value of the iodine number. The substitution seems to be rather influenced by the chemical nature of the oil experimented upon. For instance, No. 9 cotton-seed stearine, with the iodine number 103, has the substitution number of 20, whereas No. 1 olive oil, with the iodine number of 85, has the substitution number of 16.

At this place we want to add that in the abstract made by Holde of De Negri and Fabris' research on oils (Ztschr. f. analyt. Chemie, XXXIII., p. 563), some misprints must have occurred. It is stated there that cotton-seed stearine has an iodine number of 8·9 and the saponification value 257, with a melting point of 32°—39° C. These figures certainly seem to be rather improbable, and are contrary to those observed by us.

Further, it may be seen from No. 13, stearic acid, that about half of the quantity of iodine, absorbed after the Huebl process, has been taken up by substitution and not by addition. The original iodine number therefore does not admit the inference that oleic acid or some acid of the olefine series, in the ratio corresponding to the iodine absorption figure, contaminates the stearic acid.

Again, we refer to the third test of oil, No. 2, in which we determined the iodine number of olive oil after the directions published by Gantter (Ztsch. f. analyt. Chemie, XXXII., p. 178). Gantter investigated the influence of mercuric chloride on the iodine number, and found that the value of the latter number is directly proportional to the amount of mercuric chloride present. He proposes to use instead of the Huebl reagent a solution of iodine in carbon tetrachloride. It will be noticed that the iodine number after Gantter is 55·2, and 82·6 after the Huebl method. But in the latter case we had a substitution of 13·1 per cent., which reduces the iodine number to 69·4, whereas in the Gantter liquid no mineral acid could be traced, which proves that no substitution had taken place. At the same time, however, we see that the Gantter solution does not act energetically enough to effect complete addition.

Very interesting are the figures given in No. 15, spirits of turpentine. C. Barenthin (Archiv. der Pharmacie, 224, p. 848) determined the iodine numbers of different essential oils, and states that spirits of turpentine has the iodine number 300. This high figure caused us to investigate the relation of substitution and addition.

The figures obtained for substitution, 492·3 and 447·4, prove that with spirits of turpentine some entirely different reaction from that of addition and substitution must take place.

A reaction different from that hitherto assumed must also take place in the Huebl solution itself. This we infer from the following experiments :—

A freshly prepared solution contained in 25 cc.—

After 12 hours : 0·6181 grm. iodine, 0·0020 grm. iodine as hydriodic acid, 0·6201 grm. total iodine.

After 36 hours : 0·6136 grm. iodine, 0·00653 grm. iodine as hydriodic acid, 0·6201 grm. total iodine.

After 84 hours : 0·5930 grm. iodine, 0·02713 grm. iodine as hydriodic acid, 0·6201 grm. total iodine.

After 132 hours : 0·5859 grm. iodine, 0·03517 grm. iodine as hydriodic acid, 0·6210 grm. total iodine.

As to the nature of the occurring reaction we cannot as yet bring any definite explanations.

From all our experiments it is apparent that the Huebl method, with the described correction, does not give the true iodine addition figure, but remains far below the figure for complete addition. When in actual experiments Huebl found that pure oleïc acid took up 89·8—90·5 per cent. of iodine, knowing that the theory requires that oleïc acid should absorb 90·07, he was highly satisfied with these figures, and founded his further investigations on these results. But from our determinations it will be clear that the close accordance of theory and practice in Huebl's experiments was only accidental, and that his iodine absorption figure for pure oleïc acid was partly caused by substitution. Therefore it will be necessary to find another salt for mercuric chloride in order to facilitate the reaction between iodine and oil, or to increase the amount of mercuric chloride in order to arrive at the correct iodine number, by means of the above correction, or to follow up Gantter's method, with the object of finding a medium which acts more effectively than the Gantter solution.

# Journal and Patent* Literature.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Improvements relating to the Process and Means for Clarifying and Filtering Liquids.* A. W. T. Hülssner and F. W. P. Röhrig, Leipzig. Eng. Pat. 54, January 1, 1894.

Clarifying and filtering chambers are constructed to work on the principle of a siphon, the advantage claimed, being that the settling out of impurities more readily takes place.

The filter described, is constructed of filtering material arranged spirally and compressed to any desired degree between two plates. Filtration can take place either towards or from the interior of the coil. Such a filter is said to have large working capacity, and also to be readily dismounted for cleaning.—L. A.

*Improvements in Filter Presses.* A. L. G. Dehne, of Halle, Germany, and C. A. Harzer, London. Eng. Pat. 575, January 10, 1894.

For the filtration of slimy precipitates a filter press is so constructed that the precipitate can be removed from the cloths, *in situ*, by forcing through them, in a direction opposite to that of filtration, a current of clean water. To effect this, the cloths are stretched across the face of each of the filtering chambers. The cloth rests against one side of a chamber during filtration, and against the face of the next chamber during the cleansing operation. Suitable channels are provided to take away the liquid from either side of the cloth.—L. A.

*Improvements in the Method of and Machinery or Apparatus for Extracting Oil from Seeds and the Like, and for Forming Cakes from such or other suitable Substance.* H. Lambert, Leeds. Eng. Pat. 3197, February 14, 1894.

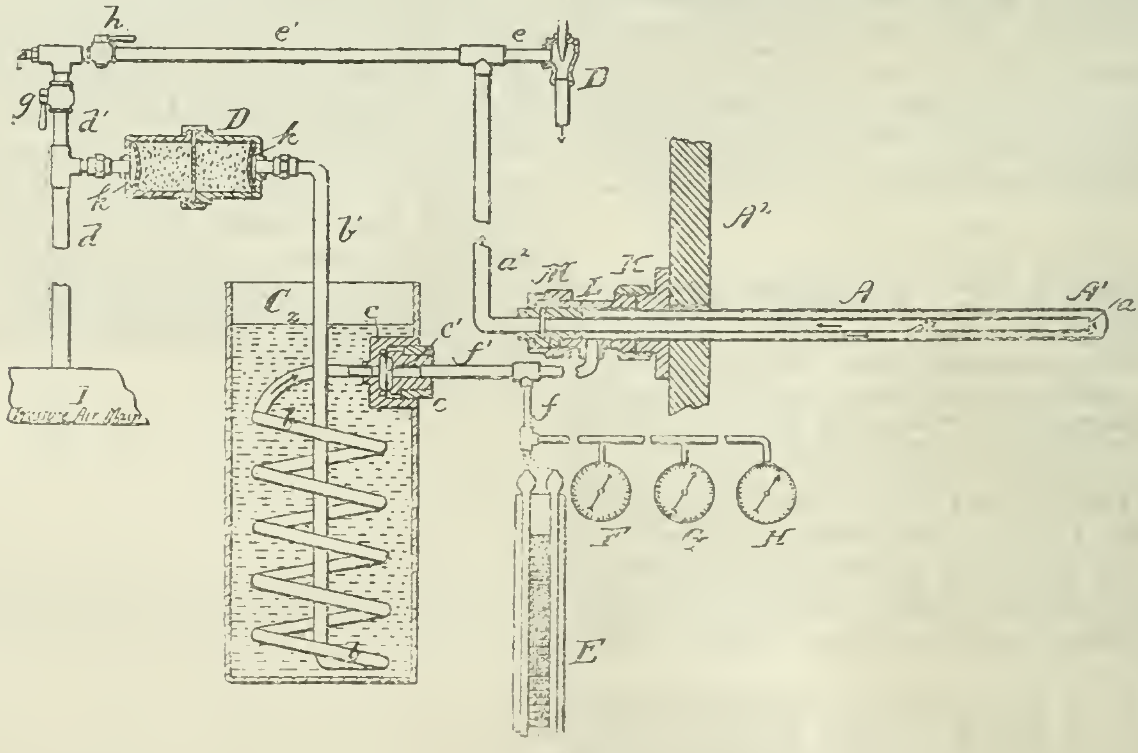
The novelty of this invention consists principally in filling pressing chambers at the bottom instead of at the top, by means of a revolving table, containing openings of the size of the cakes required, into which the plates are dropped, the whole being revolved until the opening is under the outlet of "the kettle." When the plate is full, the table is turned again to allow the other plates to be filled in rotation.—J. J. K.

*An Improved Drying Machine for Drying Spent Wash, Sludge, and other Materials.* F. I. Cooke, Ravenscourt, Bexley, Kent. Communicated by M. Haecking, Dortmund, Germany. Eng. Pat. 3851, February 22, 1894.

The material to be dried is charged into a series of half-cylindrical troughs, within which are a number of stirrers, arranged helically upon a rotating shaft. As the material is propelled along the troughs by the stirrers, it is heated by means of the hot air and gases from a furnace, or other heating and drying medium, passing through a jacket below or else through the troughs and directly in contact with the material therein.—E. G. C.

*Improvements in Pyrometers.* E. A. Uehling and A. Steinbart, both of Birmingham, Jefferson, State of Alabama, U.S.A. Eng. Pat. 9664, May 17, 1894.

The apparatus shown in sectional elevation by the figure, measures temperature by means of the change in the pressure of air flowing through the apparatus. Air from the main I, enters the pipe *d*, and after passing through the filter D, is conducted to a coil *b* in the vessel C, where



Pyrometer.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

its temperature becomes constant. It then passes the minute aperture $c'$, and enters the platinum tube A by the pipe $f'$, where it is exposed to the temperature required to be measured, and by means of the minute aperture $a'$, the air flows away through the concentric tube $a$ and away by the pipe $a^2$. The change in the pressure produced by the flow of air in the pipes between the two minute apertures $c'$, $a'$, is measured by the manometer gauges F, G, H, and affords a measure of the temperature. The pressure of the entering air may be adjusted by means of a pressure regulator, aud in a modified arrangement, the air may be aspirated through the apparatus.—E. G. C.

*Improvements in Separating Solid from Liquid Matter, more especially relating to the Treatment of Slimes, Finely-divided Ore, Precipitates, and Sewage.* C. Raleigh, Johannesburg, S.A.R. Eng. Pat. 21,082, November 6, 1893.

In the improved filtering apparatus, "the filter bottom is divided into numerous sections; one series, comprising alternate sections, being connected to one pipe, and the other series, comprising the remaining sections, to another pipe. The fluid is for a time injected through one pipe and series of sections, and ejected through the other pipe and series of sections, and then, by turning a fourway cock, the action is reversed." To facilitate precipitation, the operation is to be conducted in a vat with a filter bottom, preferably divided into sections, and connected with an exhaust pump, which is not only used to circulate the liquid by withdrawing it below the filter-bed, and return it to the upper part of the vat, but also serves to inject, intermittently, air or liquid, and thus prevent the filter-bed becoming choked.—D. A. L.

*Improvements in the Method of and Means for Carbonating Liquids.* H. J. Haddan, London. Communicated by The Ferry Manufacturing Co., New York, U.S.A. Eng. Pat. 23,032, November 27, 1894.

The liquid to be carbonated is introduced into the top of a closed vessel containing the gas under pressure by means of a central vertical pipe, and it first impinges upon a perforated cone, whereby it is broken up, so as to offer a large surface to the gas as it trickles down the sides of the vessel. A number of discs and cones perforated by conical holes are interposed at intervals, to still further break up the liquid as it falls, and thereby render the action of the gas more efficient. The vessel is provided with pressure and water-level gauges, and there is an outlet at the base for the carbonated liquid to flow away.—E. G. C.

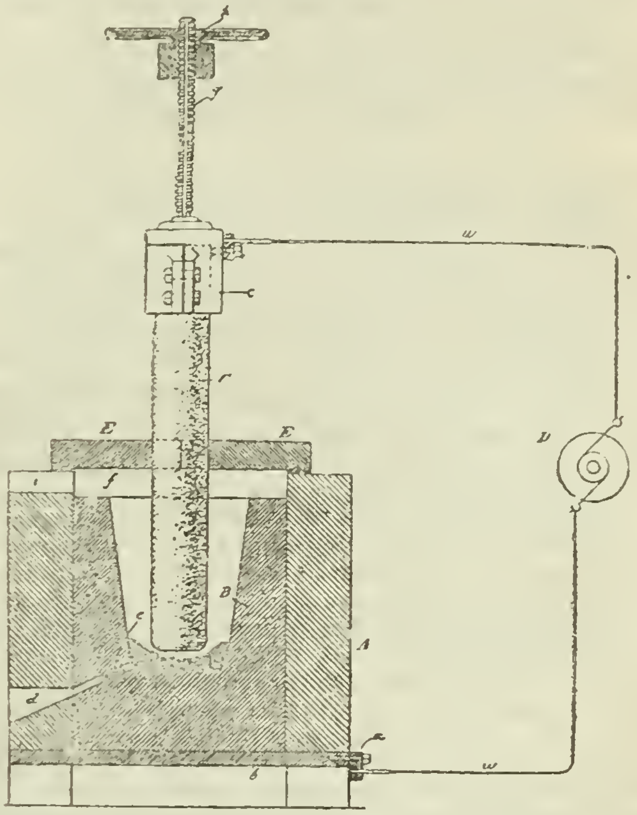
## II.—FUEL, GAS, AND LIGHT.

*Calcium Carbide and Acetylene.* F. Wyatt. Eng. and Mining J. 1894, **58**, 556—558.

In 1892 Maquenne described, in the Comptes rend. (this Journal, 1893, 288), a method of preparing barium carbide, $BaC_2$, by heating together barium carbonate, magnesium, and charcoal in an iron bottle, and showed that this substance evolved acetylene on treatment with hydroxylated compounds. In 1893 Travers prepared calcium carbide by heating the chloride and charcoal with sodium, and from this he also produced acetylene (Proc. Chem. Soc. 1893, 15; and this Journal, 1893, 178). Meanwhile Willson, experimenting upon the production of calcium in his electric furnace at Spray (North Carolina, U.S.A.), obtained a fused black homogeneous mass, which became solid and brittle on cooling, by treating a mixture of lime and carbon with a current of 4,000—5,000 ampères. The furnace is shown in the figure, in which A represents an outer shell of firebrick, enclosing a carbon or graphite lining B, with a small tap-hole $d$, provided with an alumina or clay plug $e$. The cover is formed of carbon plates E, separated from the lining by an insulating space $f$, and perforated in the centre, to pass the carbon electrode C, which receives vertical adjustment by means of the threaded shaft $g$ and nut $h$. The electrical connections with the dynamo D are made as shown, that with the furnace being effected through the iron plate $b$. The charge consists of lime, intimately mixed with an excess of finely-divided carbon; combination and fusion ensue in the immediate neighbourhood of the arc, and thence spread steadily through the mass. The black product is nearly pure calcium carbide, and evolves pure acetylene on treatment with water—

$$CaC_2 + 2H_2O = C_2H_2 + Ca(OH)_2$$

The actual results in practice are the production of 2,000 lb. of the carbide in 12 hours, from a mixture of 1,200 lb. fine coal dust and 2,000 lb. of burnt lime, at an expenditure of 180 E.H.P. per hour. Valuing this amount of coal at 2·50 dols., of lime at 4·00 dols., the E.H.P (from water) at 6·00 dols., and the labour at 2·50 dols., the cost of 2,000 lb. of calcium carbide works out to 15·00 dols., or of 2,000 lb. of acetylene to 37·00 dols.



Willson's Electro Smelting Furnace.

The specific gravity of the carbide is 2·22 at 18° C. It is not affected by heating it in hydrogen, or to 1,200° in nitrogen, or in contact with silicon or boron at a bright red heat, or with sodium or magnesium at the softening point of glass, or with tin at a red heat. At temperatures above a red heat, it alloys with iron. It becomes incandescent when heated with chlorine, bromine, or iodine to temperatures of 245°, 350°, and 305° respectively. At a dull red heat it burns in oxygen, forming calcium carbonate; and in sulphur vapour at 500° it forms calcium sulphide and carbon bisulphide, with incandescence. Water is decomposed very rapidly, forming pure acetylene as already described, but with steam, even at a red heat, the action is less rapid, and the gaseous product contains free hydrogen. In dilute acids it behaves as in water, but in ordinary sulphuric acid it evolves an odour of aldehyde, whilst fuming nitric or sulphuric acids have but slight action upon it. With dilute chromic acid, acetylene is formed, but with the fused acid, as also with potassium nitrate or chlorate, or with lead chromate, it oxidises with incandescence. Lead peroxide oxidises it with incandescence below a red heat, and the lead reduced in the reaction contains calcium. In dry hydrogen chloride gas it becomes incandescent, and produces a gas containing much hydrogen.

By this process acetylene is obtained far more conveniently, and at a much cheaper rate than by any of the older processes, and it should find an extensive application in industrial organic chemistry. At the same time, its high percentage of carbon renders it very valuable as an illuminating agent, especially for the enrichment of water-gas or other poor illuminants, or even in admixture with ordinary air. Highly diluted in this way (but only so), it is capable of yielding a pure white and smokeless flame; and the authors state that experiments made by the Electric Gas Company show that 2,000 lb. of the calcium carbide, on mere admixture with water, yield 10,500 cub. ft. of acetylene, which, mixed with the required volume of air, affords a gas equal in illuminating value to 100,000 cub. ft of city gas of 22—25 candle power per 5 ft. standard burner. Allowing an extra 15·00 dols. per ton for freight and contingencies, beyond the price estimated above, the cost of such gas would be 30 cents per 1,000 cub. ft. The ease with which the carbide may be packed, transported, and used, mark out the illumination of country houses and of railway cars as a special field for its application.

—W. G. M.

### *Oil-Gas.* W. A. Noyes, W. M. Blinks, and A. V. H. Mory. J. Amer. Chem. Soc. 1894, **16**, 688—697.

This is an investigation of the gas made by the Citizens' Fuel and Gas Company of Terre Haute. The largest of the three generators used, has a capacity of about 450 cub. feet per minute. It is constructed of $\frac{3}{8}$-in. boiler steel, is 20 ft. high and 8 ft. in diameter, and is lined with fire-brick to a thickness of 16 ins. Within, it consists of three empty chambers 2 ft. or 3 ft. high, alternating with two compartments 5 ft. high, filled with unmortared brick chequer-work. Above all is a heavy iron door, and at the bottom is the gas delivery. The generator is first heated by oil, steam-injected into the top and middle empty chambers, together with a sufficient air-supply; then this supply is cut off, and the petroleum to be gasified is introduced through three jets into the top chamber. The chequer-work is thus so rapidly cooled that in from 7 to 10 minutes the process of gas-generation must be again replaced by that of heating. The gas passes from the apparatus to a water-seal, where it is mixed with air, which is steam-injected through a 4-in pipe, as the gas alone is too rich for use in ordinary burners. A stream of water flowing through the water-seal box condenses the tar, which is carried to the tar-well. The gas is then passed successively through a cold-water scrubber, a tubular condenser, a second scrubber, and two purifying boxes containing "Laming's mass" (wood-shavings treated with copperas and lime), thence it runs through the station meter to the holders. The temperature of gasification was measured by introducing various salts with known fusing-points, wrapped in sheet iron. At the lowest temperature employed (at the end of gasification), sodium chloride refused to melt, but potassium chloride fused readily; whilst at the highest temperatures calcium fluoride was unaltered, but sodium carbonate fused. The maximum and minimum temperatures are therefore estimated at from 900°—1,000° C. and 750° C. respectively.

The composition of the gas, determined at three separate times by means of Orsat's apparatus, was as follows :—

| —— | 1. Undiluted Gas. | 1. Diluted Gas. | 2. Diluted Gas. | 3. Diluted Gas. |
|---|---|---|---|---|
| Carbon dioxide ........ | 2·3 | 2·1 | 0·7 | 0·8 |
| Illuminants............ | 28·1 | 19·9 | 19·3 | 15·9 |
| Oxygen ................ | 0·2 | 5·9 | 7·0 | 7·7 |
| Carbon monoxide ...... | 0·6 | 1·8 | 0·0 | 0·0 |
| Methane............... | 44·8 | 32·3 | 33·2 | 36·0 |
| Hydrogen.............. | 20·5 | 14·2 | 6·9 | 6·1 |
| Nitrogen............... | 3·5 | 23·9 | 32·9 | 33·5 |
| $CO_2$ from total carbon.. | 115·7 | 85·6 | 85·5 | 77·0 |
| Illuminants { Ethylene | 16·2 | 10·3 | 6·3 | 7·5 |
| Illuminants { Propylene | 11·9 | 9·6 | 13·0 | 8·4 |
| English heat units per cub. ft. | 1,025 | 744 | 741 | 678 |

For the calculation of the heat of combustion, the illuminants have been regarded as consisting only of ethylene and propylene. The small percentage of oxides of carbon in the gas, shows that the steam injected cannot have acted upon the carbon of the oil in the generators, but must have passed through the apparatus unchanged, even at a temperature of 700° to 900° C. This observation has been confirmed by other experiments. The crude gas contained 1·83 grains, the purified gas 0·025 grain of sulphur per cub. ft.

The average quantity of oil (containing 86 per cent. C + 14 per cent. H) required to make 1,000 cub. ft. of diluted gas is 11·5 to 12 gallons, of which 1·5 to 2 gallons are used for heating; and by comparing the calorific powers of the oil and of the gas produced from it, it would appear that about 44 per cent. of the heating power of the oil is transferred to the gas.

The photometric luminosity of the gas (Sample 2, above) found by means of a Methven slit, standardised with an amyl acetate lamp, was as follows (per 5 cub. ft. per hour): Argand burner = 28·4, 5-ft. bat's wing = 32·2, small Welsbach = 48·3, and large Welsbach = 47·1 c.p. Using different kinds of bat's wing burners, the best result was obtained with the larger sizes and with a smooth, as opposed to a forked, flame. The illuminants were collected by passing 125 litres of the gas through an iced-bottle condenser for the tar, ammoniacal cuprous chloride for acetylene, dilute sulphuric acid to retain ammonia from the copper solution, and, finally, bromine contained in two Drechsel wash-bottles. The benzene was found by Hempel and Dennis' method (this Journal, this number, page 196). The benzene amounted to 1·2 per cent.; and a considerable acetylene precipitate was obtained. After washing with dilute caustic soda solution, the bromine compounds were distilled; more than half came over between 127° and 150°, and the residue, recrystallised from alcohol, melted at 113°—113·5°, and contained 85·11 per cent. of bromine. It is probably identical with that ($C_4H_6Br_4$) found by Armstrong and Miller in Pintsch oil-gas (this Journal, 1886, 374). The distillate re-distilled, gave three fractions, boiling at 129°—133°, 133°—139°, and 139°—143°, respectively, in descending order of importance; and the vapour density of the first corresponded fairly with that of ethylene bromide.

The amount and character of the tar varies; but no essential difference was found between the qualitative composition of a viscous and that of a comparatively thin sample. The tar was first distilled by means of superheated steam and then by direct heating, frothing in the latter case being overcome by a preliminary heating in an open dish until it ceased. Benzene and phenol were not actually isolated, but were probably present in small proportions; a considerable quantity of naphthalene was separated, and about 0·35 per cent. of anthracene, whilst from the fraction distilling about 425°, a solid melting at 250° (probably chrysene) was obtained, and from the higher fractions, a green crystalline substance, melting at 240°, was separated, but in quantities too small for identification.—W. G. M.

### *The Determination of Benzene in Illuminating Gas.* W. A. Noyes and W. N. Blinks. J. Amer. Chem. Soc. 1894, **16**, 697.

*See under* XXIII., *page* 196.

### *A Substitute for Platinum in Incandescent Glow Lamps.* W. Bolton. Ber. d. Deutsch. Elektrochem. Ges. 1894, 58—60.

As platinum has approximately the same coefficient of expansion as glass, it can be easily fused into a glass bulb or tube, making a good joint, which does not crack on cooling. For this reason platinum wires are almost invariably used for conducting the electric current to the carbon filaments of incandescent lamps. Probably something like 500 kilos. of platinum are annually used in Europe alone for this purpose. Naturally there have been many attempts made to replace it by a cheaper substitute; and the author here chronicles another, but gives no satisfactory evidence that it has stood the test of practice.

The oxygen of the air readily attacks aluminium when finely divided or amalgamated with mercury. The amalgamation is better effected with a salt of mercury than with mercury itself. Soon after the aluminium has been treated with a solution of the mercury salt, there rises up a voluminous mossy growth of aluminium oxide. This soft and finely-divided oxide becomes, after strong compression, a compact mass through which air cannot penetrate. This property of aluminium is utilised as follows:—A piece of aluminium is introduced into a glass tube, which is then heated before the blow-pipe. The aluminium melts and is drawn out, together with the glass tube, until the latter is reduced to about $\frac{3}{4}$ mm. in diameter. On cooling, we get an aluminium wire enclosed in a glass tube. The latter certainly cracks and splits, but this does not matter, for it is only intended to protect the wire from melting and running out when it has to be fused into a thicker glass mantle. Fig. 1 shows two such wires *Al* fused into a glass mantle *Gl*, which forms the lower part of a glow-lamp (Fig. 2). The inner ends of the wires are connected to the carbon filament *k k*. The upper end S of the bulb, before it is sealed off, forms a tube through which the air is pumped out. As the joint between the aluminium wires *Al* and the glass mantle *Gl* is not perfectly good, air tends to leak between them into the bulb, and this leakage has to be stopped as follows:—While the pumping is going on, a concentrated solution of mercuric chloride is dropped at *a a* where the wires enter the glass mantle. By the action of the air-pump the solution is sucked up between the glass and the aluminium, and amalgamates the surface of the latter. The oxygen of the air, which penetrates in, attacks the aluminium and converts it into oxide (O, Fig. 1). The oxide as it swells up, makes a tight joint between the aluminium and the glass.—D. E. J.

Fig. 1.

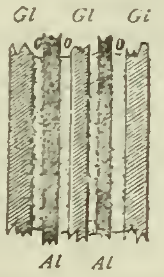
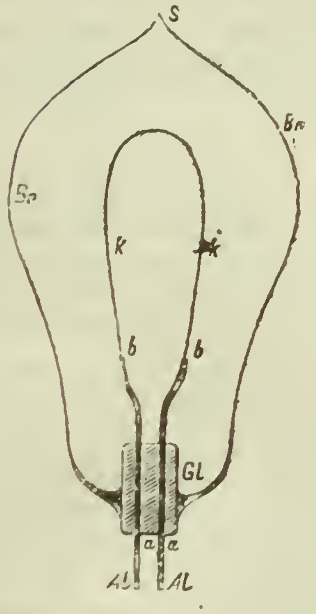


Fig. 2.



## PATENTS.

*Improvements in the Manufacture of Gas for Heating and Illumination.* J. A. Wanklyn and W. J. Cooper, both of New Malden, Surrey. Eng. Pat. 20,215, October 26, 1893.

The patentees have invented "an artificial material, the equivalent of ordinary cannel coal," which they manufacture by immersing wood-charcoal in hydrocarbon and other carbonaceous liquids, when considerable quantities of the liquids are found to be absorbed by the solid. The wood-charcoal may have had as source any ordinary wood, but preferably that wood-charcoal, which has been produced at almost the lowest temperature at which carbonisation can be effected, should be used. The carbonaceous liquid may be petroleum and its products, such as kerosene and astatki, gas tar, and other cheap carbonaceous liquids.

It is found that charcoal, such as described, absorbs mineral oil with great ease and in very large proportions, in some cases as much as three times its weight being absorbed by the charcoal.

Gas "of a character like ordinary cannel-gas" is manufactured from the "artificial cannel" in the ordinary way; but, as the material of the patentees is somewhat fragile, it is advantageous to protect it by some receptacle (such as a length of stove piping), the charged receptacle being then put into the gas retort. After giving off its gas, the receptacle is withdrawn and cooled. A further quantity of mineral oil is then poured upon the residual charcoal in the receptacle; the mineral oil is absorbed, regeneration of the artificial cannel being thereby effected. "Properly prepared" charcoal may be thus employed "very many times."

The patentees claim (1) the manufacture of artificial cannel as described; (2) the production of a gas like cannel gas from their material; and (3) the regeneration of the material.—E. R. B.

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*Improvements in and in Apparatus for Manufacturing Oil-Gas.* W. R. Herring, Huddersfield. Eng. Pat. 23,433, December 5, 1893.

For the efficient manufacture of "permanent oil-gas of high illuminating quality," by the destructive distillation of hydrocarbons, great attention must be paid to the temperature at which the operation is conducted. The suitability of the temperature depends, according to the patentee, on the specific gravity of the oil, being the higher, the heavier the oil employed; moreover, as the specific gravity of a given oil augments *pari passu* with the progress of its decomposition, the temperature should also progressively increase.

To carry into practice these principles the patentee causes oil to flow through two or more retorts, which are enclosed in flues of special construction, and heated by the combustion herein of producer gas with heated air; the arrangement being such that a very accurate adjustment of temperatures can be obtained.

In the figures, of which Fig. 1 shows a front view partly in section, and Fig. 2, a vertical section in a plane at right angles to the foregoing, A, A, indicate an upper series of retorts, and B, B, a lower series. Into the former, hydrocarbon is fed from the sight feed glasses N, by the siphon tube *n*, and after flowing along this retort, passes by (see Fig. 2) *l*, L, and $L^1$ into the retort B.

In the upper retorts little more than distillation of the lighter oils takes place, and there is here practically no separation of carbon, but in the lower retorts complete vaporisation of the residue ultimately takes place, with separation of carbon, which is removed from time to time.

The gas formed in the upper retorts is collected in the cross collecting pipes I, I (see Fig. 1) and passes through the stop valve $J^1$ into the ascension pipe J, J, and thence to the condensing main K. Similarly, gas made in the lower retorts passes by M, through $M^1$ into K; but as M enters K underneath the latter, any distillate condensed in K will flow down into one of the lower retorts B, for further treatment.

The heating arrangements have been planned with great care, and are as follows:—There is a central combustion chamber C (see Fig. 1), into which heated producer gas, passing from the main E, through the conduit $e$, is admitted by a series of central apertures $e^2$, in its floor. On either side of each of these apertures is an aperture, $f^2$, supplying heated air. The flame and heated gases escape on either side from C by $c$ (see Figs. 1 and 2) into B¹, a flue partly surrounding B, which is protected by a fire-brick casing from direct contact with the flame, a more regular heating being also, it is to be remarked, collaterally secured by this arrangement. Having traversed the length of B¹ the heated gases pass by D¹, D¹, apertures on either side, through the arch D into the vertical flue H⁵, thrice through H⁴, H³, H², and H¹ successively, as shown by the arrows in Fig. 2, to the outlet flue O, the draught being regulated by the damper $h$. C¹, in the crown of the arch, is normally closed, as represented in Fig. 2, but is capable, if necessary, of transmitting the gases direct from C to H⁵, giving thereby greater heat in the upper flues; on the other hand, cold air can be admitted by $h^1$, $h^2$, $h^3$, and $h^4$, still further controlling the temperature.

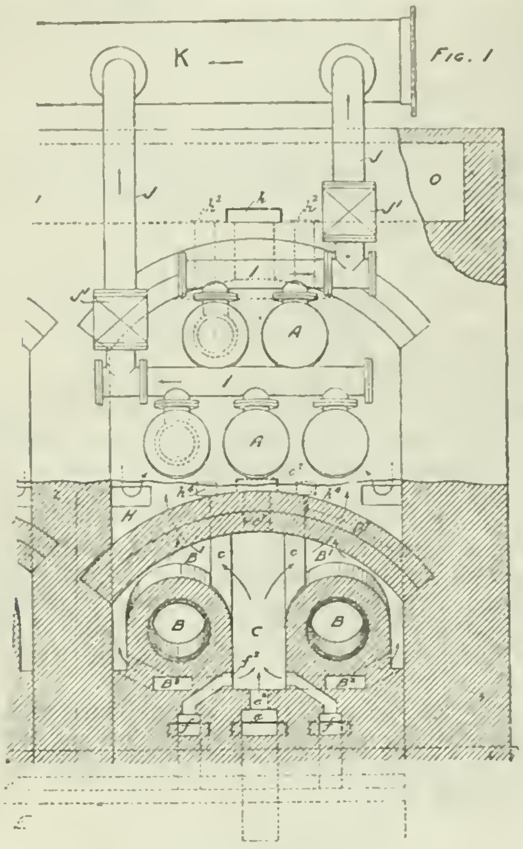
Fig. 1

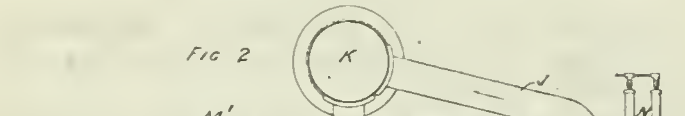
Fig 2

The patentee states that no purification of the gas manufactured is necessary, unless sulphur compounds exist in the oil employed. The carbon deposited in the retorts is very small; "being not more than about one-fifth of that produced by the best known methods." This result the patentee considers to be due to the continuousness of the process, to the careful selection and maintenance of suitable temperature, and to the absence of excess of oil at any given stage of the process; noxious absorption of valuable gas constituents by any such excess being avoided.

The patentee particularly points out that his process differs from other propositions—wherein hydrocarbon is partly gasified at one temperature, the by-products fractionally condensed, and these distillates gasified at different temperatures, which are the higher, the heavier, distillate—inasmuch as the alternate distillation and condensation of the oil, in such processes, involves a waste of heat and fuel. Moreover, no adequate means of regulating the temperature has been previously pointed out.

The following table gives "an example of the actual results obtained" with the patentee's apparatus: "The grades of temperature indicated in the appended tabular statement being those suited to successive stages in the continuous fractional distillation of an oil having an initial specific gravity of from 870 to 880 degrees":—

Temperature of retorts A at point where oil enters from 300° to 400° F.

Temperature of that section of retorts A which lies in flue H¹ from 450° to 500° F.

Temperature of that section of retorts A which lies in flue H² from 600° to 650° F.

Temperature of that section of retorts A which lies in flue H³ from 800° to 900° F.

Temperature of that section of retorts A which lies in flue H⁴ from 1,000° to 1,100° F.

Temperature of that section of retorts A which lies in flue H⁵ from 1,200° to 1,300° F.

Temperature in upper end of retort B from 1,400° to 1,600° F.

Temperature in lower end of retort B from 1,600° to 1,750° F.

—E. R. B.

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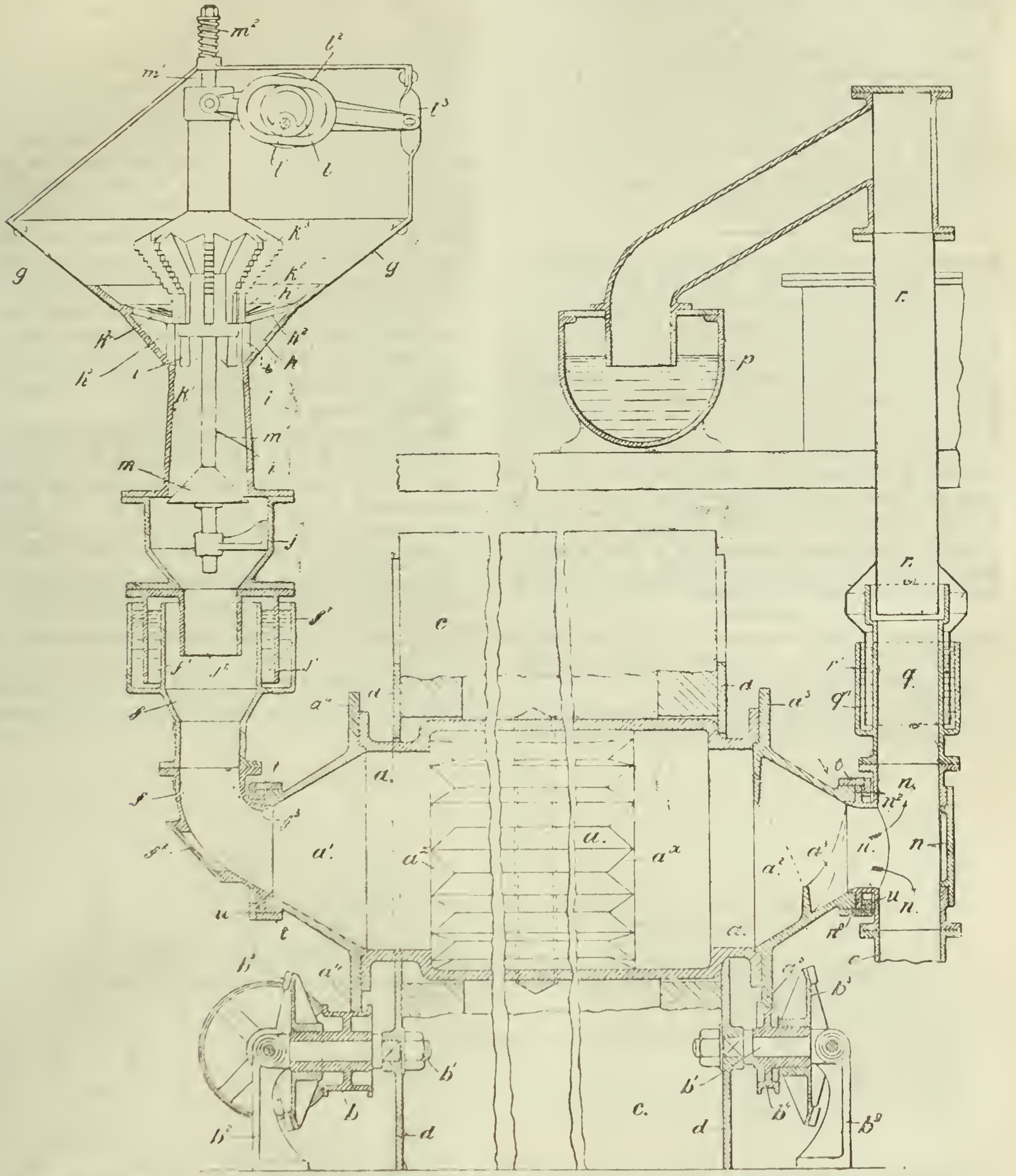
### *Improvements in or connected with Apparatus for Making Gas from Coal or Analogous Materials.* J. H. R. Dinsmore, Liverpool. Eng. Pat. 23,950, December 13, 1893.

The inventor proposes to make coal-gas from coal by a practically continuous process, worked mechanically, and to this end, has invented suitable apparatus, which is the subject of the present patent.

The apparatus consists, in principle, of a retort (which is suspended in an oven, and which is rotated during the destructive distillation of the coal), of a mechanical feeding apparatus and of a discharging apparatus to remove the coke; it is intended to be worked continuously, and the feeding arrangement is such that practically no air is introduced with the coal, and the inventor therefore claims to make gas, in large quantity, and of high illuminating power, with relatively small plant.

The accompanying figure shows a sectional elevation of the entire apparatus and in it the retort is seen to be composed of a central portion, $a$, $a$, $a$, and two conical end-pieces $a^1$ and $a^2$ respectively, these three parts—accurately fitted together by means of the flanges at $a^4$ and $a^5$, which are bolted together,—forming therefore, a single structure. The retort is suspended in the furnace $c$, partly upon lateral rollers (not shown in the figure), which are mounted on the plates $d$, $d$, at either side of the furnace, and partly by its flanges $a^4$ and $a^5$, upon the two rollers $b$ and $b^4$. These latter rollers, mounted each on a shaft $b^1$, are connected with and driven by the bevel gearing $b^3$, and thus supply the means for rotating the retort. The working joint, which is that between the two ends of the moving retort and the stationary parts $f$ and $n$ adjoining them, is capable of lubrication, and is kept gas-tight by the following arrangements in the following manner:—To the flanged end of the retort is attached the ring $t$, and to it is screwed another ring *u*, in a plane at right angles to that of *t*. When *u*, which is put on in separate halves, is screwed up, the flanges $f^3$ and $n^2$ of the stationary parts are in accurate adjustment with the ends of the retort.

Anteriorly, by means of the elbow *f*, and the water-lute $f^1$, the retort is in communication with the feeding apparatus. The latter comprises a hopper *g*, affixed to the mouth-piece *h* of a tapered shoot *i*, which in its turn communicates through the box *j* with the elbow *f*. In the mouth-piece *h*, there is a floor or horizontal partition $h^2$, perforated by radial slots $h^1$, and communication between the hopper and the shoot *i* is through these slots into an intermediate chamber $k^3$, and thence by the vertical slots $i^1$. In the centre of *h*, and occupying most of the upper part of the cavity of *i*, is the feeder proper. This is a plunger, capable of an up-and-down motion on the axially-placed rod $m^1$, $m^1$, and carrying a head with serrated projections $k^3$, $k^2$, which fit respectively, at the end of the down stroke, into the horizontal ($h^2$) and vertical ($i^1$) slots before mentioned.



The up-and-down motion of the plunger is imparted to it by the lever $l^2$, itself worked by the cam *l*, on the shaft $l^1$. The axial rod $m^1$, $m^1$, carries at its lower end a head *m*, which, when held up against the end of *i*, by the spring $m^2$, forms a valve.

The action of the apparatus is as follows:—Normally, *i* is full of crushed coal, air being thereby almost completely excluded from the apparatus, and when the plunger descends, coal in the slots $h^2$ and $i^1$ in the chamber $k^3$, and in the upper part of *i*, is forced to descend. Under the additional pressure so brought about, the valve *m* opens, and some coal escapes into *j*. Upon the ascent of the plunger, the spring $m^2$ closes *m*, and further coal is then able to enter *i* through the slots $h^2$ and $i^1$.

Having fallen through $j$, $j^2$, $f$, and $a^1$, the coal arrives at the commencement of the highly-heated central part ($a$, $a$) of the retort. The internal surface of this part of the retort is corrugated or provided with rib-like projections ($a^x$), which may be arranged zig-zag, or so as to give a tapered formation to this part of the retort; the effect being that the coal is gradually worked through the retort, giving off its gas and becoming coked during the transit. Arrived at the other end, $a^2$, of the retort, the coke is caught by the spiral vane $a^3$, which projects from this part of the internal surface, and is by it worked into the ⊤-branch pipe $n$, $n$, $n$, through the lower branch of which it drops into the pipe $o$, which latter may conveniently dip into water and be sealed thereby. The gas passes, by the upper branch of $n$, into the ascension pipe $q$, $r$, $r$, and then by $s$, into the hydraulic main $p$.

$n^1$ in $n$, and $f^2$ in $f$, are windows or doors for cleaning and inspection purposes.—E. R. B.

*Improvements in Apparatus for Burning Methylated and other Spirit, Hydrocarbon Oils, and the Like.* W. E. Caddell, London. Eng. Pat. 815, January 13, 1894.

The chief feature in this invention is the employment of block or powdered kieselguhr or other absorbent, non-inflammable material (preferably contained in a metal dish) which can be saturated with spirit, &c. by immersion, or from a reservoir by gravitation or pumping. By means of a coil or dish, within or below the mass of kieselguhr, the contents of the latter may be vaporised by the application of heat from a little burning spirit or other source, particularly in the case of colza and other heavy oils. The apparatus, when fitted with a proper stand, may be used for heating kettles or other articles, or may be arranged as a blow-pipe jet after the manner of the spirit lamps used by plumbers. One form, consisting of a stick or tube of kieselguhr, can be fitted in a suitable case, and when dipped in the liquid fuel, used for lighting gas, candles, &c.—C. S.

*Improvements in the Manufacture of Gas from Mineral Oils, and in the Apparatus Employed therefor.* J. Galletly, Edinburgh, and H. Armour, Edinburgh Eng. Pat. 1490, January 23, 1894.

The principal object of the inventors is to afford means for the manufacture of large quantities of gas, from mineral oils and from liquid hydrocarbons generally, with comparatively few retorts, and with economy, both in labour and in plant; the process being a nearly continuous one.

Their apparatus comprises the horizontal, cylindrical metal retort A (see Fig. 1), free to rotate on the hollow shaft B, which itself is supported by the plumber blocks C, C. Both retort and shaft are slowly rotated, preferably in opposite directions by $W^1$ and $W^2$ ratchet-wheels, attached to retort and shaft respectively. A specially claimed feature of the apparatus is the arrangement for scraping, during gasification, the inside of the retort, and so at once cleansing it from the carbon which is constantly being deposited upon it. This apparatus consists of a series of cast-iron or steel scrapers, each consisting of a rectangular segment S, carrying one (Fig. 3) or two (Fig. 2) arms, each arm ending in a scraping plate, shaped to the curve of the retort and bevelled to a sharp cutting edge. There is a rectangular hole in each scraper, and through this hole passes the shaft B; the shaft, where it traverses the retort, has a square section. All the scrapers are thus suspended from the shaft. The rectangular opening in each scraper is slightly wider than the side of the shaft, and thus each scraper can slide across the shaft as the latter turns, so bringing each scraping plate to the lower surface of the retort during each revolution. The scraping plates are set at an angle to the shaft, and are long enough to overlap each other; the effect of this arrangement being to drive the detached carbon to the end of the retort, whence it may be periodically removed by the doors $N^1$, $N^2$.

The oil is introduced, in a regulated stream, by the pipe H, into the shaft B, where it gets heated and partly vapourised, and whence it passes by the openings I, I, into the retort. Here it is converted into permanent gas, which then passes through the openings J, J, into the shaft B, and thence through the valve K into the gas-main L. The gas-carrying part of B is separated from the oil-carrying part of B, by the plug P.

As shown in Fig. 1, the retort is arranged at some distance above the furnace bars; this condition, and the motions of the retort and of the shaft, greatly assisting in the maintenance of a uniform temperature throughout the manufacture. When sufficient gas of the desired quality (a lower heat giving a smaller volume but of richer gas than does a higher heat) has been obtained, the oil is shut off and the gas in the retort swept out by a current of steam from the pipe St.

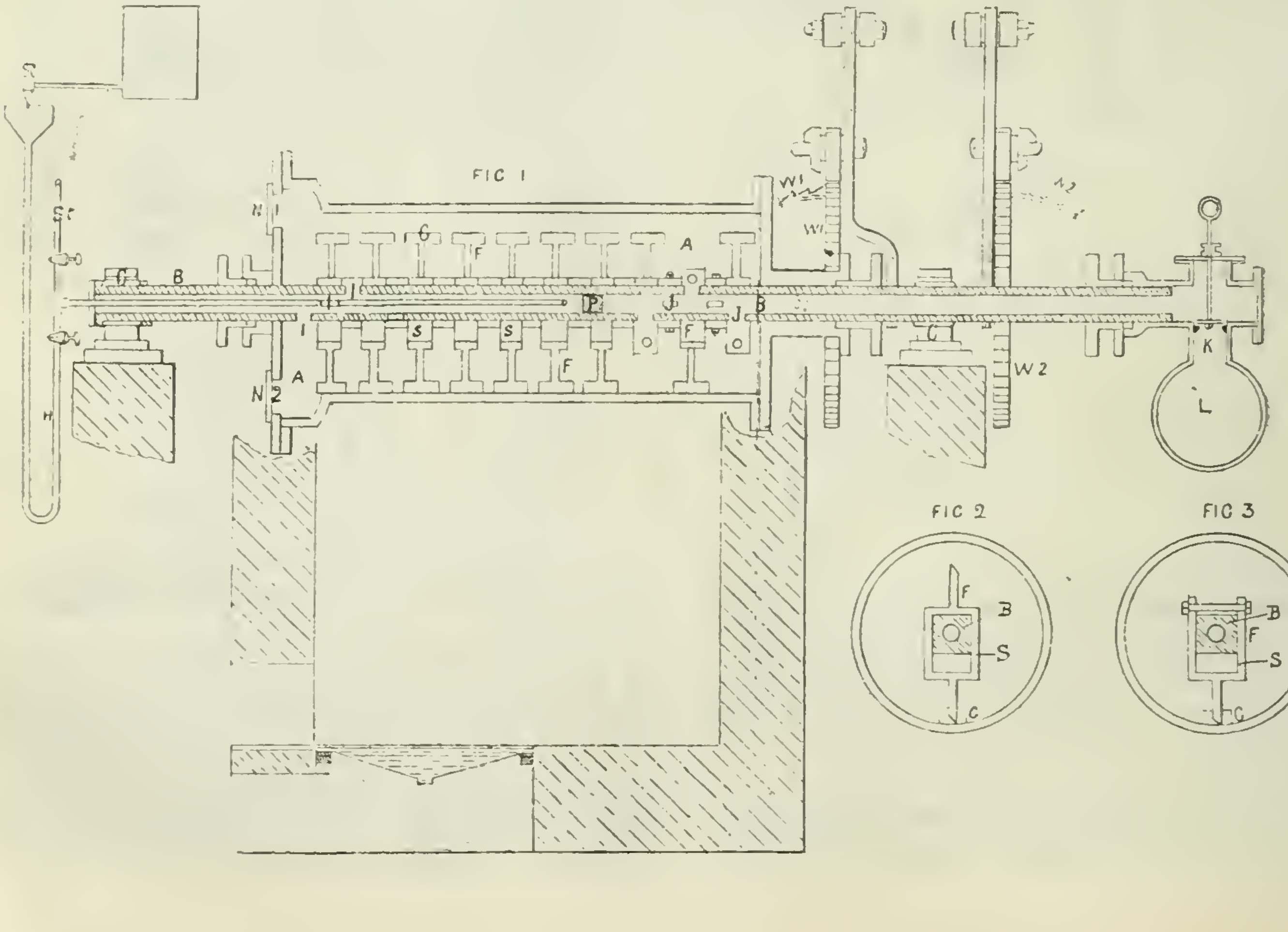


FIG 1

FIG 2

FIG 3

The inventors state that the horizontal position preferred for the retort, though not essential, is chosen, as the apparatus is then least likely to get out of shape, in consequence of the variations of temperature it experiences.—E. R. B.

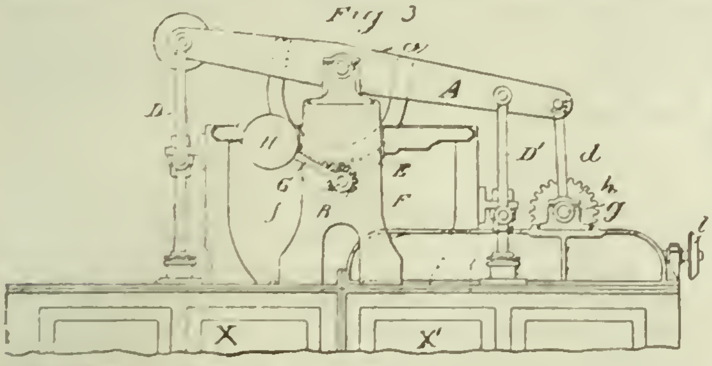
### *Improvements connected with Incandescent Lamps or Burners.* H. Tee, Liverpool. Eng. Pat. 1605, January 25, 1894.

It has been found with those incandescent lamps and burners where a network mantle of incombustible matter is suspended about the flame of a Bunsen burner that the mantle suffers deterioration at its lower edge, leading, ultimately, to its destruction, by reason of the excessive current of air and gas to which it is exposed.

The inventor therefore proposes certain modifications of the existing ordinary structure of such lamps and burners: consisting, in one case, of a cylinder of metal closed at the bottom and surrounding the burner, situated midway between the sides of the burner and the chimney and reaching up some little distance above the level of the lower edge of the mantle. The air drawn in, by the heated mantle and by the flame, passes between the chimney and the cylinder and therefore does not impinge against the bottom of the mantle. In his second improvement, the inventor makes use of an annular piece of metal, whose edges are so turned up that it forms an annular trough contained by two concentric cylinders of metal, of which the inner closely fits the cylindrical burner, whilst the outer is held midway between the chimney and the burner. The lower edge of the mantle is situate in the trough and therefore, as in the other case, the air current is kept away from it.—E. R. B.

### *Improvements in Apparatus to be used in the Purification of Coal-Gas or for Analogous Operations.* C. C. Walker, Donnington, near Newport, Shropshire. Eng. Pat. 1659, January 25, 1894.

The patentee's present invention relates to apparatus such as are described in Patents Nos. 1478 of 1880, and 14,925 of 1888 (this Journal, 1889, 112), wherein dipping devices suspended, *e.g.*, by D and D, in Fig. 1, at each end of a rocking beam A, are alternately lowered into and raised from liquid, contained in suitably placed vessels, X X¹.



It is found that when the dipping device at one end of the beam is more deeply submerged in the liquid than is that at the other end of the beam, the engine driving the machine has to overcome unequal loads, owing to the greater buoyant effect of the liquid on the more deeply submerged device.

The patentee now does away with this disadvantageous peculiarity of his apparatus, adding the toothed sector E, under the fulcrum of the beam A; the said toothed sector engaging the pinion F, whose axis *f*, carries the arm G, with weight H.

H is borne vertically when the beam is horizontal, and as the ends of the beam are alternately lowered and raised, it travels to one or other side of the axis *f*. The weight of H and the length of G, are so calculated as to exert a leverage on the beam equal, or about equal, to the difference in weight, owing to buoyancy, of the dipping devices, when these are submerged, to a greater or lesser extent.—E. R. B

### *Process for the Manufacture of Combustible Gas.* O. Imray, London. From The Société Anonyme des Moteurs thermiques Gardie, Nantes, France. Eng. Pat. 4283, February 28, 1894.

In a hermetically closed gas producer, lined with refractory material, the inventors expose carbonaceous substances, to air, mixed with a small quantity of steam; the operation being conducted at a high temperature and under considerable pressure. Any combustible matter rich in carbon, particularly petroleum, may be employed, and a constant volume of it is to be maintained; the steam, which is to be superheated in correspondence with the pressure in the producer, is "intended for enriching the combustible gas by its decomposition in the producer"; the temperature employed is nowhere definitely stated in the specification; the minimum pressure is to be 3 kilos. per 1 sq. cm. (say, 40 lb. per 1 sq. in.), for it is at this pressure that the gas produced commences to be entirely free from condensible carbon compounds. It is, however, advantageous to employ still higher temperatures and pressures.

The inventors consider their process novel, in that combustible gas is usually made under atmospheric or very low pressures, and they further state that, carried out under the above conditions, it "produces phenomena which have hitherto been unknown," for the effect of the high temperatures and pressures employed, is to prevent the formation of hydrocarbons of high molecular weight, whilst promoting that of hydrocarbons of low molecular weight. No tar, pitch, or oil is therefore produced, and, as the high temperatures and pressures favour the combination of the carbon, but not that of the nitrogen, no trace of ammonia, ammoniacal products, nor of cyanides, is produced. Scrubbing and purifying plant is therefore unnecessary, as is also storage plant; the inventors specially maintaining that their gas is directly applicable for combustion.

The following table contrasts Gardie gas with Dowson gas, the latter having been freed from those condensible tars and ammoniacal products, which are always presen tin it, when just made:—

| Dowson Gas. | | | Gardie Gas. | | |
|---|---|---|---|---|---|
| Composition in Vol. at 0°–760°. | | Calorific Capacity. | Composition in Vol. at 0°–760°. | | Calorific Capacity. |
| H | 18·73 | | H | 15·0 | |
| CO | 25·07 | 1311·10 calories. | CO | 24·0 | 1648·95 calories. |
| $CH_4$ | 0·31 | | $CH_4$ | 5·5 | |
| $C_2H_4$ | 0·31 | | $C_2H_4$ | 0·5 | |
| N | 49·08 | | N | 51·5 | |
| O | 0·03 | | O | 0·5 | |
| $CO_2$ | 6·57 | | $CO_2$ | 3·0 | |
| | 100·00 | | | 100·00 | |
| | | | (Producer charged with Swansea anthracite.) | | |

The composition is deduced from the mean of over 100 analyses by M. Maisonneuve, while the calorimetric determinations are by Dr. A. Witz, of Lille.—E. R. B.

### *Improvements in Steam Boiler Furnaces and other Furnaces.* S. Bond and J. Pickerill, both of Birmingham. Eng. Pat. 4439, March 2, 1894.

The improvements of these inventors consist, firstly, in an apparatus, which they arrange immediately in front of the bridge of the furnace, whereby heated air is supplied to the partly burnt fuel gases, passing over the bridge, and secondly, in an air-admitting apparatus, placed at the front part of the grate of the furnace, immediately over the dead-plate; by these means they prevent or suppress, wholly or in great measure, smoke.

Fig. 1 represents, in perspective, the apparatus which admits air near the bridge, while Fig. 2 shows a vertical section through one of its flues. Fig. 3 shows a longitudinal vertical section through a Cornish boiler, fitted with both the improvements of the inventors.

The first apparatus consists of a series of hollow bricks *e*, *e*, of fire-clay or of cast iron, placed side by side, at distances apart regulated by the projections $e^2$, $e^2$, $e^2$. There is thus formed a double series of vertical air flues, viz., those flues (*g*, *g*, *g*) which are between the bricks and those (*f*, *f*, *f*, *f*) in the bricks, by virtue of which air can pass direct from the ashpit *b* (Fig. 3) to the boiler flue *a*, entering at a point immediately above the bridge. The bricks are supported on the valve-box *h*, which, in its turn, is supported at one side, upon the fire-bars, by means of the projections $h^3$, $h^3$, and, on the other side, by the projections $h^4$, $h^4$, which are built into the bridge *c* (Fig. 3). In the valve-box is the valve *i*, turning on pivots $h^2$, at the sides of the box and operated by the link and lever arrangement *m*, *l*, *k*, from the front of the boiler; by means of this valve, the air, passing into the vertical flues, is readily controlled. When the furnace is at work, the whole of the upper part of this apparatus will be in a state bordering on incandescence, and the air passing through it will become correspondingly highly heated.

The inventor's second apparatus consists of a grating *q*, supported on the dead-plate *r* (Fig. 3), and separated from the bars (*d*) of the furnace grate by an air-space or cross-opening *s*. Fuel is burnt on this grating just as on the furnace grate, and air rising through *s* becomes heated, and, mixing with the fuel gases passing over *q*, assists in their combustion and in keeping down smoke at the front of the fire-grate.

Fig. 1.

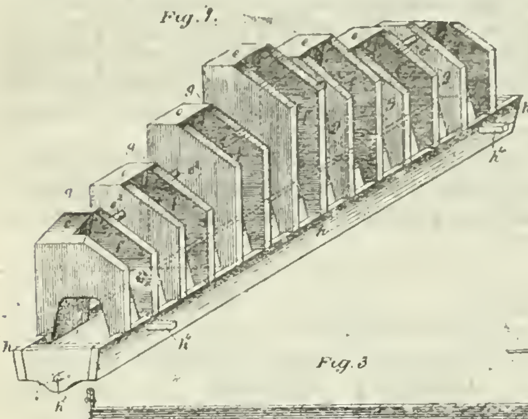


Fig. 2.

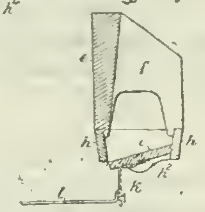
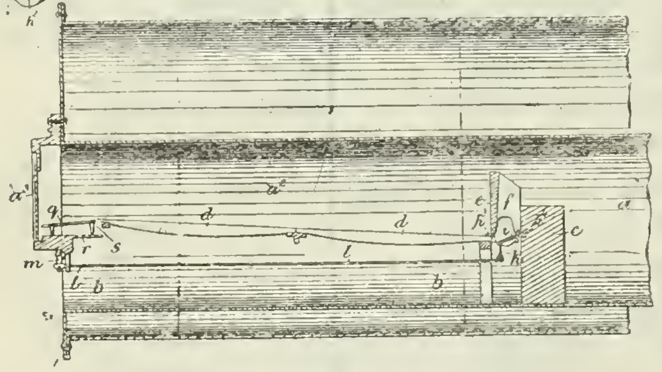


Fig. 3



Though particularly applicable to the furnaces of steam boilers, these inventions may also be fitly applied to puddling, mill, and other furnaces, the fire-places of which are provided with bridges.—E. R. B.

### *Improvements in or connected with Gas Producers or other Furnaces.* C. W. Pinkney, Smethwick. Eng. Pat. 6679, April 3, 1894.

This is a device for ensuring a regular feed of fuel to gas generators or other furnaces, with an automatic indication of the necessity for replenishing the supply. A hopper of large size, and, preferably, decreasing diameter (in order to relieve the pressure), is fixed in direct connection with the furnace, and contains the indicator, consisting of a flat plate resting on the surface of the fuel and connected by a chain or rod with a spindle passing through the hopper lid and kept up by a spring. As the fuel sinks the chain uncoils, or the rod descends, until the hopper is empty, whereupon the weight of the plate pulls the spindle down, and in so doing operates the bell, whistle, or any other audible signal attached to it.—C. S.

### *Improved Mode of Treatment and Apparatus for the Carburation of Gases.* F. Bremme, Gleiwitz, Germany. Eng. Pat. 17,679, September 17, 1894.

This patentee remarks that "an essential disadvantage of all apparatus employed for carburating gas hitherto proposed, is that, by using a carburating liquid which consists of ingredients having different vaporising points, the most volatile parts evaporate first and the less volatile remain behind"; irregularity of carburetting therefore ensues.

In claim 1 he states that his "process of carburation" is "distinguished in this, that the controlled quantity of the inflowing carburating liquid is immediately evaporated in an evaporator in such a manner that no liquid residue can collect there." The apparatus, which is described and figured, provides for the constant and visible delivery of a definite quantity of hydrocarbon to a tubular evaporator: its use is claimed in the application of the above process.
—E. R. B.

### *Improvements in Muffle Furnaces.* W. P. Thompson, Liverpool. From J. Fürbringer, Schirnding, Bohemia. Eng. Pat. 21,326, November 6, 1894.

The object of this furnace is to regulate the heating and cooling of the goods to be burnt in such a manner as to avoid risk of fracture through sudden alterations of temperature.

The ground plan of the apparatus is U-shaped, and the heat is applied to the central portion made of fireclay, while the two arms, which are in direct communication with the centre, and are intended, one for preliminary heating, and the other for cooling down, are of iron to facilitate heating and cooling.

The heated gases from the fire are made to circulate around the muffle, by means of partitions, before escaping into the smoke chamber, and the hot air from the cooling chamber is led into the furnace, partly below the grate and partly just above the flame, thus economising heat and ensuring perfect combustion of the gases.

The trays are made of sheet metal, rivetted to three bars of iron covered with fireclay, and these slide on three similar rails placed on the floor of the chambers.—C. S.

### *New or Improved Spirit Burner for Heating Purposes.* E. Lent, Berlin. Eng. Pat. 22,992, November 27, 1894.

The spirit reservoir of this lamp is of annular form, supported by a tripod, and the supply of spirit to the burner—which is fixed in the centre of the ring and supported by the tube of communication—is admitted by a screw tap. The burner itself consists of a cylindrical vaporising chamber, pierced by a central tube, which projects underneath the chamber and carries at its lower end a dish. To start the apparatus spirit is admitted into the vaporiser, whence it escapes through an aperture fitted with a wick, and drops down into the dish. On ignition, this spirit heats the chamber and vaporises the spirit therein, which then escapes through a row of small holes at the upper end, and takes fire by contact with the other flame. The supply of spirit, and the consequent dimensions of the flame are regulated by the screw tap.—C. S.

# III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Nitrogen in Fuels and the Yield of Ammonia by their Dry Distillation.* H. Tichauer. Journ. Gasbeleucht. 1894, **37**, 363.

The percentage of nitrogen in fuels ranges from 1 to 2 per cent., calculated on the combustible material. The percentage is, as a rule, smaller the older the fuel formation. The ammonia produced during dry distillation ranged from 0·17 grm. to 0·58 grm. per 100 grms. of fuel, the quantity again being generally smaller the older the fuel formation. The ammonia produced generally represented from 13 to 24 per cent. of the nitrogen in the fuel, but with peat (*i.e.*, fuel of recent formation) the percentage of ammonia rose to 35·7 per cent. of the nitrogen. When coke is treated at 800°—900° with steam, as much as 85 per cent. of the nitrogen can be obtained as ammonia. This fact should be practically applicable in gasworks, or certainly in connection with coke ovens, a current of steam being passed into the retorts before the removal of the coke.—L. T. T.

*Examination of Two Varieties of Crude Benzene from Coke-Oven Gases.* G. Lunge and H. von Kéler. Zeits. angew. Chem. 1894, 637—640.

It has long been known that in carbonising coal, only a small portion of the benzene is condensed with the tar, by far the largest proportion remaining as vapour in the gas, and it is now generally assumed that the illuminating power of gas is to a great extent due to the presence of benzene vapours. Whilst all proposals to extract benzene from coal-gas are manifestly impracticable, the gas being thereby deprived of its most valuable illuminating agent, and whilst at the present time the carbonisation of coal, in such a way as to make the production of benzene the principal aim, has been a failure, as far as economy is concerned, it has been found more profitable to deprive the gases obtained as a by-product in coke-making of benzene before burning them, seeing that they are always more than sufficient for heating the ovens and boilers even after removing the benzene. Although Carvès was the first to carry out this idea in France, the process of obtaining tar and ammonia in coke making, together with the extraction of benzene from gas, has been brought to a high state of development in Germany, and this in spite of the circumstance that England and America are the largest coke-producing countries. Owing to the fact that a new principle could not be claimed as underlying this new industry, much secrecy has been observed, and for this reason the authors have experienced considerable difficulty in securing authentic samples of unmixed coke-oven benzene for chemical investigation. They have, however, recently succeeded, through the kindness of R. Rütgers, of Berlin, in obtaining samples of two products, prepared by absorption (presumably in heavy coal-tar oils) and compression respectively. Having obtained about 10 litres of each, the first distillation was effected in Claudon and Morin's copper apparatus and the subsequent fractionations of the products in a Linnemann three-bulb tube.

1. *Absorption-benzene.*—Clear yellow liquid of disagreeable tarry odour. Specific gravity at 16° = 0·875. Begins to distil at 18°. The first fractions consist largely of unsaturated fatty hydrocarbons containing, among others, crotonylene (boiling at 18°—20°). The presence of mercaptans was detected by the offensive odour. From the fraction boiling between 30° and 40°, a ketone was isolated according to the method described by Schulze (Ber. **20**, 409). For lack of material, it was impossible to state whether the two ketones, acetone and methylethyl ketone, found by Schulze, were present. Methyl-isocyanide (Nölting, this Journal, 1885, 269) was separated by treating the product of the action of dilute sulphuric acid, with caustic potash, ammonia being evolved. Acetic acid was then discovered in the residue by the cacodyl reaction. The presence of carbon bisulphide was established by the xanthate, thiocyanate, and phenylhydrazine reactions, and the quantity determined by the method described by Holland and Phillips (this Journal, 1884, 295). The estimation of unsaturated fatty hydrocarbons was effected approximately by titration with sodium hypobromite, according to Allen (*ibid.* **21**, 588). Thiophen was estimated by determining the total sulphur and deducting therefrom the quantity due to carbon bisulphide. The tar bases and phenols were determined in the usual manner. The aromatic hydrocarbons were separated by subjecting the benzene to fractional distillation after removing the above impurities. The principal fraction distilled between 75° and 81°. This gave a loss of 0·4 per cent. when treated for 10 minutes with 10 per cent. of strong sulphuric acid, and yielded 95 per cent. of pure benzene on redistillation. The following analysis gives the composition of the sample of absorption-benzene examined :—

Benzene, 85·10; toluene, 11·63; xylene, 1·54; higher homologues, 0·09; unsaturated fatty hydrocarbons, 0·41; bases, 0·08; phenols, 0·08; thiophen, 0·46; carbon bisulphide, 0·01; methylisocyanide, 0·0024; mercaptans, 0 00018; residue, 0·62 per cent. by weight.

2. *Compression-benzene.*—Dark liquid, resembling light oil from coal-tar in appearance. Specific gravity at 16° = 0·893. Begins to boil at 30°. Analysis gave the following results :—

Benzene, 67·03; toluene, 15·61; xylene, 2·18; higher homologues, 6·41; naphthalene, 3·79; higher boiling aromatic hydrocarbons, 1·42; unsaturated fatty hydrocarbons, 0·96; thiophen, 0·71; phenols, 0·11; tar bases, 0·28; residue (pitch), 1·50 per cent. by weight.

The quantity of "light stuff" is very small, but the fraction distilling above the boiling point of benzene is much larger than in the preceding case. The high boiling portions contained naphthalene, and the fraction coming over between 150° and 190° gave Krämer and Spilker's cumarone reaction (this Journal, 1890, 275).

3. *Commercial 90 per Cent. Benzene from Coke-Oven Gases.*—The authors obtained a large sample from the Julienhütte in Upper Silesia. It was extracted by absorption, and had been washed in the usual way with concentrated sulphuric acid and caustic soda. Specific gravity at 16° = 0·883. Tar bases, phenols, unsaturated fatty hydrocarbons, carbon bisulphide, and non-nitrifiable substances could not be detected. The fractionation was conducted in three ways. The results, which are given in detail in the original paper, show the great uncertainty attaching to the commercial method of testing, caused by apparently insignificant deviations in manipulation. In method I. 100 cc. of the benzene were measured in a graduated cylinder and poured into a 150-cc. fractionating flask completely enveloped in asbestos sheeting. The same cylinder was used as receiver, without being dried. The thermometer graduated to fifths of a degree was fixed in the flask, so that the upper edge of the mercury bulb was level with the lower edge of the side tube. The condenser had a cooling tube 75 cm. in length. The distillation was so regulated that 3 drops passed over in 2 seconds. In method II. the distillation was conducted in a Martius flask placed on a disc of asbestos cardboard having a central hole 4 cm. in diameter. All other conditions were the same as in the preceding case. In method III. the distillation was effected as in II., the only difference being the position of the thermometer, which, in this case was inserted into the globular part of the flask. The following results were obtained :—

| — | I. | II. | III. |
|---|---|---|---|
| Commencement of distillation. | 76·0° | 85·5° | 78·4° |
| Per cent. of distillate at 85° | 65·0 | 67·0 | 62·3 |
| „ „ 90° | 82·9 | 83·5 | 82·0 |
| „ „ 95° | 89·5 | 88·0 | 87·8 |
| „ „ 100° | 92·4 | 88·5 | 91·0 |

D. B.

*Tar-like Petroleum from Balachany-Sabuntschi-Rayon.* K. K. Charitschkow. Zap. bak. otd. imp. russk. techn. obschtsch. 1894, **9**, 20.

From a well a little over 1,000 ft. deep, an oil was obtained differing entirely from ordinary crude petroleum. It was a dirty-brown thick liquid containing much water and suspended sand, which could not be removed either by filtration or subsidence. When purified by solution in light petroleum, separation from water and suspended matter, and evaporation of the solvent at 110° C., the oil formed a very viscous and hygroscopic black liquid, with a pleasant bituminous odour. Its sp. gr. was 0·9525, flashing point 157°, co-efficient of expansion 0·000561, and specific viscosity (Engler's method) 15·923. Between 250°—275° C. 0·3 per cent. distilled over, and between 275° and 310° C. a further 6·6 per cent. of a specific gravity of 0·879. This latter oil might be used as a lubricant, but its production would hardly be economical. The crude oil is too viscous for transit by pipe lines, and there seems little prospect for its economic use. A very similar heavy viscous oil was obtained some years ago from a well 1,200 feet deep, sunk by the Caspian Company.
—L. T. T.

*Villon's Purification Method for Mineral Oils.* T. J. Ellin. Zap. bak. otd. imp. russk. techn. obschtsch. 1894, **9**, 28.

*See under* XII., *page* 167.

*Estimation of Sulphur in Volatile Organic Compounds, Petroleums, &c.* C. F. Mabery. Amer. Chem. J. **16**, 544.

*See under* XXIII., *page* 197.

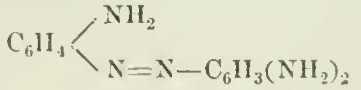
*Investigations relating to Petroleum.* A. Riche and G. Halphen. J. Pharm. Chim. 1894, **30**, 289.

*See under* XXIII., *page* 191.

## IV.—COLOURING MATTERS AND DYES.

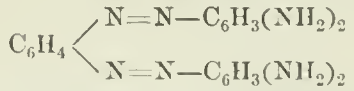
*The Constitution of Bismarck Brown.* W. Vaubel. Chem. Zeit. **18**, 1894, 1501.

By the action of nascent bromine upon Bismarck brown a tetra-bromo compound is obtained. The formation of this product shows that of the two formulæ—



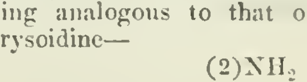
$$C_6H_4\left\langle\begin{array}{l}NH_2\\ N{=}N{-}C_6H_3(NH_2)_2\end{array}\right.$$

and



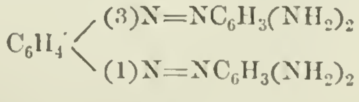
$$C_6H_4\left\langle\begin{array}{l}N{=}N{-}C_6H_3(NH_2)_2\\ N{=}N{-}C_6H_3(NH_2)_2\end{array}\right.$$

proposed for this dyestuff the second is the correct one, the substitution being analogous to that of meta-phenylenediamine and chrysoidine—



$$C_6H_5N{=}NC_6H_3\begin{array}{l}(2)NH_2\\ (4)NH_2\end{array}$$

which take up three (*o*- and *p*-) and two atoms of bromine respectively. Bismarck brown, in fact, mainly consists of *m*-phenylenediamine diazo-*m*-phenylenediamine—



$$C_6H_4\left\langle\begin{array}{l}(3)N{=}NC_6H_3(NH_2)_2\\ (1)N{=}NC_6H_3(NH_2)_2\end{array}\right.$$

—F. M.

*Estimation of Triphenylmethane Colouring Matters by Means of the Reaction with Nascent Bromine.* W. Vaubel. J. für prakt. Chem. 1894, 347.

*See under* XXIII., *page* 196

### PATENTS.

*The Manufacture or Production of Hydroxyanthraquinonequinolines.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 2325, February 2, 1894.

By heating anthraquinone or polyhydroxyanthraquinone derivatives with sulphuric acid in presence of boric acid these bodies are further hydroxylated, and this process has now been applied to hydroxyanthraquinonequinolines. For instance, alizarin blue, which is a dihydroxyanthraquinonequinoline, when treated with sulphuric acid and boric acid, readily yields dihydroxy- and trihydroxy-alizarin blue, and the process is a shorter and more economical one than that described in Eng. Pats. 14,353 and 15,121 of 1888 (this Journal, 1889, 770 and 772), according to which only a large excess of strong fuming sulphuric acid is used. A mixture of 10 kilos. of dry alizarin blue, 10 kilos. of crystallised boric acid, and 200 kilos. of sulphuric acid of 66° B. is heated to 260°—270° C. The reaction is complete when the blue colour of the melt has reached its maximum and there is no longer a copious evolution of sulphur dioxide. The melt, after cooling, is then poured into water and the dyestuff filtered off. It consists of a mixture of dihydroxy- and trihydroxy- alizarin blue, and yields greenish-blue shades on chromium mordants. The same process can be applied to the β-quinoline derivatives of flavopurpurin, anthrapurpurin, and similar hydroxyanthraquinones, and also the temperature and strength of the sulphuric acid may be varied within certain limits without affecting the result.—T. A. L.

*The Manufacture of a Bluish-Red Dye belonging to the Rosinduline Series.* Read Holliday, and Sons, Ltd., and K. B. Elbel, Huddersfield. Eng. Pat. 2503, February 5, 1894.

When the α-naphthol sodium disulphonate of Eng. Pat. 5103 of 1891 (this Journal, 1892, 344), is treated with sodium nitrite and acetic acid, it yields a nitroso-naphthol sodium disulphonate, crystallising in orange-red needles or plates, sparingly soluble in water, and which is converted by heating with ammonia under pressure into the corresponding nitroso-naphthylamine derivative. By heating either of these compounds with an equal weight of aniline salt and three times their weight of aniline for 6—8 hours to 140°—160° C., a red melt is obtained, which is freed from excess of aniline either by distilling with an excess of caustic soda or by treatment with hydrochloric acid. In the former case, the colour separates from the liquor after the aniline has been driven off, whilst in the latter, the residue after extraction is dissolved in hot water and caustic soda, filtered, and precipitated from this solution by an excess of caustic soda or by salt. It forms red plates with a yellowish metallic lustre. For use as a dye, it requires to be sulphonated, for which purpose the recrystallised sulphonate is decomposed by hydrochloric acid, and the precipitated free sulphonic acid is washed, filter-pressed, dried, ground and dissolved in twice its weight of sulphuric acid of 66° B. The melt is raised to 50° C. for one hour, or allowed to stand for 12 hours at the ordinary temperature, and on pouring into water, the new sulphonic acid separates out. After filtering and washing with brine, it is dissolved in dilute caustic soda and precipitated as a crystalline sodium salt at 80°—90° C. by adding salt or an excess of caustic soda. The new colouring matter dyes wool bluish-red from an acid bath, the colour being fast to light and milling.
—T. A. L.

*The Manufacture or Production of Dyestuffs.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 2591, February 6, 1894.

The colouring matters referred to are alkylation products of some of those described in Eng. Pats. 5112 and 11,533 of 1892 (this Journal, 1893, 259 and 595). They are obtained by combining the diazo-derivatives of dehydrothiotoluidine, its homologues, and sulphonic acids of these bodies with those aromatic amines, which, after combination, are capable of being diazotised, rediazotising these amido azo-compounds, combining them with phenol, cresol, resorcinol, or naphthol, and alkylating the products so produced. A dyestuff giving reddish-brown shades on unmordanted cotton, fast to light, acids and alkalis, is prepared as follows:—34·2 kilos. of dehydrothio-*p*-toluidine sodium sulphonate are diazotised by means of 7 kilos. of sodium nitrite and the necessary quantity of hydrochloric acid. The sparingly soluble diazo compound is added to an aqueous solution of 24·5 kilos. of 1·2′-naphthylamine sodium sulphonate and 50 kilos. of sodium acetate. After stirring about 12 hours, the temperature is raised to 90° C., and the whole is made alkaline. The amido-azo-compound is salted out, filtered off, mixed with a small quantity of water and an excess of sodium nitrite (1·5 mols. instead of 1 mol.) and diazotised by adding hydrochloric acid. After stirring for 12 hours the diazo compound is filtered off and added to a solution of phenol in water containing potash lye or potassium carbonate. The mixture is well stirred and sufficient dilute potash lye added to neutralise the phenolic hydroxyl, which is gradually liberated. After 12 hours the whole is heated to 60°—70° C., and the product which requires alkylation, is salted out and filtered off. It is mixed as a paste with the necessary quantity of ethyl bromide, potash, and ethyl alcohol, and heated under pressure on the water bath for about eight hours, when it is separated in the usual manner.—T. A. L.

*The Production of Azo-Colouring Matters upon Fibres.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 2592, February 6, 1894.

The colouring matters, known as "ice-bordeaux" and "paranitraniline red," give bluish-claret and yellowish-red shades, when the diazo compounds of α-naphthylamine and *p*-nitraniline respectively are printed on materials padded with β-naphthol. A bluer shade than paranitraniline red is obtained by the employment of *o*-nitro-*p*-phenetidine of Eng. Pat. 4407 of 1892 (this Journal, 1893, 258), instead of *p*-nitraniline, but owing to the cost it has not come into general use. The patentees now find that nitro-diamines and substituted nitro-diamines produce valuable colouring matters giving the shades desired. The products mentioned are (1·3)-nitrobenzidine, (1·2)-nitrobenzidine, nitrotolidine or dinitrobenzidine, and the following quantities are given for the employment of the first-named compound:— A mixture of 11·5 kilos. of nitrobenzidine, 7 kilos. of sodium nitrite, and 37 litres of water, is mixed with 190 kilos. of a neutral thickening material. After thoroughly cooling, the mixture is stirred into a cold mixture of 30 litres of hydrochloric acid (22° B.), 120 litres of water, and 250 kilos. of a neutral thickening material, and after adding 35 kilos. of sodium acetate, the diazo compound prepared, is printed on to the fabric grounded with β-naphthol. After drying, the material is soaped, washed, and again dried, giving a strong bluish-red shade fast to light and washing. The fastness can be increased by the employment of Turkey-red oil, sodium aluminate or other suitable mordant.

—T. A. L.

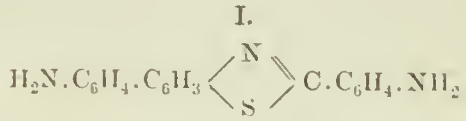
*Manufacture and Production of a New Diazo Compound for Use in Dyeing and Printing.* J. Altschul, Manchester. Eng. Pat. 2758, February 8, 1894.

The patentee describes the preparation of the nitrosamine salt of *p*-nitraniline which he calls "nitraniline S" (*cf.* Eng. Pat. 20,605 of 1893, this Journal, 1894, 1189). When this substance, which forms a brownish-yellow crystalline precipitate, is dissolved in water and treated with acids, it gives a yellowish white precipitate, which subsequently dissolves, forming a solution of the nitrodiazobenzene salt, which can be used for producing *p*-nitraniline red on cotton impregnated with β-naphthol. The patentee considers nitraniline S to be the sodium salt of *p*-nitro-diazobenzene and gives the following quantities for its preparation and decomposition. A solution of 6·9 kilos. of *p*-nitraniline is obtained by boiling with 20 litres of hydrochloric acid of 36° T. and 20 litres of water, and is then cooled down with constant agitation. About 20 kilos. of ice are added and a solution of 3·6 kilos. of sodium nitrite in 15 litres of water, is then added. After filtering the diazo solution thus obtained, it is run with constant agitation, into 40 litres of soda-lye of 66° T., 40 litres of brine containing 30 per cent. of NaCl, and 20 kilos. of ice. The new compound is completely precipitated by subsequently adding 70 litres of brine. After standing a short time, the precipitate is filtered off, washed with brine and dried at a low temperature. In order to obtain the diazo solution herefrom, 2½ kilos. are stirred into 5 kilos. of hydrochloric acid, 2 litres of water, and 2 kilos. of ice. The precipitate which at first forms, gradually dissolves, and after filtering, the solution is diluted to 200 litres, and has then added to it 7 kilos. of sodium acetate dissolved in 50 litres of water. The solution thus obtained, as already mentioned gives a bright and brilliant red on cotton bottomed with β-naphthol.—T. A. L.

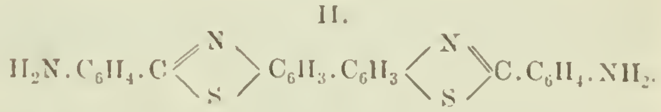
*Manufacture of New Bases containing Sulphur, of their Sulpho-acids, and of Colouring Matters Derived therefrom.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 3026, February 12, 1894.

The bases referred to are obtained by heating together benzidine, *p*-toluidine and sulphur with or without the addition of naphthalene. According to the quantities of *p*-toluidine and sulphur acting on one molecule of benzidine, two different bases are obtained which are distinguished as I. and II. and are said to be probably represented by the following formulæ:—

I.



II.



The first base is prepared by heating together 18·4 kilos. of benzidine, 10·7 kilos. of *p*-toluidine, 12·8 kilos. of sulphur, and 30 kilos. of naphthalene until there is no further evolution of sulphuretted hydrogen. The melt is then dissolved in 50 per cent. sulphuric acid and the sulphate of the base is precipitated by pouring this solution into water, when it forms a yellow precipitate. For the preparation of the second base, 18·4 kilos. of benzidine, 21·4 kilos. of *p*-toluidine, 21·6 kilos. of sulphur and 40 kilos. of naphthalene are heated in the same way, and the base is subsequently separated in a similar manner. Both these bases can be diazotised and combined with naphthols and their derivatives, of which the following is an instance; 32 kilos. of the sulphate of base I. in paste form and 60 kilos. of hydrochloric acid (20° B.) are diazotised with a solution of 7 kilos. of sodium nitrite. After filtering, the solution of the diazo compound is added to a solution of 25 kilos. of β-naphthol-α-sulphonic acid and 50 kilos. of 25 per cent. ammonia. The colouring matter, which forms immediately, is filtered off, pressed and dried, and dyes unmordanted cotton red. A similar method is employed in the case of the second base. The bases can also be sulphonated, of which the following is an example. The base is dissolved in three times its weight of fuming sulphuric acid, containing 23 per cent. of anhydride, and the melt is heated on the water bath until a sample dissolves easily in sodium carbonate solution. The melt is then poured into water and the precipitated sulphonic acid filtered off. The sulphonic acids dye unmordanted cotton, and may thus be diazotised on the fibre and combined with amines and phenols and their derivatives, or the sulphonic acid may be diazotised in the ordinary manner and combined with amines and phenols or their derivatives, giving colouring matters which dye unmordanted cotton. The new bases and their sulphonic acids may also be treated by the processes which have been applied to primuline, dehydrothiotoluidine and their sulphonic acids. —T. A. L.

*The Manufacture or Production of Azo Dye-stuffs.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3032, February 12, 1894.

As already described in Eng. Pat. 25,074 of 1893 (this Journal, 1894, 1191), the naphthalene tetrasulphonic acid obtained by sulphonating 2.3′-naphthalene disulphonic acid yields two isomeric dihydroxynaphthalene disulphonic acids on fusion with alkalis, one of which, the R acid, crystallises out on acidulating the melt, whilst the other, the Y acid, is separated by adding potassium chloride to the filtrate. The present specification relates to the production of colouring matters from the latter acid, as it has been found that with certain diazocompounds, it gives pure yellow azo-dyestuffs. The solution of diazobenzene chloride from 20 kilos. of aniline, 50 kilos. of hydrochloric acid, and 15 kilos. of sodium nitrite, is run into a solution containing 70 kilos. of dihydroxynaphthalene disulphonic acid Y, and an excess of soda. On adding hydrochloric acid, the colouring matter separates in reddish crystals which can be filtered off. By dissolving in hot brine and allowing the solution to cool, it forms brilliant flat green needles, and dyes wool a pure yellow not materially affected by acids or alkalis, and tolerably fast to light. The colouring matter from *m*-nitraniline also yields pure yellow shades on wool, whilst those from *p*-toluidine and *p* nitraniline are reddish-yellow, and from *o*-toluidine are brownish-yellow.—T. A. L.

*The Manufacture and Production of New Mordant Dyeing Colouring Matters, and Intermediate Products relating thereto.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 3036, February 12, 1894.

These colouring matters which give blue or greenish shades on chromium, aluminium, tin, and similar mordants, are obtained by condensing certain amidonaphthol sulphonic acids with tetramethyl- and tetraethyl-diamidobenzhydrol. This forms leuco-compounds which, on careful oxidation, yield what are termed intermediate colouring matters. These on further oxidation and subsequent reduction are converted into hydroquinonoid products, which are valuable mordant dyeing colouring matters. An alternative method for obtaining these bodies, is to treat the intermediate colouring matters with hot soda solution. The 1.2.3′, 1.2.2′, and 1.2.1′-amidonaphthol sulphonic acids are suitable for the purposes of this invention. The following is a typical example:—About 27 kilos. of tetramethyldiamidobenzhydrol and 24 kilos. of 1.2.3′-amidonaphthol sulphonic acid are boiled in about 290 kilos. of 50 per cent. acetic acid until the blue colour of the hydrol has disappeared. After cooling, the leuco-compound is filtered off and washed with alcohol. It is dissolved in about 5,000 litres of water and 42 kilos. of 95 per cent. sulphuric acid, and oxidised with 32 kilos. of 80 per cent. lead peroxide paste. The intermediate colouring matter so formed can then be precipitated with salt and boiled with 5 per cent. sodium carbonate solution, but it is preferable to work as follows:—About 64 kilos. of lead peroxide paste are added to the solution containing the intermediate compound, and the mixture is continually stirred. The blue colour of the solution almost disappears, and a green crystalline precipitate is formed. This is filtered off, washed with cold water, dissolved in 1,800 litres of water and 450 kilos. of sulphuric acid, filtered from lead sulphate and excess of lead peroxide, and the filtrate is treated with 43 kilos. of a solution of sodium bisulphite containing 20 per cent. of total $SO_2$. After standing 2 or 3 hours the colour of the solution changes from yellowish-brown to claret-red. On adding an alkali, the new mordant dyeing colouring matter separates as a blue precipitate. In order to purify it, after filtering off, it is dissolved in cold dilute alkali and precipitated with salt. The dyestuff so obtained, gives blue shades on alumina and greenish blue on chrome mordants which are fast to light, soap, and fulling. It is not necessary to isolate the leuco-compound, but the product may be directly oxidised after diluting with water.—T. A. L.

*The Manufacture or Production of Colouring Matters.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 3113, February 13, 1894.

This is an extension of Eng. Pat. 14,345 of 1893 (this Journal, 1894, 723) and refers to the production of colouring matters from dinitro-anthraquinone, by heating this substance with sulphuric acid in presence of boric acid. It has been shown previously that when the boric acid is omitted, naphthazarine is the chief product of the reaction. According to the present invention, when dinitroanthraquinone is treated as already mentioned it yields two dyestuffs, which have been termed "dyestuff A" and "dyestuff B." A mixture of 10 kilos. of 1·4′-dinitronaphthalene, 15 kilos. of crystallised boric acid and 250 kilos. of sulphuric acid is heated to 200°—220° C., when a gentle reaction sets in. When the melt has become bluish-red, it is allowed to cool, and poured into 1,000 litres of water, raised to the boil and filtered. On cooling, "A" separates out as a blackish-violet precipitate, and is filtered off, whilst "B" is precipitated from the filtrate by adding salt. As regards the properties of these two bodies, A dissolves in glacial acetic acid, easily in hot, and sparingly in cold water, and its solution is bluish-red. In ammonia it dissolves to a violet-red, in soda lye to a violet, and in concentrated sulphuric acid to a currant-red solution. It gives reddish-violet to black shades on chrome mordanted wool. The dyestuff B gives bluer shades on the same mordant. It is sparingly soluble in cold water, more easily in cold dilute sulphuric acid and hot water. In glacial acetic acid it dissolves to a cherry red solution, and gives a yellowish-red solution in concentrated sulphuric acid. The solution in ammonia is carmine-red and magenta-red in soda lye. Both these dye-stuffs differ from naphthazarine by the colour with which they dissolve in soda-lye, naphthazarine giving a blue coloured solution.—T. A. L.

*Tris-Azo Dye-stuffs.* S. Pitt, Sutton, Surrey. From L. Cassella and Co., Frankfort-on-the-Maine Germany. Eng. Pat, 3301, February 15, 1894.

An extension of Eng. Pats. 19,330 of 1890 (this Journal, 1891, 917), 6972 of 1891 (this Journal, 1892, 345), and 14,993 of 1892 (this Journal, 1893, 674). The two following combinations are described:—(1.) The yellow solution of the tetrazo compound from 20 kilos. of *p*-diamido-diphenylamine is run into an alkaline solution of 24 kilos. of γ-amido-naphthol sulphonic acid. The intermediate compound, which separates as a black precipitate, is made acid with hydrochloric acid and diazotised with 7 kilos. of sodium nitrite, an operation which takes from 3—6 hours. The tetrazo-azo compound is then added to an alkaline solution of 22 kilos. of *m*-phenylene diamine, and the colouring matter which separates is filtered off and dried. It dyes unmordanted cotton black. (2.) The diazo-solution from 15 kilos. of acet-*p*-phenylene diamine is combined with an alkaline solution of 24 kilos. of γ-amido-naphthol sulphonic acid. The product is then heated with caustic soda for several hours to split off the acetyl group, and after cooling, 14 kilos. of sodium nitrite are added and the mixture is made strongly acid by means of hydrochloric acid. When a clear solution is obtained, it is allowed to run into an alkaline solution of 23 kilos. of resorcinol, and the colouring matter which forms directly, is precipitated by salt. It also dyes unmordanted cotton black. The phenylene diamine or resorcinol may be replaced by *m*-tolylene diamine, *m*-amido-phenol or their substitution products, and similar colouring matters are obtained. In like manner the γ-amido-naphthol sulphonic acid may be replaced by other amidonaphthol sulphonic acids, as for instance the amidonaphthol disulphonic acid which is obtained according to Eng. Pat. 15,175 of 1889 (this Journal, 1890, 854) by heating β-naphthylamine trisulphonic acid with caustic alkalis.—T. A. L.

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*The Manufacture and Production of New Nitrosamine Compounds suited for Use in the Preparation of Diazo-Compounds.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 3397, February 16, 1894.

This is an extension of Eng. Pat. 20,605 of 1893 (this Journal, 1894, 1189), and describes the further preparation of certain nitrosamine salts by the action of alkalis on salts of the diazo-compounds. The patentees now find that in the case of those amines which contain no substituting acid group or groups, or only one halogen or sulphonic or carboxyl group, it is necessary to treat the diazo-compound with caustic alkali at a much higher temperature than was employed for the conversion of, for instance, *p*-nitraniline. It has also been found that the alkali salt of the diazo-compound is formed as an intermediate product in the formation of the nitrosamine, whereas this step in the process cannot be observed in the cases of those substituted amines referred to in the first-mentioned patent. The temperature varies with the particular amine, depending upon the presence or absence of substituting groups in the amido-compound, and upon their nature. Thus, unsubstituted primary amines, or those which contain methyl or methoxyl groups, require heating to about 100°—120° C., or even higher, whilst, if one halogen, carboxyl, or sulphonic acid group or the like be present, the diazo-compound is converted into the nitrosamine by heating on the water-bath at 100° C. Tetrazo compounds behave in the same way. Thus, tetrazo-diphenyl reacts like diazobenzene, and tetrazo-dibromo-diphenyl like bromo-diazobenzene. When treated with sufficient mineral acid, the nitrosamine salts are converted into the corresponding diazo-compounds. The nitrosamines give no colouring matter when mixed with sodium β-naphtholate, but if the mixture be saturated with acetic acid, the diazo-compound is formed, which yields the corresponding azo dyestuff. About 10 kilos. of a solution containing 25 per cent. of *p*-bromo-diazo-benzene chloride are mixed with 70 kilos. of a 50 per cent. caustic potash solution. An amorphous yellow precipitate is formed, and the whole is heated on the water-bath. The yellow solution which results, deposits crystals of the potassium compound described by Griess, when the temperature has reached about 85° C. The heating is continued until no colour is obtained with sodium β-naphtholate. The whole is then allowed to cool, and the crystals of the nitrosamine salt which separate out, are filtered off. The diazo-compound of *p*-amido-benzoic acid may be treated in a similar way.—T. A. L.

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*Improvements in the Manufacture of Naphthazarin and of New Intermediate Products related thereto.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 3828, February 22, 1894.

According to this patent, naphthazarin, which hitherto has only been prepared from α- or 1.4′-dinitronaphthalene, can now be obtained from the isomeric 1.1′-dinitronaphthalene, for which two processes are given. By treating 1.1′-dinitronaphthalene with sulphuric acid in presence of a reducing agent (aniline, α-naphthylamine, phenylhydrazine, tin, and iron are mentioned), an intermediate product is formed, which, on boiling with dilute acids, is converted into naphthazarin. The second process consists in submitting a hot sulphuric acid solution of 1.1′-dinitronaphthalene to the action of an electric current, when the same intermediate compound as above is formed, which yields naphthazarin in the manner described. This process can also be applied to the 1.4′-dinitronaphthalene, and hence, when this method is employed, it is unnecessary to separate mixtures of the two dinitronaphthalenes. According to the first process, about 10 kilos. of 1.1′-dinitronaphthalene and 10 kilos. of aniline are mixed and added to 200 kilos. of 96 per cent. sulphuric acid. The mixture is heated to 125°—130° C., and kept at this temperature for about 8—10 hours, until all the dinitronaphthalene has disappeared. The violet-red melt which results is, after cooling, poured into ice-water, and the solution filtered. On boiling this solution, which contains the intermediate product, and allowing it to cool, the naphthazarin separates out and can be filtered off. The intermediate product can be separated by carefully adding caustic soda, but it is soluble in an excess. In the electrolytic process for the production of naphthazarin, 1 kilo. of 1.1′-dinitronaphthalene is dissolved in about 20 kilos. of sulphuric acid and heated to about 130° C. in a vessel provided with a porous diaphragm. The cathode is immersed in the hot solution of dinitronaphthalene and the anode in sulphuric acid, the two solutions being separated by the diaphragm. A current of about 15 ampères per sq. decimeter, is then passed through the cell, until the dinitronaphthalene has been converted into the intermediate product. The melt is then allowed to cool, poured into water, and worked up as before. As already mentioned, a mixture of 1.1′- and 1.4′-dinitronaphthalenes may be employed in this process, giving a mixture of the intermediate compounds, which may readily be converted into naphthazarin.

—T. A. L.

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*An Improved Hair-Dye.* A. Lumière, Lyon-Monplaisir, France. Eng. Pat. 21,336, November 6, 1894.

The substance claimed is a salt of diamidophenol, preferably the hydrochloride which on oxidation gives a brown colouring matter dyeing hair, according to the strength of the solution, auburn to black. In order to prevent the too rapid oxidation of the diamidophenol, a solution is prepared as follows:—About 10 grms. of diamidophenol hydrochloride and 15 grms. of sodium sulphite are dissolved in 90 cc. of water and 10 grms. of alcohol.—T. A. L.

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## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

### PATENT.

*Improvement in the Treatment of Textile Vegetable Fibres.* A. F. B. Gomess, South Kensington. Eng. Pat. 810, January 13, 1894.

The invention consists in boiling the vegetable fibres (especially those of the urtica family) for some hours with zinc-dust and caustic alkali, using the former in such proportion that the zinc oxide formed shall go into solution. The fibres are afterwards boiled in an alkaline hydrate, washed, and bleached. (See this Journal, 1891, 218.)

—S. P. E.

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## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*The Aluminium Sulphate of Commerce.* H. v. Kéler and G. Lunge. Zeits. angew. Chem. 1894, 669—678.

The authors have examined 13 different samples of commercial aluminium sulphate with regard to the impurities contained therein and the influence of the latter upon the tints obtained in Turkey-red dyeing and alizarin printing.

The chief impurities contained in the samples were iron and sodium salts and free sulphuric acid. One sample also contained zinc (0·00156 per cent.). The percentage of iron varied from 0·00050 to 0·0051, that of free sulphuric acid from 0·53 to 1·05. Tatlock's colorimetric method of conversion of the iron into rhodanate, extraction of the latter with ether, and comparison of the tint of the ethereal solution with that of a solution of known percentage (this Journal, **6**, 276 and 352), is recommended for the estimation of the iron. In the estimation of the free sulphuric acid the best results were obtained by Beilstein and Grosset's method, which consists in adding to a solution of from 1 to 2 grms. of the sulphate in 5 cc. of water, 5 cc. of a cold saturated solution of ammonium sulphate and, after separation of the greater part of the ammonia alum formed, by standing and frequent stirring, 50 cc. of 95 per cent. alcohol, and titrating the aqueous solution of the residue left on the evaporation of the alcohol on the water-bath, in the usual manner.

Dyeing experiments made in the manner generally adopted for Turkey-red dyeing with pure aluminium sulphate, to which definite quantities of iron ammonia alum (0·0005 to 1 per cent. of iron) had been added, and with aluminium acetate from the various commercial sulphates (of known percentage of iron), showed that up to 0·001 per cent. of iron the difference in the tint is inappreciable, whilst above that amount the deterioration of the colour is readily recognisable. Ferrous and ferric salts show no difference in this respect up to a total amount of 0·0005 per cent. of iron; above this, ferrous salts have less of an objectionable influence than ferric salts. The presence of zinc in the aluminium sulphate has a decidedly deleterious influence upon the purity of the dyed shades. In calico printing far larger quantities of iron are admissible in the mordant. Quantities of iron up to 1 per cent. intentionally added to the aluminium sulphate, did not affect the tint; even extract of Persian berries, the most sensitive dye to iron, gave good results with the richest in iron (0·005 per cent.) of the commercial aluminium sulphates. This unexpected result may be due to the fact that in printing much less mordant is fixed upon the fibre than in dyeing, and that therefore the exceedingly small quantity of iron present shows no effect.—F. M.

### *Chromium Formate.* C. Häussermann. J. prakt. Chem. 1894, **50**, 383—384.

This salt, which as yet has not been described, is obtained by dissolving moist chromic hydroxide in hot formic acid of sp. gr. 1·15—1·2. On cooling, the solution deposits a mass of dark green, faintly lustrous needles, the composition of which corresponds to the formula—

$$Cr(CHO_2)_3.2[Cr(CHO_2)_2OH] + 4\tfrac{1}{2}H_2O.$$

Dried over sulphuric acid the salt loses $1\frac{1}{2}$ molecules of water, and when heated in this partly dehydrated condition to 100°—110° a further reduction of the water of crystallisation to $1\frac{1}{2}$ molecules takes place. Chromic formate dissolves with difficulty in cold water, more readily so in hot water and hot alcohol. The aqueous solution reddens litmus paper, and shows considerable stability on heating. Chromic formate can be used like chromic acetate for mordanting cotton in dyeing with alizarin.—F. M.

### *Straw Bleaching and Dyeing.* A. M. Villon. Textile Colorist, **18**, 267—268.

The various kinds of straw, rye, rice, wheat, and "bobonax" are sorted according to their natural colour and variety, and bleached, either with chloride of lime, sulphurous acid, hydrogen peroxide, or sodium dioxide.

Chloride of lime is used for light shades, the straw being allowed to stand 12—24 hours in a clear 5 per cent. solution. It is then washed with water, then with a 2—3 per cent. solution of sodium hyposulphite or nitrite, and finally with water again. The last traces of chlorine are removed by drying in bright sunlight. Instead of chloride of lime, electrolytically produced hypochlorites of magnesium, sodium, and aluminium may be advantageously employed, the hypochlorites thus prepared possessing greater decolorising power than those produced by ordinary chemical methods.

The process of bleaching with sulphurous acid is similar to the "sulphuring" or "stoving" used for wool bleaching. It may also be well carried out with a sulphurous acid solution. The straw is covered with a solution of sodium bisulphite and hydrochloric acid gradually added. It is then well washed successively in water, ammoniacal water, and water again. The formation of sulphuric acid in this process renders the straw brittle.

Straw is bleached by hydrogen peroxide, but the simple bleaching in such a solution, made alkaline by the addition of sodium silicate or tungstate, does not give a pure white. The best results were obtained by a combination of two of the above processes, as follows:—

The straw is washed, the grease removed by sodium carbonate, passed into a solution of chloride of lime, then subjected to the action of ozonised water, treated with dilute oxalic acid solution, and finally washed.

The ozonised water is prepared without the aid of electricity. Oxygen is led over certain peroxides, such as those of lead, manganese, and barium, heated to redness, and the resulting gas is led into water.

The above method of bleaching is cheap, and gives a pure white straw, the fibre not being in any way injured.

After bleaching, the straw is dyed exactly in the same way as other vegetable fibres, but care must be taken that the temperature of the bath does not rise above 60° C., otherwise the straw suffers in structure and strength.

—H. I.

### *The Present State of Woollen Printing.* C. F. S. Ruhbg. Textile Colorist, **18**, 265—266.

The author describes a method for the production of white or coloured patterns on coloured grounds by means of zinc dust or tin salt as discharges.

*Zinc Dust Discharge.*—The zinc dust paste is made by mixing 775 grms. of zinc dust with 200 grms. of glycerin and 4 lb. of water, and adding in the cold 995 grms. of sodium bisulphite and 95 grms. of ammonia.

This mixture is printed on the dyed woollen fabric with or without the addition of dyestuffs. The fabric is then steamed for 1 hour at a pressure of 6—7 lb., passed into a bath of dilute acetic or sulphuric acid, and then washed or soaped.

The following colouring matters are discharged by zinc dust under these circumstances, and are therefore suitable for dyeing the ground colour. *For Blue:* Alkali Blue (colour completely destroyed), Opal Blues, Soluble Blues, Guernsey Blue, Alkali Violet, Victoria Blue, Diamine Blue; Benzo Blues give only fairly good results. *For Red:* Chromotropes, Amaranth, Acid Magenta, Victoria Rubine, Victoria Scarlets, Crystal Scarlets, Croceines, Azo Rubines. *For Orange and Yellow:* Orange extra, Croceine Orange, Tropaeolines, Anthracene Yellow C, Diamine Yellow N, Diamine Golden Yellow, Victoria Yellow. *For Violet:* Formyl Violet S 4 B. *For Green:* Acid Green. And *for Black:* Naphthol Black, Diamine Black; a good discharge only obtainable in the case of light shades.

The following dyestuffs are not discharged, and are suitable for mixing with the paste. *Red:* Eosine and allied dyestuffs, Amaranth, Safranines, Fast Diamine Red F, Diamine Scarlet B. *Yellow:* Fulling Yellow O, Thioflavines F. and S, Phosphine. *Blue:* New Methylene Blue N. *Green:* Naphthol Green B.

*Tin Salt Discharge.*—This discharge is made by mixing tin crystals with sodium acetate and stiffening with starch and gum water. It is printed on the fabric, which is afterwards steamed for 20—30 minutes, washed, and dried. Colours suitable for dyeing the ground, discharged by tin salt are the following. *Red:* Brilliant, Crystal, and other Scarlets, Brilliant Croceines, Azo Rubine A, Amaranth, Orchil Substitute, Fulling Reds, Bordeaux Reds, Cloth Reds, Chromotropes, Benzo-purpurins, Diamine Red NO, Diamine Scarlet B, Hessian Purple, Azo Fuchsine G, Fast

Red E, Azo Bordeaux, Azo Cochineal, Azo Eosine, Carmoisine B. *Blue:* Sulphone Azurine, Brilliant Sulphone, Azurine, Benzo-Cyanine, Benzo-Blues, Diamine Blues. *Orange and Yellow:* Orange extra, Croceine Orange, Tropaeoline, Fulling Yellow O, Diamine Yellow N, Azo Yellow, Victoria Yellow, Fast Yellow. *Green:* Diamond Green, Acid Green, Naphthol Green, Diamine Green B. *Violet:* Victoria Violets, Congo Corinth, Azo Acid Violets. *Black:* Diamond Black, Victoria Black, New Victoria Black, Diamine Black, Naphthol Black; with the last two, good results are obtained only in lighter shades.

The following dyestuffs are not discharged by tin salt, and may be mixed with the paste and printed for the production of coloured patterns. *Red:* Safranines, Eosines, Rhodamins, Acid Magenta, Pyronine, Rosinduline GG. *Orange and Yellow:* Auramine, Quinoline Yellow, Thioflavine S and F, Primuline, Oxyphenine, Phosphine. *Green:* Acid Green, Fast Green bluish. *Blue:* New Blues, New Methylene Blues, Fast Acid Blue B, Indophenol, Methylene Blue. *Violet:* Fast Acid Violet 10 B, Acid Violet 5 B, and 6 B, Methyl Violet, Fast Neutral Violet B. —H. I.

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*The Nature of the Dyeing Process.* G. v. Georgievics. Mitt. Tech. Gew. Museum in Wien, 4 (7, 8, 9, and 10), 205—220.

Two theories have been propounded for the explanation of the dyeing process—the chemical and the mechanical. These two arose at almost the same time, and recently the chemical theory has received great support from the experiments of E. Knecht on the one hand and L. Vignon on the other, and has been upheld by Erdmann, Hummel, and Noelting, whilst the latter theory has found but few defenders.

O. N. Witt has quite recently tried to unite these two views by explaining the dyeing process as a phenomenon of solution. This explanation has been subjected to attack, but without much result.

The author was led to examine these theories experimentally, and he divides his work into three parts:—1st. The Chemical Theory of Dyeing. 2nd. Witt's Solution Theory. 3rd. The Mechanical Theory, with discussion of results.

The following paper forms the first part of the series:—

### *Part I.—The Chemical Theory of Dyeing.*

The chief arguments in favour of this theory are as follows:—1. Magenta, methyl violet, and chrysoïdine are hydrochlorides of bases, and on dyeing wool or silk with these dyestuffs E. Knecht found that the colour base was taken up, and the hydrochloric acid remained quantitatively in the bath. He explained this by assuming that the wool and silk played the part of acids towards the colour bases and formed with them salt-like compounds. (This Journal, 1888, 819; Ber. 1888, 1556.)

2. Rosaniline base is colourless, only its salts being coloured, yet wool may be dyed magenta in an ammoniacal solution of this base (Jaquemin).

3. The red solution of amidoazobenzene sulphonic acid dyes yellow, which is the colour of its salts. Here we must assume that wool and silk play the part of bases towards this acid.

4. According to E. Knecht (Ber. 1889, 1123–5), wool takes up such dyes as picric acid, naphthol yellow, &c., in quantities proportioned to their molecular weights.

5. L. Vignon (this Journal, 1894, 248, Comptes rend. 623, 24), from the thermochemical examination of wool and silk, states that they certainly possess acid and basic properties.

#### *a. Dyeing with Magenta, Methyl Violet and Chrysoïdine.*

The author does not look upon Knecht's experiments as entirely free from objection, especially with regard to the method adopted for determining chlorine (Volhard's process) in the bath, since he finds that on boiling pure wool with water there is always a small quantity of a substance precipitable by silver nitrate in the liquid, which would more or less vitiate the results.

He therefore repeated Knecht's experiments. Purified cashmere and silk were gently boiled for three-quarters of an hour with a weighed quantity of magenta, methyl violet, and chrysoïdine respectively.

The dye liquors were then neutralised with pure sodium carbonate, and after evaporation the chlorine in the residue determined by ignition with lime. The results confirmed those of Knecht; in all the experiments the HCl present in the colouring matter was found quantitatively in the dye-bath, which was only partially exhausted of colour.

In order to observe the influence of temperature, the experiments were repeated with silk, at the temperature of the room, with wool at 45° C. (dyeing not taking place at a lower temperature). After dyeing, the colouring matter and chlorine left in the bath were estimated, the former by means of C. H. Wolff's colorimeter and the latter as before described.

*With silk after standing at the room temperature for one hour*, it was found in each of the three cases that about half the colouring matter and all the chlorine remained behind in the bath.

*With wool at* 45° C.:—25 grms. of wool were dyed at this temperature for $\frac{1}{2}$—$\frac{3}{4}$ hour, in a bath containing 400 cc. water. The results were as follows:—

| — | Colouring Matter. | Containing Chlorine. | After Dyeing. | |
|---|---|---|---|---|
| | | | Colouring Matter. | Cl in Bath. |
| | Grm. | Grm. | Grm. | Grm. |
| Magenta | 0·2012 | 0·0163 | 0·017 | 0·0102 |
| Methyl violet | 0·2088 | 0·01585 | 0·017 | 0·0118 |
| Chrysoïdine | 0·2011 | 0·031 | 0·04 | 0·0233 |

These experiments show that the wool at a moderate temperature absorbs a portion of the chlorine, which was indeed qualitatively found on the dyed fabric. The process is therefore at this temperature not a quantitative one, but is analogous to mordanting, both the acid and base being absorbed.

The author then examined the behaviour of chemically indifferent substances, towards these colouring matters.

Porous porcelain plates, such as are used in laboratories for drying purposes, were broken into small pieces, and three portions of 100 grms. each were covered with solutions of the three different colouring-matters and allowed to stand for about 1 hour at the temperature of the room. The colour solutions were then poured off and the pieces washed with water. The amount of colouring matter and chlorine present in the bath liquors were then estimated as before.

| Colouring Matter. | Amount used. | Cl calculated. | Colour in Liquor. | Cl in Liquor |
|---|---|---|---|---|
| | Grm. | Grm. | Grm. | Grm. |
| Magenta | 0·2045 | 0·0166 | 0·08 | 0·0158 |
| Methyl violet | 0·2007 | 0·0152 | 0·09 | 0·0152 |
| Chrysoïdine | 0·2015 | 0·0309 | 0·122 | 0·0235 |

Hence in all three cases *the whole of the hydrochloric acid of the colouring matter remains in the bath*, although the porcelain had taken up a large amount of colour. Glass behaves similarly. It is well known to all chemists who have worked with magenta, that it is almost impossible to remove the colouring matter from a glass vessel by merely washing with cold water. A glass beaker was filled with a moderately concentrated magenta solution of known strength, and after standing for some time the liquid poured out and the vessel repeatedly rinsed with cold water; finally the red superficial layer dissolved in boiling water and the colouring matter and chlorine estimated. It was found to contain chlorine in slightly less amount than was requisite to combine with the colour base.

Glass beads were dyed in the same way with the three colouring matters; after pouring off the liquor and washing with cold water until the wash liquor was barely coloured; the residual colouring matter was removed by boiling water and estimated. Here, again, no trace of chlorine could be found in any of the three cases.

These experiments prove that on dyeing porcelain and glass with these colours a quantitative process takes place, the colour bases are taken up, and the combined hydrochloric acid remains behind in the bath. They do not differ from those with silk and wool, which Knecht brings to the support of the chemical theory; he viewed this process as a chemical change taking place between the wool or silk on the one hand and the colouring matter on the other; but in the dyeing of porcelain and glass—an equally quantitative process—such a view would be hardly accepted by any chemist. The author therefore rejects Knecht's explanation of the process, and seeks for another. Two cases are possible: either the hydrochlorides of the bases are decomposed by the substance of the porcelain or glass, or they were so before contact with those chemically inert substances.

The first assumption is not tenable, since the two substances are chemically inactive, and the author accepts the second, *viz.*, that *Magenta, Methyl violet, and Chrysoïdine become dissociated in aqueous solution.*

This explains all the facts, besides supplying the reason why on dyeing wool at 45° C., not merely the colour base, but also HCl is taken up.

An experiment proved that wool itself will take up HCl at 45° C., whilst at 100° C. no acid is absorbed.

The wool takes up more acid at 45° C. when treated with hydrochloric acid alone, than when a colouring matter is in the bath. Porous porcelain behaves in exactly the same manner.

The assumption that the hydrochlorides of these colour bases are dissociated in aqueous solution is quite in keeping with the modern views of the nature of solution. It is supported by the fact that on heating a dilute magenta solution to boiling, it becomes lighter in shade, but on cooling regains its original colour. Heat tends to promote dissociation of the magenta. Methyl violet and chrysoïdine behave in the same way.

E. Fischer and E. Schmidmer have used filter-paper strips dipped into a solution as a means of showing the dissociation of certain double salts therein, the salts rising in the strips according to their relative velocity of diffusion.

A tube filled with a roll of filter paper was dipped at one end into a solution of magenta, and, after standing, the amount of colouring matter and chlorine in the part above the surface of the liquid estimated as before. Chlorine was found present in more than 20 times the amount required to combine with the colour base present in the strip.

Miolati (Ber. 26, 1788) has, by examining the molecular conductivity of magenta solutions, arrived at the same result. Magenta is dissociated in aqueous solution.

To what, then, is the red colour of magenta-dyed silk or wool, due?

It cannot be due to magenta itself, for all the HCl remains in the dye-bath, nor to a compound of rosaniline base and the silk- or wool-substance, for glass and porcelain behave in the same way.

But rosaniline base is colourless!

Since, however, rosaniline base is turned red by exposure to the action of the $CO_2$ of the air, may not the colour of the dyed fabric be due to rosaniline carbonate?

This is, however, disproved by the fact that when magenta-dyed wool is bleached by the action of caustic alkali or ammonia, the mere washing with water perfectly free from $CO_2$, restores the colour.

That the carbon dioxide of the air has nothing to do with the production of the magenta colour may be thus shown. Cotton padded with a concentrated solution of magenta is introduced into a vessel containing pure, cold, dilute caustic potash so that it is entirely covered by the liquid; the colour of the cotton is unchanged and the liquid remains colourless, although by the action of the alkali all the HCl must be neutralised and the carbon dioxide of the air excluded.

The following experiment gives a method for the preparation of the substance to which the magenta colour of the dyed fabric is due.

If a cold solution of magenta be precipitated with slightly more than the calculated amount of caustic soda or potash necessary to combine with the whole of the HCl present, we obtain a dark violet-red precipitate, which is the *coloured rosaniline base.*

This substance results, by an intramolecular change, from the colourless base, when salts are formed, and it can also be obtained by treating the same with water or by continued heating in a moist atmosphere.

The rosaniline base exists in two forms: (1) as carbinol, (2) as ammonium base; the first is colourless, the second magenta-red.

If this explanation be true, a solution of the coloured base should possess the same colouring power as a chemically equivalent quantity of the hydrochloride. A direct colorimetric comparison of the aqueous solution of the coloured base with a magenta solution, proved that the former was weaker than the latter.

This difference in shade might be due: 1st. To the specimen used containing some colourless base. 2nd. The coloured base in the free state might be weaker in shade than that present in magenta. 3rd. The difference in colour might be brought about by the presence of HCl, since it is possible that the hydrochloride is more intensely coloured than the base.

By dyeing equal weights of silk in the two solutions to exactly the same shade and comparing the baths colorimetrically before and after dyeing, it was found that the first two suppositions were incorrect, and therefore the difference in colour strength depends on the fact that the hydrochloride of the base is more intensely coloured than the free base itself.

The examination of the constitution of the coloured rosaniline base is reserved for another publication, but the author adds that analysis proves that it is not the carbonate of rosaniline. It behaves like magenta-dyed wool or silk towards alkalis; by heating with alkalis (passing into the carbinol form) it is decolorised, but recovers its original shade by washing with water. Colourless rosaniline base is therefore only stable in *alkaline* solution: or in the moist condition, only in presence of alkali. Hence a *colourless aqueous* solution of rosaniline, of which Knecht speaks, does not exist, and the experiment of Jaquemin which he brings forward to the support of the chemical theory, being carried out in alkaline solution, may be explained as follows:—Wool and silk absorb the base out of the colourless alkaline solution, and, since the alkali is not taken up in the same proportion, the base changes into the coloured form.

*The reactions which take place in dyeing with Magenta are therefore as follows:*—On dissolving the dyestuff in water it is dissociated. If a substance for which rosaniline base has an adhesive attraction, be brought into this solution, the base is taken up in its coloured form and a magenta-dyed body is obtained.

Dyeing with methyl violet, chrysoïdine, and other basic dyestuffs, may be explained in the same way.

*Dyeing with Amido-azobenzene Sulphonic Acid.*—The author finds that wool and silk dyed with a moderately concentrated solution of this body are red, but when strongly wrung out or washed they change to yellow.

If, however, wool be dyed with a very concentrated solution it remains permanently red.

The explanation is simple: wool and silk are not under ordinary conditions dyed red, since they are not able to take up sufficient colouring matter out of a weak solution of this substance, but show exactly the same colour as a very dilute solution of the dyestuff.

Wool or silk dyed with amido-azobenzene sulphonic acid, when boiled with water, give up their colour, and a *yellow* solution is obtained.

Strips of filter paper or strands of silk dipped into a concentrated solution of this dyestuff, show first a red and then, where the water is in excess, a yellow zone. On washing, they both give the same yellow colour, but the filter paper gives up its colour more readily, since cellulose has not great attraction for this dyestuff.

*Dyeing with Picric Acid, Tartrazine, &c.*—The author refers to Knecht's experiments with these dyestuffs, which have already been mentioned, and calls attention to Von Perger's and Ulrich's repetition of his work. They found that Knecht's results are unreliable (Lehne's Färber Zeit. 1891, 373).

L. Vignon's thermochemical work will be discussed in a future paper.—H. I.

*The Practical Applications of Ozone.* O. Fröhlich. Ber. d. deutsch. Elektrochem. Ges. 1894, 30.

*See under* XI., *page* 164.

### PATENT.

*Improvements in the Manufacture of Coloured or Patterned Waterproof Fabrics, and in the Means or Apparatus Employed therein.* T. Birnbaum, Bow, Middlesex. Eng. Pat. 561, January 10, 1894.

The invention relates to the production of designs upon rubber or other waterproof fabrics. A ground layer of dough of one shade is spread, and stripings are produced by means of a notched gauge, and the said stripings may be modified by means of an oscillating gauge. The overlay dough is removed by means of combs, of which the teeth scrape off the portions between the reserved stripings. The ornamented fabrics thus produced may be finished by the application of plain or tinted farina, which produces the effects of a corded or ribbed shot-silk or like fabric.—V. C.

## VII.—ACIDS, ALKALIS, AND SALTS.

*The Manufacture of Salt.* T. Ward. J. Soc. Arts, December 14, 1894, 78—88.

The usual method of obtaining the brine from deep deposits is to pump it up through a pipe entering the bore-hole, while water is run down the interspace between that pipe and another wider pipe enclosing it; the inner pipe being usually $3\frac{1}{2}$ inches, and the outer pipe 5 inches in diameter. As a column of 120 feet of water balances one of 100 feet of saturated brine, the work of pumping is, by this system, minimised. In America, in places, the water is forced down under high pressure, so that no pumping is needed; the bore-holes going in some cases to a depth of 2,500 feet.

Saturated brine at 60° F. contains $26\frac{1}{2}$ per cent. of salt. 100 parts of water retain in solution at the boiling point (226° F.) 40 parts salt, and at 32° F., $35\frac{1}{2}$ parts. A "good brine" contains 1 part salt to 3 parts water. The salinometer is graduated in ounces of salt per gallon—not the imperial gallon, but the old wine gallon of 231 cubic inches—and a saturated brine is a "2 lb. 10 oz. brine," having a specific gravity of 1·2.

All salt made by help of the sun's heat is known as "solar salt." In Syracuse, New York State, many thousands of shallow wooden pans, about 18 feet by 16, and 4 or 5 inches deep, are used in making solar salt from a weak brine. The pans are covered in wet weather, and are drawn or "harvested" twice a year. In Germany, natural very weak brines are caused to trickle upon huge thorn hedges built up so as to receive prevailing dry winds, troughs being placed below to catch the strengthened brine.

The Kara Boghaz Gulf, connected to the East Coast of the Caspian Sea by a passage 5 feet deep and 150 yards wide, has an area of more than 2,000 square miles, and although the Caspian Sea water received, flowing in at the rate of 3 miles an hour, contains under 1 per cent. of salt, it is estimated that 350,000 tons of salt are daily deposited on the bottom of the gulf, so great is the evaporation.

In cold regions salt is obtained from brine by freezing out the water; and it has been proposed to obtain salt by the same system here, producing the cold artificially, but this, the author points out, involves freezing three tons of water for each ton of salt obtained. Most of the salt made in England is from brine evaporated by direct heat, slack or small coal, costing from 5*s.* to 6*s.* a ton, being the fuel used. There are many patented plans for economising heat, mostly depending on the generation of steam and application of the heat evolved on its condensation, and of these the vacuum process is mentioned as one of the most successful. One process consists in lighting a mixture of gas and air under pressure in "a small kind of diving-bell, and all the heat thus generated is communicated to the brine, in which the heater is immersed." Steam processes are extensively used in America, and particulars of these are given. The universal presence of calcium sulphate in brines is stated to interfere materially with the vacuum pan and many other patented processes. Brine is easily affected, as to the quality or grain of salt to be obtained from it, by small quantities of such substances as soap, glue, and resin, the presence of which is said to "poison" the brine. Even a small fragment of butter will change the working of a pan, and the author states "it is the knowledge of these various apparently trifling things that distinguishes the old saltmaker from the novice; and the lack of this knowledge that renders so many patents useless."

*Bay Salt*, the coarsest variety manufactured, is obtained from brine brought nearly to boiling, and then allowed to cool quickly, thorns being laid over the bottom of the middle portion of the pan, and strings stretched across from side to side, on which the cubic crystals of salt form. Next in coarseness is *Fishery Salt*, which approaches most nearly to solar salt. The brine is concentrated at a very moderate temperature, and the salt crystals are given time to "feed." The addition of a small proportion of alum tends to harden the crystals. *Common Salt*, the most cheaply made of any kind, is usually made at from 170° to 190° F. in very long pans. Starting with saturated brine, the yield is about 2 tons of salt for each ton of fuel consumed. It is taken out of the pan daily, every other day, or on the third day for the coarser kind. It is this salt that is used for alkali-making, glass works, and agricultural purposes. *Fine and Coarse Butter Salt* are made in open boiling pans, shorter than those used for inferior kinds. *Patent Butter Salt*, the finest variety made, is prepared from brine kept boiling in circular, covered pans, in which the brine is constantly agitated by mechanical rakes. Butter salt is drawn out of the pan and allowed to drain, but if drained in moulds or tubs and then stoved, it is called *Handed Squares Stoved.* Or the dried masses obtained are broken in a mill, and the fragments put into sacks or bags; this salt is known as *Factory-filled Stove Lumps.* For the finer qualities, the salt is sieved to the required degree of fineness, and is frequently put up in jars, bottles, drums, and in paper packets.

In Belgium, Holland, and Denmark, rock salt is largely imported to saturate weak brines for preparing the finer kinds of salt. Brine is also thus formed along the coasts of Ireland and Scotland. American brines are commonly treated with quicklime in the reservoirs, where the deposit is allowed to settle. When magnesium and calcium chlorides are present in objectionable proportion, the salt obtained is washed "in a solution of saturated brine and soda."

For 1893 the total salt manufactured in the United Kingdom was 1,924,029 tons, which was less by 34,000 tons than the yield of the preceding year.—E. S.

*Management and Consumption of Material in the Ammonia-Soda Manufacture.* H. Schreib. Chem. Zeit. **18**, 1894, 1947—1952.

The author compares the quantities of materials required by theory and those actually used in the various processes of the ammonia-soda manufacture, and discusses the possibilities of further improvement. Some points of importance in the working of the plant are at the same time touched upon. (See also this Journal, 1890, 64—65.)

*Lime-burning.*—The short-flame kilns into which fuel and limestone are thrown mixed together, are so efficient that but minor improvements appear possible. This high degree of efficiency is due principally to the fact that all the air serving for combustion is previously heated by having to pass through the lime already burned, thus taking up most of the heat stored up in the latter. In the case of under-fired kilns this advantage is lost. Moreover, a better utilisation of the fuel takes place when burned in close contact with the pieces of limestone, than when burned on fire-bars, and the excess of air required for combustion is less. At the same time labour and repairs are reduced to a minimum. In the actual working of these kilns, it is possible to produce 100 kilos. of quicklime with a consumption of 15 kilos. of coke. Although this quantity is frequently exceeded, the maximum consumption may be put down as 20 kilos. per 100 kilos. of lime.

The amount of heat required by theory for the production of 100 kilos. of lime ( = 178 kilos. $CaCO_3$), allowing for the loss sustained at the high temperature of the escaping gases and by radiation, is 85,120 calories. This figure is arrived at as the sum of the following items :—

| | Cal. |
|---|---|
| Decomposition of 178 kilos. $CaCO_3$ | 77,250 |
| Loss of heat in escaping gases (150° C.) | 2,670 |
| Radiation of the kiln (14 square metres surface per hour, at 300 cal. per hour and square metre) | 4,200 |
| Loss of heat in lime drawn | 1,000 |
| | 85,120 |

Assuming the coke used, to possess a fuel value of 7,700 cal., and allowing for a loss of heat of 10 per cent. in the escaping gases and through incomplete combustion, 13·1 kilos. of coke would be necessary to produce the 85,120 cal. required by theory.

The percentage of calcium carbonate in limestone being variable (92—98 per cent.), the amount of fuel required for calcination varies proportionately. Thus, a limestone containing 96 per cent. of carbonate, 3 per cent. of silicates, iron, &c., and 1 per cent. of moisture, and furnishing a burnt lime of 94 per cent. CaO, 1 per cent. $CaCO_3$, and 3 per cent. of impurities, would require 80,882 calories, namely :—

| | Cal. |
|---|---|
| For decomposition of 168 kilos. of $CaCO_3$ | 71,912 |
| For evaporation of 1·7 kilos. of water | 1,100 |
| Loss of heat | 7,870 |
| | 80,882 |

To produce these would need 12·4 kilos. of coke, a quantity which may be taken as the theoretical average for 100 kilos. of lime. This approaches the amount used in practical working (15 kilos.) so closely that no further economy appears likely to be effected. The greater importance, moreover, must be attached not so much to the direct saving of fuel as to the attainment of a perfect combustion and the consequent high percentage of carbonic acid in the gases.

In the ordinary method of lime-burning the amount of carbonic acid in the kiln gases does not exceed 33 per cent. vol. The methods which have been proposed for obtaining a richer gas, and which are founded on the employment of superheated steam, or on the use of independently and externally heated chambers for containing the limestone (thus preventing the carbonic acid from the latter getting diluted with the combustion gases), do not appear to have met with any practical success.

*Absorption of the Carbonic Acid.*—The chief progress made in this direction in recent years is due to the use of solutions of the proper degree of concentration and the consequent working of the plant to the full extent of its capacity. The management of the absorbing process influences in a great measure the entire process of manufacture. In the case of the solutions used being too weak, the bicarbonate requires a comparatively longer time to separate out, the apparatus is not fully utilised, and more power is required for pumping the gases through the necessarily higher column of liquid. At the same time the distillation of the ammonia is influenced disadvantageously, owing to the larger quantity of liquor having to be heated, and also to the greater loss of ammonia in the liquor. In the case of the waste liquors being evaporated for further utilisation, another loss would result from the same cause. The amount of bicarbonate precipitated from the liquor is dependent both on the quantity of ammonia and of salt contained in the latter. This is shown by experiments on the small scale, giving the following results :—

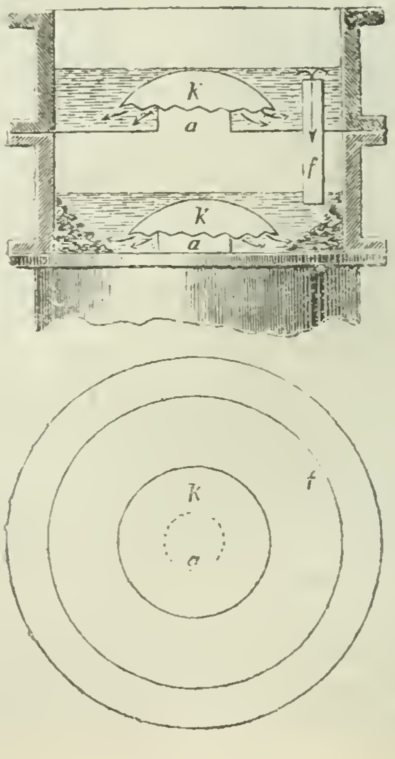
| Solution used. Quantity in Grms. per Litre. | | Yield of $Na_2CO_3$ in Grms. per Litre. |
|---|---|---|
| $NH_3$ | NaCl | |
| 34 | 296 | 90 |
| 48 | 289 | 115 |
| 66 | 273 | 146 |
| 89 | 258 | 168 |

In working on a large scale the results are very similar. The saturation of brine containing a high percentage of ammonia (7·5 per cent. = 75 kilos. per cubic metre) is a matter of some difficulty, especially in the case of columns or towers being used. This fact, which formerly led to the exclusion of strong liquors, was in a large measure due to the neglect of analytical checking, the dilution of the brine by the aqueous vapour accompanying the ammonia being disregarded, with consequent bad results.

The absorption of the carbonic acid takes place either in columns or plain cylindrical vessels. The employment of columns frequently gives rise to obstructions either by the deposition of ammonium sesquicarbonate in the gas-conducting pipes, or by incrustation in consequence of the separation of sodium bicarbonate as a solid mud in places where the agitation of the liquor is not sufficiently vigorous. Especially during stoppages of the process this is apt to take place, and sometimes the entire contents of the column, more particularly in the lower portion, are converted into a crystalline mass.

The segments of the ordinary form of column invariably have a flat horizontal bottom (Fig. 1). The gases rise

Fig. 1.



through the central tube *a*, and, on striking against the cap K, are deflected and made to pass through the liquor in the direction of the arrows. Thorough agitation is obtained as long as the quantity of gas is in the right proportion to the dimensions of the column. If, however, the diameter of the latter be too great a sediment forms (as indicated by the shading in Fig. 1), which may cause trouble if too bulky to be removed again by a stronger current of gas.

In another type of column (Fig. 2) the central tube is replaced by a number of smaller tubes. This construction, although apparently more correct from a theoretical point of view, likewise does not prevent the formation of sediment, which, taking place gradually ultimately leads to entire obstruction. In some columns the bottom of the segments is simply perforated (Fig. 3). The pressure of the gas passing through the perforations keeps the liquor on the plates, thus causing it to descend through the overflow tubes. When the apparatus is stopped all the liquor collects at the bottom. The advantage of this form of column consists in the fine division of the gases during their passage through the liquor. The perforations are, however, liable to become clogged, and the working of the apparatus is somewhat difficult, owing to the necessity of avoiding variation in the pressure of the gases.

Fig. 2.

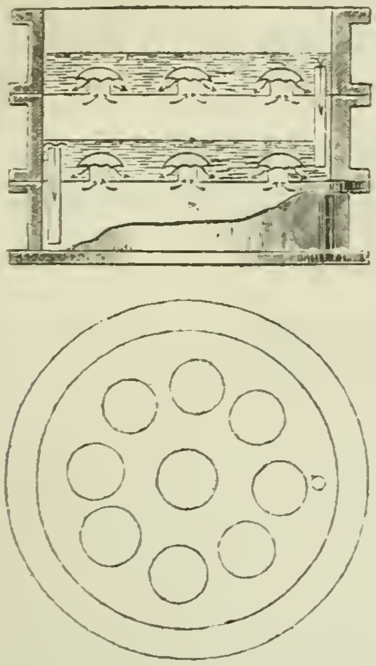
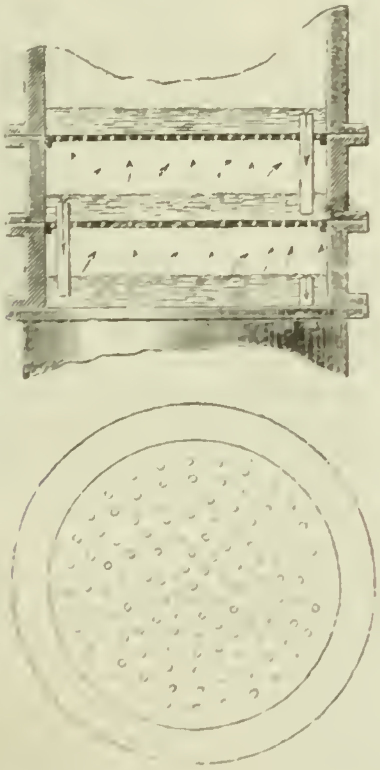


Fig. 3.



If pots or boilers be used in the place of columns, these should be provided with a conical bottom (Fig. 4, *b*) whereby the accumulations of bicarbonate, which are liable to take place in flat-bottomed vessels (Fig. 4 *a*), are avoided. A column embodying the same principle is shown in Fig. 5. The segments of this consist in reality of conical vessels of comparatively large capacity.

Fig. 4.

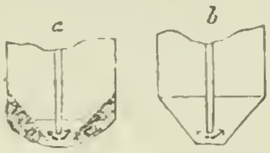
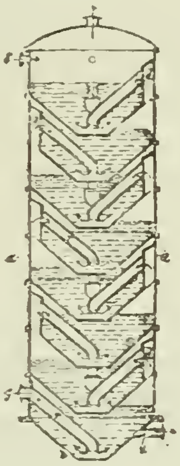


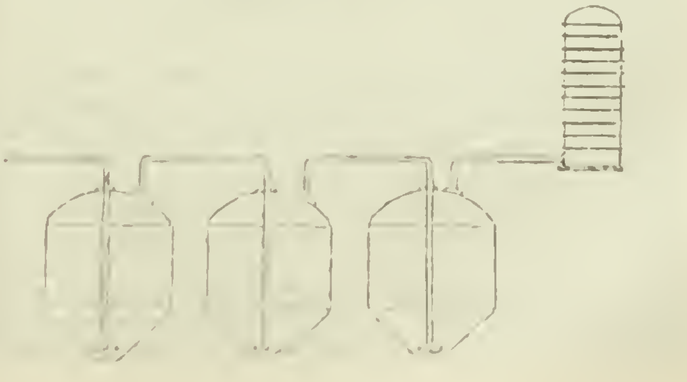
Fig. 5.



Although theoretically the most correct of all apparatus for the absorption of the carbonic acid, the column yet possesses the drawback of being liable to become obstructed and of favouring the production of finely crystalline almost muddy bicarbonate. The former disadvantage can to a considerable extent be overcome by avoiding interruption of the gas current by the use of well-constructed air-pumps and by having reserve pumps. The formation of muddy bicarbonate is a more serious difficulty, and is due chiefly to its rapid separation in the small volume of liquor contained in the single segments. Hence the superiority of the column, Fig. 5, in which, owing to the greater cubical contents (up to 4 cubic metres) of the segments, precipitation takes place slower and therefore yields a coarser bicarbonate. This is necessary for the purpose of avoiding loss in the subsequent operation of washing.

The experience gained in actual working seems to show that a combination of boiler-shaped vessels with a column (Fig. 6) is the best plan to adopt. In the column the ammoniacal brine is saturated sufficiently to produce normal

Fig. 6.



ammonium carbonate, whilst in the vessels the further conversion into bicarbonate and the precipitation of the sodium bicarbonate are carried out. The utilisation of the carbonic acid in this plant can be as complete as in a single column. The latter, however, is less expensive, and the pressure it opposes to the air-pumps somewhat less than that of the former. For a production of 10,000 kilos. of soda in 24 hours a column of 15 segments would be necessary, each with a height of 40 cm., or 6 metres for the total height of the column of liquid. In the combined system of three vessels (each 3 metres) and a small column of 10 segments of 20 centimetres each, the total height of the column of liquid amounts to 11 metres. Taking the average specific gravity of the liquors at 1·18, the pressure in the column would be 1·7 atmospheres, that in the combination system 2·3 atmospheres. This difference of the pressure is not a matter of great moment, as the saving of coal resulting from its reduction would not be very considerable.

The calculation of the quantities of materials required for the precipitation of the bicarbonate gives the following results:—10,000 kilos. of soda require 4,150 kilos. of carbonic acid, and the same quantity is necessary for the corresponding amount of sodium bicarbonate, making in all 8,300 kilos. One half of this is constantly being recovered from the bicarbonate by the calcining process. Taking the unavoidable loss at the outside figure of 12 per cent., the lime furnace would have to furnish 5,150 kilos. of carbonic acid, or 9,000 cubic metres of gases (at 15° and 760 millimetres pressure) containing 32 per cent. vol. $CO_2$. The production of this quantity requires 7,600 kilos. of limestone and 570 kilos. of coke. More lime must, however, be burned to get a sufficient quantity for the decomposition of the ammonium chloride. For aspirating the necessary 900 cubic metres of kiln-gases at the rate of 6·25 cubic metres per minute and forcing them through the liquor at a pressure of 2·2 atmospheres 15 units of horse-power are required, but in actual working 8 cubic metres of gases per minute must be allowed for, raising the number of units of horse-power required by the pump to 20.

The gas resulting from the calcination of the bicarbonate contains 50 per cent. vol. $CO_2$, and would furnish 4,540 cubic metres at this percentage. For moving this volume at the rate of 4 cubic metres per minute a 12-horse-power compressor is needed.

In the saturating process with carbonic acid, 70 per cent. of the total amount of sodium chloride may be precipitated as bicarbonate, if the liquor used contain 270 kilos. NaCl and 75 kilos. $NH_3$ per cubic metre. The 70 per cent. represent 171 kilos. of soda, 5 per cent. of which are lost in washing the bicarbonate, leaving 160 kilos. as the actual yield of soda per cubic metre of ammoniacal brine. 100 kilos. therefore required 62 cubic metres of ammoniacal brine or 170 kilos. of salt.

The above figures, which show a better result than that generally obtained in practice, may be taken as the limit it is possible to reach by the method now universally adopted. Whether, by a change of the principles of the present methods, the result may be further improved it is scarcely possible to say. The alcohol method of de Grousillier and the use of solid ammonium bicarbonate proposed by Schlösing have not been adopted on the large scale. What certainly would be an improvement, is the employment of cheap high-percentage carbonic acid. This in some places is furnished by natural springs, and would place the soda manufacture upon a very favourable footing provided there be no difficulty in obtaining the other raw materials cheaply.

*Distillation of the Ammonia.*—The advantageous management of this process greatly depends on the manner in which the absorbing process is conducted. The less the quantity of mother-liquor the less also will be the consumption of heat and the size of the necessary apparatus. The latter may consist either of columns or of boilers, the former being the most suitable for the purpose. Owing to the vigorous boiling of the liquor in the column, more especially in its lower compartments, the ammonia is expelled completely and speedily. The addition of the lime must be carefully controlled, both to avoid loss of lime and loss of ammonia. In working on a comparatively small scale it is preferable to use three or four vessels in combination with a column. In the latter, merely the ammonium carbonate is expelled, while the ammonium chloride is decomposed in the vessels.

Reducing the production of mother-liquor to a minimum, the amount of steam required for 10,000 kilos. of soda in 24 hours is as follows:—

| | Cal. |
|---|---|
| For heating 61 cubic metres of mother-liquor from about 15° to 120° | 6,100,000 |
| For heating 20 cubic metres of milk of lime from about 50° to 120° | 1,330,000 |
| For decomposing and distilling 2,400 kilos. of ammonium bicarbonate (1 kilo. = 263 cal.) | 630,000 |
| For distilling 3,200 kilos. of ammonia (1 kilo. = 570 cal.) | 1,824,000 |
| Radiation, 500 square metres at 650 cal. per metre and hour | 7,800,000 |
| Total | 17,684,000 |
| To be deducted from this sum for heat generated in the reaction $2NH_4Cl + Ca(OH)_2 = 2NH_4OH + CaCl_2$ (30 cal. for each molecule of $CaCl_2$ or 31 cal. for each kilo. of soda) for 10,000 kilos. of soda | 310,000 |
| | 17,374,000 |

Taking kilo. of steam to give 500 cal., that required for the above quantity amounts to 34,750 kilos. With careful firing 80 per cent. of the fuel value of good coal (7,500 cal. per kilo.) may be utilised, generating for 1 kilo. of coal, from feed water heated to 90°, 10·5 kilos. of steam at 6 atmospheres pressure. For 34,750 kilos. of steam 3,310 kilos. of coal would therefore be consumed. This figure represents the minimum consumption of coal for regenerating the ammonia used in the production of 10,000 kilos. of soda. An economy in the consumption of steam might be effected by using solid lime instead of milk of lime or by distilling in a vacuum. The latter method is already being practised, but is said to save only about 5 per cent. of the heat usually required, the vacuum being maintained only in the last portion of the distilling apparatus. There can, however, be but little doubt as to the possibility of producing a vacuum in the entire apparatus, and thus keeping the liquor at a temperature below 70°. The arrangement of the plant might be analogous to that serving for evaporation in the sugar manufacture. The calculation of the amount of heat required for distillation with a vacuum gives the following figures:—

| | Cal. |
|---|---|
| Mother-liquor = 61 cubic metres to be heated from 15° to 70° | 3,300,000 |
| Milk of lime = 20 cubic metres to be heated from 50° to 70° | 400,000 |
| $NH_4HCO_3$ = 2,400 kilos. | 550,000 |
| $NH_3$ = 3,200 kilos. | 1,720,000 |
| Radiation = 500 square metres at 350 cal. per hour | 4,200,000 |
| Total | 10,170,000 |

This corresponds to a consumption of 1,950 kilos. of coal.

Of the various methods of using the steam necessary for working the process, that consisting in the employment of direct steam for the engines and of the waste steam from the latter for the distillation, is the most economical and most generally used, although not in every respect the most agreeable. A comparison of the power required for the various engines and machines used in the ammonia-soda manufacture gives the following figures:—

| | H.P. |
|---|---|
| 1. The compressor for the kiln gases, drawing 8 cubic metres per hour and forcing them against a pressure of 2·2 atmospheres | 20 |
| 2. The compressor for the carbonic acid from the bicarbonate roasters, 4 cubic metres of gas against 2·5 atmospheres pressure | 12 |
| 3. Vacuum pump for the filters | 4 |
| 4. Water pump | 6 |
| 5. Various small pumps for brine, milk of lime, &c. | 2 |
| 6. Engine for the Thelen furnace | 4 |
| 7. Limestone and coke elevator | 2 |
| 8. Various elevators | 1 |
| 9. Mill | 6 |
| 10. Friction in transmission | 13 |
| Total | 70 |

In case of the waste steam from the engines being used for distilling, and the pressure of 2·5 atmospheres, to be overcome in the stills, being allowed for, 2¼ kilos. of coal per hour are consumed for each horse-power or 3,780 kilos. for 70 horse-power in 24 hours. This quantity being more than is required for the distillation, a reduction in the quantity of coal used to 3,500 kilos. is effected by only using 60 horse-power for distillation, and letting the waste steam, representing the remainder, escape into the atmosphere, or by employing a condensing engine of proportionate power.

The amount of coal required in working with the employment of a vacuum is, for the 10,170,000 cal., or the 20,340 kilos. of steam, which must be generated, 1,950 kilos. The engines require about 1·1 kilos. of coal per hour and horse-power, or altogether, in 24 hours, 1,840 kilos. The heat represented by the remaining 110 kilos. of coal would then have to be supplied by steam direct from the boilers.

*The calcination of the Bicarbonate.*—17,630 cal. are needed for decomposing 100 kilos. of bicarbonate. In order to obtain 100 kilos. of sodium carbonate 212 kilos. of moist bicarbonate containing 25 per cent. of water must be calcined. The amount of heat necessary is—

| | Cal. |
|---|---|
| For 159 kilos. $NaHCO_3$ at 176 cal. .......... | 28,000 |
| For 53 „ $H_2O$ at 640 cal. ............... | 33,920 |
| | 61,920 |

to which must be added about 200 cal. for heating the gases to 105° and 12,000 cal. for radiation, bringing the total up to 7,600 cal. for 100 kilos. of soda. In well-constructed roasting apparatus 70 per cent. of the fuel value of the coal consumed are utilised (5,200 cal. per kilo.). The quantity of coal necessary for 100 kilos. of soda, is therefore 14·5 kilos.

*Summary of Results.*—The figures given above are not reached in actual working, and the results obtained in different works vary greatly. A comparison of the calculated figures with the best obtained in practice is given in the following table :—

| —— | Calculated. | Practice. |
|---|---|---|
| | Kilos. | Kilos. |
| Coke, per 100 kilos. of limestone ..... | 6·5 | 8 |
| Limestone per 100 kilos. of soda ..... | 120 | 170 |
| Quicklime „ „ ..... | 60 | 85 |
| Salt „ „ ..... | 170 | 190 |
| Coal „ „ ..... | 50 | 90 |
| Ammonium sulphate per 100 kilos. of soda. | 0·75 | 0·75 |
| | Cubic Metres. | Cubic Metres. |
| Lime furnace gas per 100 kilos. of soda | 90 | 110 |
| Ammoniacal brine „ „ | 0·62 | 0·82 |
| Waste liquor from the distillation ... | 1·20 | 1·70 |
| Units of horse-power................ | 0·7 | 1·1 |

The deviation of the figures, representing the results obtained in practice from those calculated, would probably be avoided by the use of a more perfect plant, and by the exercise of greater care in the management of the same. The difference is especially marked in the absorbing or carbonating process. The calculated results are based on the assumption of a high rate of conversion of the salt into bicarbonate and a high degree of utilisation of the carbonic acid in the rich furnace gases. This accounts for the low number of units of horse-power and the small consumption of coal. The efficiency of the steam-producing plant is another factor of importance in this respect. A utilisation of 80 per cent. of the fuel value of the coal is readily attainable, but frequently is not reached. There is also no difficulty in heating the feed water to 90° by utilising the heat of the condensing water from the distillation and that of the waste liquors.

The following table gives a comparison of the actual with the calculated cost of production of 100 kilos. of soda of 98 to 100 per cent. :—

*Calculated Cost.*

| | M. |
|---|---|
| Salt, 170 kilos., at M. 0·40 per 100 kilos. .............. | 0·68 |
| Limestone, 120 kilos., at M. 0·20 per 100 kilos. ........ | 0·24 |
| Coke, 8 kilos., at M. 1·80 per 100 kilos. ................ | 0·15 |
| Coal, 50 kilos., at M. 1·30 per 100 kilos. ............... | 0·65 |
| Ammonium sulphate, ¾ kilo., at M. 28 per 100 kilos.... | 0·21 |
| Labour and supervision .............................. | 0·70 |
| Repairs.................................................. | 0·40 |
| Various expenses ...................................... | 0·30 |
| Interest on capital...................................... | 0·90 |
| Cost of administration ................................ | 0·50 |
| Package................................................. | 0·15 |
| | 4·88 |

*Actual Cost.*

| | M. |
|---|---|
| Salt, 190 kilos., at M. 0·40 per 100 kilos. .............. | 0·76 |
| Limestone, 170 kilos., at M. 0·20 per 100 kilos. ........ | 0·34 |
| Coke, 14 kilos., at M. 1·80 per 100 kilos. ............... | 0·25 |
| Coal, 90 kilos., at M. 1·30 per 100 kilos. ............... | 1·17 |
| Ammonium sulphate, ¾ kilo., at M. 28·0 per 100 kilos. | 0·21 |
| Labour and supervision .............................. | 0·80 |
| Repairs ................................................. | 0·40 |
| Various expenses ...................................... | 0·30 |
| Interest on capital...................................... | 0·90 |
| Cost of administration ................................ | 0·50 |
| Package................................................. | 0·15 |
| | 5·78 |

These figures are based on medium prices for the materials, some works deriving part of the latter from their own mines, quarries, and brine wells, and being so fortunately situated financially as not to be obliged to take into account the interest on the invested capital, may be able to produce more cheaply, but even in that case the cost will always be somewhere near M. 4·50 per 100 kilos.

*Utilisation of the Residues.*—Little reliable information can be given on the profitableness of the production of chlorine from the waste liquors of the ammonia-soda process. Of the methods proposed for the recovery of the chlorine, either as such or as hydrochloric acid, those founded on the decomposition of magnesium chloride have most chance of success. Theory admits of the advantageous working of the decomposing process as regards the consumption of heat and power. There are, however, difficulties which have so far prevented the general adoption of the processes in question. These are : incomplete decomposition and consequent loss of work and material, great wear of the plant employed, insufficient development of the mechanical part of the process (which entails the treatment of tenacious semi-fluid or caking products), and the high cost of producing solid magnesium chloride. Péchiney's method of decomposing the magnesium chloride is said to have stood the practical test at the soda works at Salindres and at Sezcakowa. In view of these reports it is difficult to account for the fact that this chlorine process has been given up again at the Stassfurt works, which have a cheaper magnesium chloride at their disposal than that which can be obtained from calcium chloride.

In Mond's method the distillation of the ammonium chloride for the recovery of the ammonia is dispensed with. The ammonium chloride is first separated in a dry form and then as vapour passed over heated magnesia, the magnesium chloride formed being subsequently decomposed with the liberation of chlorine. The separation of the ammonium chloride from the liquors in Mond's process has frequently been incorrectly interpreted. It is generally accepted that the cooling alone is sufficient for the purpose of accomplishing this separation, whereas in reality an actual displacement of the ammonium chloride by sodium chloride takes place, the precipitation of the former being assisted by passing ammonia through the liquor and by cooling to + 4°. The liquor filtered off from the precipitated ammonium chloride contains about 6 per cent. of ammonium chloride besides 23 per cent. of salt, and can be used over again in the carbonating process. The saving effected in this method, owing to its dispensing with the evaporation of solutions and the distillation of large quantities of liquor, is evident. The difficulties connected with it seem to be in the construction of apparatus capable of resisting the wear and tear in working. Nothing definite is known as to the actual cost of producing bleaching powder by this method.

*The Present Position of the Ammonia-Soda Industry.*—In spite of the views expressed to the contrary, the Soda Syndicate formed in 1891 is still in existence and promises fair to last even though a number of independent new works should be built besides the one already erected at Heerdt. The outcry on the part of consumers against the high prices maintained by the Syndicate needs no comment. A fact worth mentioning is the success of the Soda Syndicate in the attempt to force the German Salt Syndicate to a promise of refusing to supply with salt any newly-founded soda-works outside the ring. This has made the erection of new works impossible in many places otherwise well suited for the purpose. Although there may still be localities enough in Germany where soda-works might be erected, this is not likely to take place now the consumer has become accustomed to the high prices.

To what extent the much-talked-of electrolytic process of making soda is likely to compete with the ammonia-soda manufacture is at present merely a matter of conjecture. Even if the truth of the reports circulated by the daily press, as to the danger arising to the ammonia soda works from the electrolytic process could be proved, there would remain for the manufacturers of soda by the latter method the difficulty of disposing of the large quantity of bleaching powder simultaneously produced. The use of this product, owing to the probable adoption of the electrolytic bleaching process in the manufacture of paper, textile fabrics, &c., is, however, likely to decrease rather than to increase. Taking all circumstances together, it seems to the author safe to predict that the ammonia-soda manufacture will hold its own for many years to come.—F. M.

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*Report in the name of the Comité des Arts chimiques upon Kessler's New Apparatus for the Concentration of Sulphuric Acid.* Aimé Girard. Bull. Soc. d'encouragement pour l'Industrie Nationale, 1894, 588—594.

SULPHURIC acid of high strengths, containing from 94 per cent. to as much as 99·5 per cent. of monohydrated acid, can only be made at a considerable cost by the usual methods of concentration, in platinum vessels, owing to corrosion of the platinum, and in glass vessels owing to frequent breakage of the vessels caused by the "bumping" of the boiling acid. Scheurer Kestner states that in concentrating a ton of acid to 94 per cent. in platinum, 1 grm. of platinum is dissolved; in concentrating to 98 per cent., 6 or 7 grms. are dissolved; whilst in concentrating to 99·5 per cent. the loss of platinum rises to 9 grms. per ton of acid. This loss is calculated as being equal to one of "1 fr. 44 per 100 kilos. of acid concentrated." Kessler's apparatus, which is described and figured in this Journal, 1892, 434, effects the concentration of acid from 52° B. to 66° B. by the application of a new principle in the concentration of acid, viz., the application of heat to the surface of the acid instead of to the bottom or sides of the vessel containing it. His apparatus, speaking generally, consists of a trough divided into compartments, and called the "saturator," which is made of siliceous material not attacked by concentrated acid, such as volvic lava, sandstone, or certain kinds of stoneware, and a tower, called the "recuperator," above the trough, and containing a series of four or five horizontal perforated shelves or "plateaux," the lower two or three made of similar acid-resisting material, and the upper two made of lead. There is, further, a condenser attached, filled with coke. The weak acid enters the apparatus at the top of the recuperator and passes downwards from shelf to shelf, finally entering the saturator, which it leaves as concentrated acid. A coke furnace discharges its hot products of combustion over the surface of the acid in the saturator and these gases then pass upwards through the recuperator, meeting the descending drops of acid and carrying away the water-vapour from the acid. The small quantity of acid carried onwards with the gases, is finally removed by traversing the condenser filled with coke, and all that leaves the condenser is almost pure water-vapour. A steam aspirator is used for drawing the hot gases from the furnace through the whole system. For a production of 5,000 kilos. of concentrated acid per day, the dimensions of the saturator are 2 to 3 metres long, by 1·70 metres wide, by 0·60 metre high, and the superimposed recuperator is 1 metre high by 1 metre square in cross section. The coke-condenser has a capacity of 3 cubic metres per 1,000 kilos. of acid concentrated per 24 hours. The coke is broken to the size of grains of rice.

The gases entering the saturator have a temperature of about 500° C., and become cooled to about 200° C. before they enter the recuperator, and on leaving this they have cooled to from 70°—80° C. at which temperature they enter the coke-condenser.

The reporter arrives at the following conclusions:—

Kessler's apparatus of the dimensions given above will produce 5,000 kilos. of acid of 66° B. (containing 96 to 98 per cent. monohydrated acid) per 24 hours.

An alembic of platinum for concentrating this quantity would cost 30,000 frs.; Kessler's apparatus costs 3,000 frs.

The consumption of fuel by the older process is about 25 to 28 kilos. per 1,000 kilos. of acid; by the new process it does not exceed 16 to 17 kilos. (11 kilos. of coke for the furnace, and 5 to 6 kilos. of coal for the steam aspirator).

The cost of platinum dissolved in concentrating is of course saved.

The acid is pure; the sulphurous acid from the combustion of the coke removes all nitrous compounds.

In the two years since its invention, seven pieces of apparatus have been erected, besides two in the inventor's works at Clermont-Ferrand. Of these seven, two have been put up at St. Denis, near Paris; one at Lille, in Kuhlmann's works; one at the Malètra works, near Rouen; one in the Hoechst works of Messrs. Meister, Lucius, and Brüning; and another at Wülfing and Co.'s works at Elberfeld; and the seventh in France, at the Puiseaux works (Loiret),—in every case with complete success.—H. S. P.

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*The Chromate Industry in Russia.* N. P. Wahlberg. Zap. imp. russk. techn. obszcz. 1894, **28**, 1.

As there is little demand for potassium sulphate in Russia, the author has endeavoured to utilise this by-product, obtained in the manufacture of chromates from chrome-iron ore, to replace a part of the potassium carbonate generally used in this process. A mixture of about 3 parts of chrome-iron ore, 4·5 parts chalk (or lime), 1·5 parts potash, and 1·5 parts crude potassium sulphate, are roasted in a reverberatory furnace, and the product treated with water whilst still red hot. The potassium sulphate does not take part in the reaction caused by the ignition, but if it be added afterwards it is impossible to obtain such an intimate mixture, and such subsequent admixture would also cool the product too much. The ignited product contains an intimate mixture of potassium and calcium chromate and unchanged potassium sulphate, and when the water is added, double decomposition at once takes place between the two latter. If necessary, still more of the potash may be replaced by potassium sulphate than is represented by the above proportions. The author finds replacement of the chalk by lime gives less satisfactory results. This unexpected effect is probably due to the chalk giving off carbonic anhydride during the ignition, thus making the mass more porous, and so allowing freer access of air and more complete oxidation of the chromium. Care must be exercised in regulating the heat during roasting, as if the temperature employed is too great, less chromate is produced. A properly roasted product should contain 15—19 per cent. of chromic acid, and the residues should not contain more than 7 per cent. of chromic oxide, but if the roasting is not carefully done, and the heat is allowed to get too high, the yield of chromic acid falls to 12—15 per cent., and the chromic oxide left in the residues rises to 10—12 per cent. The percentage of chromic oxide in ores used by the author varied from 35 to 53 per cent.

The further working is carried on as usual, the separation of the different constituents being based on their different solubilities. At 15° C. 100 parts of water dissolve 60·92 parts $K_2CrO_4$, and only 12·4 parts $K_2Cr_2O_7$; at 100° C. 100 parts of water dissolve 79·1 parts of $K_2CrO_4$, 94·1 parts of $K_2Cr_2O_7$, and only 26·3 parts of $K_2SO_4$. The chromate present is converted into bichromate by adding the necessary quantity of sulphuric acid, and the potassium sulphate is then removed by concentration at 100°.

The author calls attention to the dangerous nature of the chromate manufacture, and the need for special precautions being taken, especially as regards the frequent washing of the hands, face, and nose, and for the packers the use of respirators.—L. T. T.

*Elimination of Potassium Perchlorate from Saltpetre.* V. Panastovic. Chem. Zeit. **18**, 1894, 1567.

The analysis of a number of samples was carried out according to Hellich's method by fusing the saltpetre in a platinum or nickel dish with manganese dioxide. The fused mass was extracted with water, the filtered solution acidulated with sulphuric acid, and the chlorine precipitated with silver nitrate. Old samples were found to contain as much as 2·5 per cent. of perchlorate; in a more recent delivery of 100 barrels, 7 barrels were found to be absolutely free from perchlorates, but 122 barrels contained above 0·25 per cent. The whole of this saltpetre was either free from chlorides or contained only traces. It is not known with certainty in how far the presence of perchlorate in saltpetre is responsible for otherwise unexplained explosions in gunpowder works, but the author cites a number of explosions which occurred in the Servian gunpowder works at Stragare and Obilicévo, and in every case the saltpetre used at the time was found to contain more or less perchlorate. To free the saltpetre from perchlorate, it is dissolved in copper pans, in water free from chlorine, until a solution of 48° B. is obtained. This solution is then drawn into copper cooling-vessels, where it is stirred until the temperature has fallen to 25° C. and the specific gravity to 28° B. The crystals which then have separated out are freed from mother-liquor, washed with water several times, and dried; they contain then only mere traces of perchlorate. The mother-liquors from this crystallisation are evaporated to 48° B., and the saltpetre, which crystallises out at 25° C., is again subjected to the above process. From the final mother-liquors resulting in this process, crystals of potassium perchlorate were obtained. The author agrees with Major Hellich that not more than 0·02 per cent. of perchlorate should be allowed in saltpetre intended for the manufacture of gunpowder.—C. O. W.

*Estimation of Sulphur in Pyrites.* T. S. Gladding. J. Amer. Chem. Soc. **16**, 398.

*See under* XXIII., *page* 190.

*Estimation of the Arsenic in Concentrated Suphuric Acid.* Stepanow and Miklaschewski. Zap. imp. russk. techn. obszcz. 1894, **28**, 182.

*See under* XXIII., *page* 189.

*Nitrogen in Fuels and the Yield of Ammonia by their Dry Distillation.* H. Tichauer. Journ. Gasbeleuchtung, 1894, **37**, 363.

*See under* III., *page* 143.

## PATENTS.

*Improvements in the Preparation of Acetic and Oxalic Acids.* H. Plater-Syberg, Paris. Eng. Pat. 23,682, December 8, 1893.

This invention relates to a process for preparing acetic and oxalic acids. The material, rich in carbohydrates, especially wood and moss, is impregnated with caustic alkalis and then heated in presence of an oxidising agent. Hot air, or a mixture of steam and hot air, may conveniently be used as the oxidising agent. Acetates and oxalates are formed, the relative proportion of each depending on the temperature employed. By working at a low temperature (about 120° C.), acetic acid and a very small quantity of oxalic acid are produced. On raising the temperature to about 300° C., and increasing the quantity of hot air, the formation of acetic acid almost entirely ceases, whilst oxalic acid is formed in large quantity. Pulp suitable for paper-making is obtained as a by-product.—J. S.

*Improvements in and connected with the Manufacture of Magnesium Hydrate.* M. N. d'Andria, Stretford. Eng. Pat. 24,563, December 21, 1893.

Calcined and slaked dolomite is placed in tanks, accessible to the tidal flow of the sea, so that the water entering may escape at the ebb through suitable outlets, the dolomite being meanwhile well stirred and allowed to subside. The process is repeated until most of the lime has passed into solution and been removed, leaving magnesium hydroxide behind. It is stated that any remaining lime may be removed by treating the sediment with dilute hydrochloric acid, a solution of a soluble magnesium salt being preferably added. The ultimate residue of magnesium hydrate may be washed and dried for package. The process may be varied by treating the calcined dolomite with "the natural flow of a large quantity of water" from any convenient source; or by supplying the dolomite to the tanks in the form of a milk through suitable conduits. It is advantageous, however, to employ sea-water, or water containing magnesium salts in solution, as such waters yield a precipitate of magnesium hydrate.—E. S.

*Improvements in Apparatus for Producing Ferro-ferric and Ferric Oxides.* A. Crossley, Cwmavon, Monmouth. Eng. Pat. 2618, February 6, 1894.

An apparatus for producing ferro-ferric and ferric oxides, by the present inventor,—described in Eng. Pat. 12,813, 1891 (this Journal, 1892, 614), consisting of a series of superposed revolving tubes or cylinders set in a furnace, alternately inclined in opposite directions, in such manner that the powdered salts fed in through a hopper into the uppermost tube may pass through a hopper or guide successively into each tube next below, and have exit by a delivery shoot from the lowest tube—is now improved upon by surrounding each tube with a refractory casing of fireclay or the like, the inside of the casing being at such distance from the tube as not to interfere with its revolution, whilst the casing on the outside is exposed to the heat of the furnace. The casings may be arranged so as to form flues; or to be surrounded by the fire gases. The oxide produced in this apparatus is stated to be pure and of uniform quality, the heat applied being uniform and steady.—E. S.

*Improvements in the Production of Sulphate of Manganese and Oxide of Iron.* A. R. Davis, Manchester. Eng. Pat. 2696, February 7, 1894.

Ferrous sulphate solution is treated with manganese peroxide, and the solution of manganese sulphate obtained is separated from the iron oxide precipitated, either to be used as such or for producing the solid salt.—E. S.

*Improvements in and Apparatus for the Treatment of Caustic Salts obtained as a By-Product in the Manufacture of Caustic Soda.* J. Brock, Farnworth, Widnes; V. C. Driffield, Appleton, Widnes; A. Carey, Gateacre, Liverpool; and F. Brown, Hough Green, Widnes. Eng. Pat. 3037, February 12, 1894.

The "caustic salts" are partially freed from caustic soda by draining and steaming, and are then, in a fairly dry condition, charged through an aperture in the side of a horizontal cylinder mounted for rotation. Carbonic acid gas, preferably hot from a limekiln, is admitted through one of the hollow trunnions, and has exit through the opposite trunnion into a short pipe leading into a condensing chamber, cooled by a flow of water through pipes. The gas issues from near the bottom of the chamber, and may be taken through another cylinder, if desired. When a supply of pure carbonic acid is available, a rapid circulation may be established by a fan, using a single revolving cylinder and condenser, and returning the excess of gas to the cylinder. The salts absorb carbonic acid in the apparatus, the sodium hydroxide present being converted into carbonate, and they may then be finished in a reverberatory furnace, forming a saleable soda ash. A stationary vessel with mechanical stirrer may be used, but the revolving cylinder described is preferred.—E. S.

*Improvements in or connected with the Manufacture of Salt.* R. C. Wilson, Birkenhead. Eng. Pat. 3413, February 17, 1894.

This invention relates to the evaporation of brine in such manner as to admit of the use of cheaper (usually smaller) fuel than ordinary, with full utilisation of the heat produced. A steam generator, preferably of the "Meldrum" type, the fires being worked with forced draught, is set longitudinally across the end of a salt pan, and on a somewhat lower level. A main steam-distribution pipe is arranged along the centre of the pan, slightly inclined upwards towards the further end, so that water condensed from steam in the pipe may flow back into the steam generator, through a tube nearly reaching the bottom, and entering at top the main pipe close to the pan. The main steam pipe has numerous branch heating pipes, closed at the extremities, and inclined upwards, but not reaching the sides of the pan, so that a sufficient clear space may be left for manipulating the salt as it falls. The pan is set upon a foundation, and rests on material such as ashes, bricks, or the like, conducting heat badly. A flue for the gases of combustion from the steam generator is provided in the foundation, some distance below the pan, through the length of which flue a pipe carrying brine from an elevated source passes, the pipe being continued upwards at the front, and curved downwards over the pan, so as to deliver a regular stream of warmed brine. When desirable, a second pan may be set beyond the first pan, under which the flue conveying fire gases is carried, especially for making "fishery-salt" or other coarse varieties, while the finer grades of salt are made in the first pan, the grade being regulated at will by the steam pressure employed. A modified arrangement is shown for the first pan, in which two main steam pipes, one above the other, are used, the extremities of the branch pipes being joined, so as to be continuous between the main pipes.

A battery of six pans may be heated from three steam generators, placed centrally, each generator serving two pans. In this case the fire gases are led under a separate pan on a higher level, through which the feed brine is taken. This pan is covered, and is provided with partial diaphragms to give the brine a zig-zag passage.

Another modification is shown, in which a pan, similarly provided to that first described, is in combination with a steam generator arranged, for the greater part, under the pan, for economy of space and prevention of radiation of heat.—E. S.

*Improvements in Evaporating Pans for the Concentration of Sulphuric Acid and other Liquids.* J. S. McDougall, Didsbury, Manchester. Eng. Pat. 21,778, November 12, 1894.

In evaporating sulphuric acid or other liquids in lead or other soft metal pans, perforated supporting plates, or spaced supports of any kind, are used, so that the fire gases may directly impinge on the pan bottom. The protecting plates for supporting the pan are preferably of cast iron, of a grid pattern, with diamond-shaped holes, with grooves running across both lengthways and by the width of the plates. An evaporating pan is shown, supported as described over flues from a fireplace, provided with siphon flushing arrangement, overflow pipe, outlet for fumes and waste gases, with other accessories.—E. S.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*A Scale of Hardness for Glass (when Heated).* W. Niehls. J. Amer. Chem. Soc. **16**, 406—408.

The term "hardness" applied to glass has reference to the degree of fusibility. Between very soft or fusible glass and very hard or infusible glass, there are many grades. A practised glass-blower brings two sorts of glass together in the form of rods, evenly, in a small pointed flame, heats them uniformly, presses them together, and then draws them slowly apart. The softer glass is drawn out more or less easily from the harder, leaving a quite pronounced edge when the difference in hardness is considerable (Fig. 1); less pronounced when the difference is not so great (Fig. 2). If the two sorts be of equal hardness, both rods draw out evenly, and there is no line of demarcation (Fig. 3).

Fig. 1.

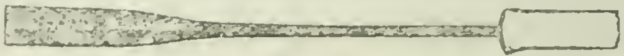


Fig. 2.

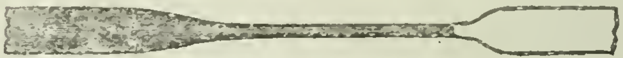
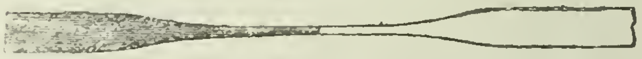


Fig. 3.



Hitherto there has been no systematic classification of glass according to hardness. This want the author has supplied by the arrangement—with the co-operation of the German Physikalisch-Technische Reichsanstalt—of a well-defined scale of hardness for glass, divided into 8 degrees, viz.:—

1. The softest glass in commerce, French crystal.
2. Soft Thuringian glass, used for artificial flowers, toys, &c., English crystal.
3. Hard Thuringian glass, used for thermometers, finer apparatus, &c.
4. Jena normal thermometer glass. (XVI‴ of Schott and Co.)
5. French hard crystal, used in Paris for normal thermometers (by Tonnelot).
6. Jena boro-silicate thermometer glass. (59‴ of Schott and Co.)
7. Jena thermometer glass free from alkalis (122‴ of Schott and Co.). Both 6 and 7 are used for high temperature thermometers and many other purposes.
8. Cavalier's Bohemian crystal glass, used for combustion tubes.

Normal scales, arranged as above, have been prepared and can be obtained through the dealers in chemical apparatus. They contain, on cardboard, illustrations of the results of fusing (as described above) each number in the series with the next following number. Compartments also are well stocked with small rods of each degree on the scale—each rod stamped with its number—to be used for testing.

—L. A.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Note on the Influence of Sea-Water on the Hardening of Hydraulic Mortars.* N. M. Koning and L. Bienfait. Thonind. Zeit. 1894, **18**, 784.

Various mixtures of Portland cement with sand, with and without the addition of hydraulic lime, were made into test-blocks by means of *a*, sea water, *b*, soft water, and submerged for periods ranging from 1—6 months in sea and soft water respectively, mechanical tests being made at intervals. The conclusions are :—

*Mortars made with soft water.*—The addition of lime increases the rate and degree of hardening, especially during the first month ; although an increase in the proportion of sand causes the effect to be less pronounced. As regards the relative rates of hardening in sea- and soft-water, a distinct difference in favour of the latter was observed in all cases.

*Mortars made with sea water.*—The addition of lime has a retarding influence on the rate of hardening in the case of mortars made with sea water.—H. T. P.

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*Paper Tiles.* Thonindustrie Zeit. 1894, **18**, 511.

*See under* XIX., *page* 182.

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### PATENTS.

*Improvements relating to the Manufacture of Artificial Marble.* H. H. Lake, London. Eng. Pat. 1157. January 18, 1894. From B. Gran, Aalborg, Denmark.

One hundred parts of gypsum, 180 parts of quartz, 70 of felspar, and 25 of calcined boric acid are mixed, moulded into blocks, slowly dried, exposed to a red heat and slowly cooled. Various coloured silicates may be added to the extent of about $\frac{1}{5}$th per cent. and may be prepared by fusing together 120 parts of quartz, 30 of borax, and 30 of nitre, together with an appropriate metallic oxide. When a flesh colour is required, a similar silicate is prepared, but without the addition of a metallic oxide, and the uncoloured silicate is crushed and mixed with three times its weight of felspar, 0·4 per cent. of oxide of gold, and 0·2 per cent. of titanium oxide. The product is sintered, recrushed and used to mix with the main composition.—B. B.

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*A Stone Composition for Repairing any Natural Stone and Refacing Cement Floors, Steps, and the like, also for making Imitation Stone and Bricks of any Colour.* J. Elliot. Eng. Pat. 15,755, August 18, 1891.

The composition is composed of natural stones of equal parts, namely, Bath, Portland, Yorkshire, and Kentish rag, also chalk flints, or sea beach ground to powder, and then placed on an iron or steel plate over a furnace to be thoroughly dried. Two parts of the ground mixture are mixed with one or two parts of Portland cement and colouring matter such as oxide of iron, yellow ochre or chrome yellow. The material is used for the purposes mentioned in the title.—B. B.

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## X.—METALLURGY.

*Recent Contributions to our Knowledge of Metallic Reducing Agents.* H. F. Keller. Journ. Franklin Institute, **138** (1891), 306—317.

The author points out that the reducing power of a substance depends in a large measure upon temperature ; and that, under certain conditions, many metals have affinities which are far more powerful than those of carbon. Berzelius was the first to employ the positive alkali-metals for isolating and preparing other elements. His disciple, Wöhler, succeeded in reducing aluminium and beryllium by the aid of potassium, and showed that *all* those metals, the oxides of which cannot be reduced by either carbon or hydrogen, may be obtained by the action of potassium upon their halogen compounds. Reactions in which metals are used as reducing agents also form the basis of several important metallurgical processes ; such as the "precipitation" of lead from its sulphide ores ; the solution of silver by the nascent lead in the blast furnace ; the amalgamation of the same metal in the iron pan ; and Deville's process of extracting "silver out of clay," recently so greatly perfected by Castner and Netto. Until recent years, comparatively little progress was made in applying the reducing properties of metals. This is partly accounted for by the tendency of metals to form alloys and by the difficulty of removing any objectionable impurity ; and partly by the high price of metals which could be used as reducing agents. This latter obstacle has now been partially removed. Aluminium and sodium are obtainable at a fraction of what they used to cost, and magnesium, extracted from carnallite, is now applied to a variety of technical uses. The remarkably high heats of formation of its oxide and chloride, as well as the great stability of these compounds, render the action of magnesium upon other oxides and chlorides particularly interesting. Winkler, of Freiberg, has made a careful and systematic investigation of its reducing action upon oxides, while Seubert and Schmidt have exhaustively studied its action upon chlorides. Of these investigations the author here gives a *résumé*, grouping the metals in accordance with the periodic law.

*Group I.* embraces a main section comprising Li, Na, K, Rb, Cs, and a sub-group consisting of Cu, Ag, Au. It was found that, with the exception of $Cs_2CO_3$, the alkaline carbonates suffer reduction to the metallic state when heated with Mg, in accordance with the equation—

$$Na_2CO_3 + 3\ Mg = 3\ MgO + C + 2\ Na.$$

The intensity of the reaction diminishes as the atomic weight increases. The reduction is best effected in a tube of hard glass through which a current of hydrogen passes. The preparation of potassium makes an excellent lecture-experiment. If illuminating gas could be used in place of hydrogen, the method might be applied on the large scale ; but, unfortunately, coal-gas contains carbon monoxide, which would form the explosive potassium-carbonyl. More promising results were obtained by employing KOH instead of $K_2CO_3$, thus :—

$$KOH + Mg = K + H + MgO.$$

Winkler is of opinion that potassium could be manufactured at one seventh its present cost by such a method. In the case of the sub-group of heavy metals, the reduction was the more energetic the higher the atomic weight.

*Group II.*—The main group consists of Be, Mg, Ca, Sr, Ba ; and Zn, Ca, Hg, constitute the sub-group. Beryllia was easily reduced by Mg. No visible sign of chemical action occurred when lime and magnesium were heated together ; the reduction proved nevertheless to be almost complete. In the case of the oxides of Sr and Ba the reduction was energetic. None of the alkaline earth metals were found to be volatile at the temperature of reduction. The hydroxides were even more readily acted upon than the oxides ; so striking and beautiful were the phenomena observed in the cases of $Ca(OH)_2$ and $Sr(OH)_2$ that Winkler proposes to use them for lecture illustration, and in pyrotechnics. The reduction of the oxides of the sub-group was very energetic.

*Group III.*—The main group embraces B, Al, (Se), Y, La, Yb ; Ga, In, Th, forming the sub-group. Three atoms of magnesium are required to abstract the oxygen from their oxides :—

$$R_2O_3 + 3Mg = 3MgO + 2R.$$

Boric acid and borate of sodium are acted upon energetically ; but instead of free boron, the residue contains magnesium boride, of variable composition. On heating alumina with magnesium, a dark-coloured product is obtained; this contains magnesium spinelle, finely-divided aluminium, and a new oxide AlO.

*Group IV.*—Gave very interesting results. It embraces a main group consisting of C, Si, Ti, Zr, Ce, Th; and a sub-group consisting of Ge, La, and Pb. Winkler shows that magnesium, when *moderately* heated in a current of carbon dioxide, does not take fire, but is slowly converted at its surface into a carbide, CO being formed at the same time. On increasing the heat the metal burns with a dazzling light, producing MgO and C. Mg also separates carbon from carbonates. A spiral of ignited Mg ceases to burn when introduced into a jar of CO; but, when strongly heated in a current of the gas, it emits light and a coating of carbide is formed. An energetic reaction occurs on heating Mg with $SiO_2$; either silicon or silicon-magnesium can be obtained by varying the proportion of Mg. Many silicates are reduced as easily as the dioxide. Titanium dioxide presented great difficulties. It was not reduced to the metallic state; a mixture of monoxide and a titanium spinelle was produced. Zirconia was reduced at a high temperature. From cerium dioxide either Ce or $Ce_2O_3$ was obtained, according to the amount of Mg employed. In the nascent state cerium was found to absorb hydrogen in large quantities; this formation of a metallic hydride at a bright red heat is a most remarkable observation.

Summed up briefly, the results obtained by Seubert and Schmidt as to the action of Mg upon chlorides are as follows:—Both the anhydrous chlorides and their aqueous solutions were tested. In the former case the substance, mixed with magnesium powder or conducted as vapour over it, was heated to a high temperature. It was found that all the chlorides could thus be reduced to the metallic state; but the reduction was incomplete in the groups of the metals of the alkalis and alkaline earths. In neutral aqueous solutions all the metallic chlorides, save those of the alkalis and alkaline earths, gave up their chlorine to magnesium. In some cases the metals were deposited in the metallic state (Ag, Au, Tl, Pb, As, Sb); but in most cases hydroxides were precipitated.—D. E. J.

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*Notes on Aluminium.* G. F. Andrews. J. Amer. Chem. Soc. **16**, 485—486.

From a large number of experiments made by the author, the following results have been obtained:—

*Alloys containing Gold.*—Alloys of aluminium and gold, although interesting, are of little practical use except for decorative purposes. With 6 per cent. of gold, the alloy is as white as pure aluminium, but more brittle; and with 10 per cent. the product has a light violet-brown colour, is harder than aluminium, and only works well at high temperatures. A 15 per cent. gold alloy is almost white, with a violet shade, very soft, and a fine-grained metal. An alloy of 50 per cent. gold is soft and spongy, and possesses a beautiful violet colour; whilst with 78 per cent. of gold, it is very brittle, and of a pinkish-violet colour. With 90 per cent. of gold, the colour is a pale violet, and with 94 per cent. it approaches a pink. Alloys containing small percentages of aluminium leave a bright violet colour on the cupel under the blowpipe. An alloy of 50 per cent. of gold, 45 per cent. copper and 5 per cent. aluminium takes the colour and polish of 14 carat gold, but easily tarnishes.

*Alloys containing Silver.*—Alloys of aluminium with 4 to 8 per cent. of silver are harder than pure aluminium, and not brittle, and take a fine polish. Their colour is similar to that of fine silver; they are used for medals, charms, &c.

*Alloys containing Nickel.*—An alloy of 50 per cent. nickel and 50 per cent. aluminium is of a dull grey colour, very porous, and too brittle to use. The following alloys of copper, nickel, and aluminium are very strong, hard and fine-grained:—With 66 per cent. of copper, 24 per cent. of nickel, and 10 per cent. of aluminium an alloy is formed which takes a fine polish, and has the colour of 10 carat gold. With 55 per cent. of copper, 33 per cent. of nickel, and 12 per cent. of aluminium the colour is a beautiful golden brown; and with $72\frac{1}{2}$ per cent. of copper, $21\frac{1}{4}$ per cent. of nickel, and $6\frac{1}{4}$ per cent. of aluminium, the colour becomes richer and deeper.

*Melting of Aluminium.*—The temperature should be kept even, and not much above the melting-point of the metal, which should be fed into the crucible in small pieces. The most useful flux is a little tallow. A crucible mainly of siliceous material, must not be used, as the aluminium attacks the silicon. In alloying, the aluminium is put into the crucible after the other metals have become liquid.

*Restoration of the Mat.*—Aluminium can be cleaned and its mat restored by dipping for $1\frac{1}{4}$ minutes in a solution of 3 ounces of caustic potash or soda in a quart of water, then washing well, and dipping in a solution of three parts nitric and three parts sulphuric acid (by volume).—S. P. E.

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*The Action of Aqueous Potassium Cyanide on Gold and Silver in Presence of Oxygen.* J. S. Maclaurin. Proc. Chem. Soc. 1895 [146], 7—8.

This is a continuation of a paper (this Journal, 1893, 359) in which the interaction of gold and potassium cyanide—the basis of the now extensively applied MacArthur-Forrest or Cassel process—was investigated.

Further results are quoted proving the necessity of oxygen. The rate of solution of gold in potassium cyanide solutions is re-investigated, and that of silver is also determined. The rate of solution increases as the concentration of the solution decreases, reaching a maximum when solutions containing 0·25 per cent. are used, and then decreasing. It is also shown that the ratio of the gold dissolved by any given cyanide solution to that of the silver dissolved by the same solution is approximately the ratio of their atomic weights. The remarkable variations in the solubility of gold and silver may be explained by the fact that the solubility of oxygen in cyanide solutions decreases as the concentration increases, and that the solvent power of the strong solutions is thus rendered less than that of the weaker solutions which are capable of taking up more oxygen. The relations of the gold, silver, and oxygen dissolved are shown in a table under headings $\frac{Au}{O}$ and $\frac{Ag}{O}$, and it is pointed out that if the amount of gold or silver dissolved depends solely on the quantity of oxygen in solution, the values $\frac{Au}{O}$ and $\frac{Ag}{O}$ should be constant; actually these values gradually decrease as the concentration of the solution increases. Therefore, in the more concentrated solutions, there is less metal dissolved than the amount of oxygen in solution apparently demands. This points to some retarding action on the motion of the oxygen molecules. As it seemed probable that viscosity would have such a retarding action, the rates of solution of gold and silver were determined in cyanide solutions rendered more viscous by the addition of various substances such as sugar and glycerin which might be assumed to exert no chemical influence on the solubility of these metals. The results show that the assumption is correct. Moreover, the viscosity co-efficients of cyanide solutions of varying strengths were determined, and the values $\frac{Au}{O}$ and $\frac{Ag}{O}$ were calculated by the aid of a formula previously given; these agree very closely with those found, showing that the rates of solution of gold and silver are proportional to the amount of oxygen in solution and to the co-efficient of viscosity.

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*Oxidising Action of Ammonia Solution on some Metals.* W. R. Hodgkinson and Lieut. N. E. Bellairs. Proc. Chem. Soc. 1895 [146], 9.

That an oxidation takes place when copper, moistened with ammonia solution is placed in contact with air seems to be generally known (Schönbein, Ber. Ak. B., 1856, 580; J. B., **56**, 311; Ann. Chim. Phys. [4], **1**, 381; Peligot, Comptes rend. **47**, 1034).

Undoubtedly both copper and ammonia become oxidised in this case. As other metals dissolve to some extent in ammonia solution, the authors have determined whether any similar oxidation took place under ordinary conditions of temperature.

As might be expected, those metals which form soluble double salts with ammonium salts are most acted on by ammonia solution.

Zinc, nickel, and cobalt are, after copper, most rapidly attacked, a considerable amount of metal in each case being dissolved. Lead dissolves more slowly, and iron, magnesium, and aluminium do not appear to dissolve at all.

In the case of copper, the formation of nitrite may be detected after 10 minutes' contact of the metal and ammonia in presence of air. To make a comparative test, the metals mentioned were exposed in small pieces to ammonia solution and air in similar flasks covered only with watch glasses during 48 hours. They were then examined for nitrite or nitrate by (1) potassium iodide, (2) ferrous sulphate, and (3) naphthylamine sulphanilic acid.

Zinc, nickel, lead, magnesium, aluminium, iron, and palladium in foil failed to form any nitrite.

The nickel was obtained from nickel carbonyl. After more than a week's exposure to the ammonia, although it formed a deep blue solution, no trace of nitrite was found. Cobalt, however, even after 12 hours, afforded a very appreciable amount of nitrite, the amount appearing to increase regularly with the time of exposure.

## PATENTS.

*Improvements in or Applicable to Apparatus for Use in the Lixiviation of Crushed Ores and other Materials of a similar Character.* C. Raleigh, Johannesburg, S.A.R. Eng. Pat. 21,081, November 6, 1893.

The improvements relate to the discharge of material from vats, &c., subsequent to leaching. A movable false bottom is placed either above or below the filter-bed (being of a very porous character in the former case), and is supported on a plunger or suspended from chains in such a way that it can be either raised above or lowered below the vat, and then tilted to let the material slip off. The bottom may also be made in sections arranged to tilt and discharge in different directions, whilst in a circular vat, the movable bottom may be rotated while it is being raised, and the material be swept off in a regular stream by means of a fixed blade or scraper. By another arrangement, the bottom may be stationary whilst one or all the sides of the vat may be movable.—D. A. L.

*Improvements in Separating Solid from Liquid Matter, more especially relating to the Treatment of Slimes, Finely-divided Ore, Precipitates, and Sewage.* C. Raleigh, Johannesburg, S.A.R. Eng. Pat. 21,082, November 6, 1893.

*See under I., page* 135.

*An Improved Method of Hardening or Converting into Steel the Surfaces of Iron Plates and other Objects made from Iron.* E. T. Zohrab, London. Eng. Pat. 23,492, December 6, 1893.

The iron is hardened by pressing peat charcoal against its surface whilst it is maintained at a suitable temperature—commonly from 1,200° to 1,500° F.—J. H. C.

*A New or Improved Process and Means for Treating Quartz containing Gold, Silver, and other Metals.* R. Pearson, London. Eng. Pat. 23,930, December 12, 1893.

With the object of facilitating the pulverising of ores and diminishing the production of float-gold, the ore is to be crushed to pieces of about 2 to 2½ inches in diameter, heated at a red heat or any temperature sufficient to agglomerate the gold and fracture the rock and then to be quenched in water, previous to comminution in rolls or other pulverising machinery. The heating, which can be made sufficiently strong and oxidising to roast pyritous or arsenical ores if desired, may be performed in an inclined revolving furnace, in which the ore charged in at the top descends by gravity and is discharged at the lower end into a vessel of water; or the ore may be carried in buckets suspended from travelling trollies and lowered first into a furnace and subsequently into a tank of water, or the heating and quenching may be effected by other means.
—D. A. L.

*Improvements in the Manufacture of Alloys.* D. W. Sugg, Westminster. Eng. Pat. 24,704, December 22, 1893.

An alloy of golden hue, malleable hot or cold, and exhibiting considerable resistance to the action of the atmosphere and weak acids, is prepared by mixing well 2¼ lb. of aluminium with 40 lb. of zinc, or *vice versâ*, and adding the ingot cast from this alloy to 50 lb. of melted copper, using in both instances nitrate of soda cake as a flux. The molten mass is stirred with an iron rod and then submitted to an increased temperature and boiled for about 20 minutes to volatilise a portion of the zinc and so render the alloy malleable. In some cases about 1 per cent. of tin is added to the molten mixture previous to the boiling; this increases the malleability at a red heat, the surface hardness and the power of resisting acids, &c., gives the alloy a finer grain, and modifies its colour.—D. A. L.

*Improvements in the Treatment of Gold Ores.* H. L. Sulman, London. Eng. Pat. 24,939, December 28, 1893.

The milling water is previously softened (when necessary) with lime, soda ash, aluminate of soda, or other suitable softener. Soap or saponaceous matter, or occasionally alum, magnesia, or other metallic salt is then added so as to reduce the surface tension of the water and lessen the amount of "float gold" held in suspension. The waste waters are run into tanks and precipitated with lime-water or a salt of lime, by which means a curd or coagulum is formed which contains the remainder of the float gold.
—J. H. C.

*Improvements in Apparatus for Pulverising and Amalgamating.* J. Robinson and M. S. Plumb, Sydney, New South Wales. Eng. Pat. 436, January 8, 1894.

The object of this machine is to recover precious metals from quartz and such like rocks. The rock is crushed by a heavy cylinder rolling on a curved bed to which a rocking motion is imparted, which causes the heavy cylinder to travel backwards and forwards over the material to be crushed. The contained precious metals are caught in mercury wells, or riffles.

Figs. 1 and 2 show longitudinal and cross sections of the machine respectively.

In Fig. 1, A is the rocking chamber, of which the roller bed B forms part, and D the crushing roller. B is curved to a half ellipse, and is rocked through the connecting rods $J^1$, $E^1$, and $F^1$ by the driving gear to the right hand.

The rock, previously broken to a suitable size, is placed in the hopper Q, and fed on to opposite ends of the bed alternately through the passages $P^1$ $P^1$ by the shutter R, which is actuated by the rocking of the chamber in conjunction with the link gear shown. The chamber A rests on the rocking plates W and Y, which are formed with ridges and grooves, as illustrated. It is also provided with buffers, B $B^1$, to take up the momentum of the roller D. The rocking chamber may contain any required number of rollers and crushing beds, the central one effecting the first reduction in size of the material undergoing treatment.

In Fig. 2, three such rollers are shown, the outer ones eing separated from the central one by screens H H. The precious metals are caught by mercury placed in the riffles marked I and O.—R. B. P.

Fig 1.

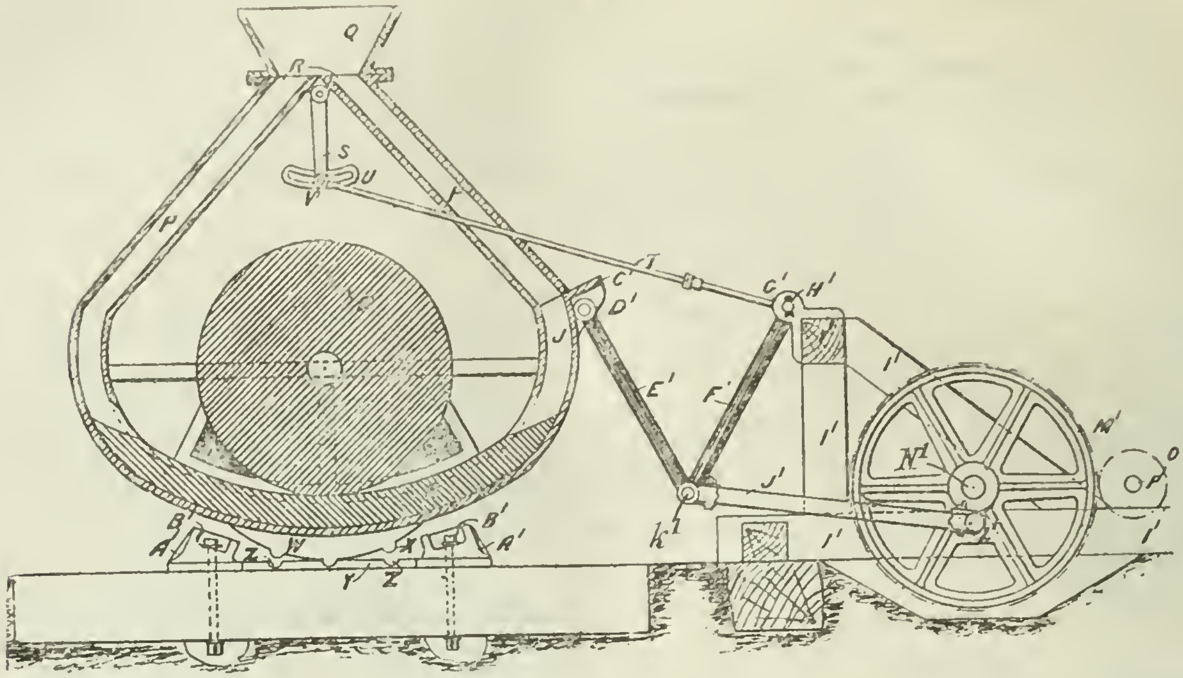
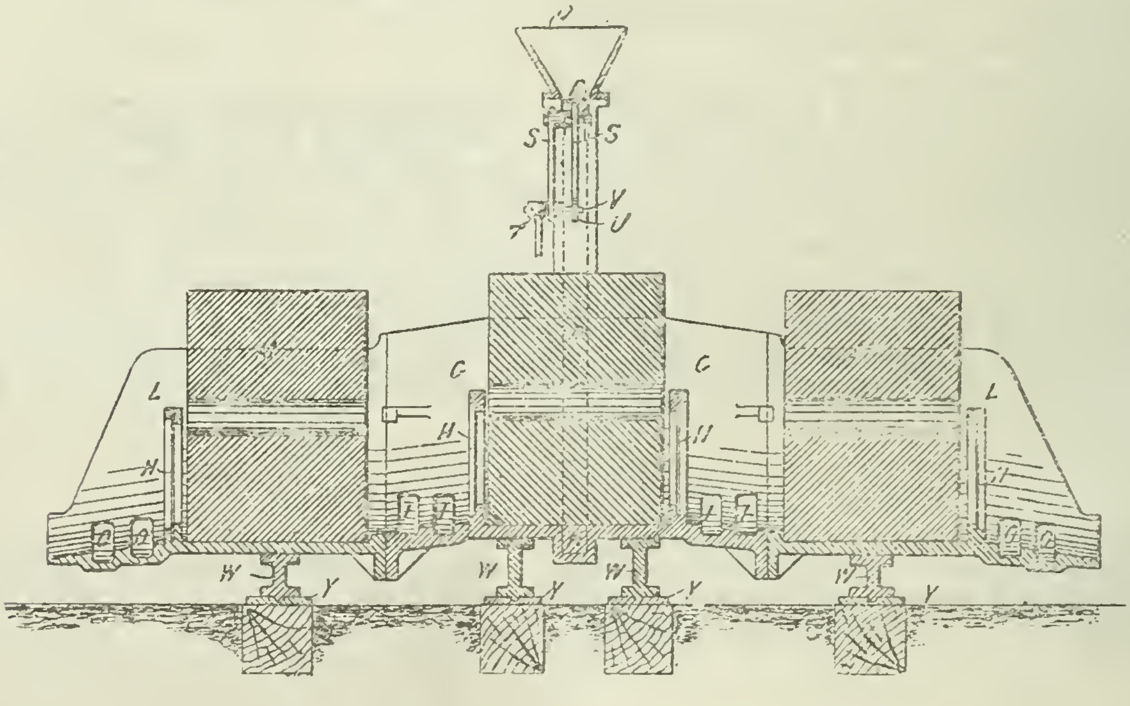


Fig. 2.



*Improvements in Roasting Furnaces.* H. F. Brown, Chicago. Eng. Pat. 9097, May 8, 1894.

Generally the improved furnace consists of an ore-roasting chamber in the form of an arc of a circle, with an open space completing the circle. Reinforcing furnaces are provided at intervals, which communicate by way of the roasting chamber with a chimney. Travelling stirrers mounted on arms working through a longitudinal slot in the wall of the roasting chamber, and moved by means of an endless cable running on guide-wheels, are provided. The stirrers are successively brought to rest in the open chamber, so as to afford opportunities for cooling. In general, the stirrers are moved in a direction contrary to that of the products of combustion, but the direction may be the same if required. The ore is fed upon the hearth of the roasting chamber at one end of the arc, and is gradually advanced by the intermittent motion of the stirrers to the other end, where it is discharged through an opening. In order to guard against injury to the furnace by expansion and contraction, it is preferred that it should be constructed in sections which, when the furnace is cool, do not quite meet.—J. H. C.

*An Improved Metallic Alloy.* D. W. Sugg, Westminster. Eng. Pat. 20,247, October 23, 1894.

An alloy suitable for table articles, cooking utensils, and various purposes, is prepared from 50 parts of copper, 40 parts of zinc, with the addition of 2½ per cent. of aluminium and 1 per cent. of nickel. The zinc is melted, the aluminium added gradually, the alloy cast into an ingot, which is added to the molten nickel and again cast into an ingot, which in its turn is added to the molten copper. But the inventor neither confines himself to the mode of procedure nor the proportions given.—D. A. L.

*A Method for the Extraction of Gold.* P. de Wilde, Brussels, Belgium. Eng. Pat. 20,872, October 31, 1894.

In this method, the solution of cyanide for the extraction of gold is rendered more active by stirring well with minium or massicot, and then decanting from the precipitate of lead oxide. To recover excess of cyanide from such solutions after the gold has been dissolved, they are treated with ferrous chloride or sulphate until the solution, on testing with ferrocyanide, gives the blue reaction. The green precipitate of alkaline and ferrous cyanides is separated by filter-press or vacuum-filter, suspended in water, and converted into Prussian blue by means of sulphuric acid, or into ferrocyanide by means of caustic soda or potash. To precipitate the gold, the solution from the filter-press or vacuum-filter is first treated with sulphurous anhydride, or sulphurous acid, or alkaline metasulphites, or any acid sulphite, and then with copper sulphate until the solution, on testing with ferrocyanide, gives the brown reaction. Or the precipitation may be effected by the use of a solution of cuprous chloride in weak hydrochloric acid, in which case the use of sulphurous acid or its salts may be dispensed with. The precipitate in either case consists of aurous and cuprous cyanides, and may be treated in various ways, thus:—By warming with sulphuric acid at 60° B. it is decomposed, and gold alone remains behind. By treating with dilute hydrochloric or nitric acid the cuprous cyanide dissolves, the aurous cyanide remains, and, after washing and drying, yields pure gold on calcination. By calcining the washed and dried precipitate in a reverberatory furnace, a mixture of gold and cupric oxide is obtained, or if the operation is conducted in a closed crucible, a mixture or alloy of gold and copper is obtained; in both cases treatment with hot sulphuric acid or dilute nitric acid will remove the copper and leave the gold as residue.—D. A. L.

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*An Improved Metallic Alloy for Use in the Manufacture of Pocket Cutlery.* A. J. Hobson, Sheffield. Eng. Pat. 22,514, November 21, 1894.

Aluminium is alloyed with from 6 to 10 per cent. of copper.—J. H. C.

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# XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*The Chloride Electrical Storage Battery.* Journ. Franklin Inst. **138** (1894), 241—247.

This is a report of the Franklin Institute, acting through its Committee on Science and the Arts, upon the chloride electric storage battery.

One of the main objects aimed at in all lead storage batteries is to obtain a large lead surface for small mass, for the capacity and discharge rates are proportional to the surface. The earlier method of doing this was to convert the lead plate into spongy lead by electrolytic action, a method both slow and expensive. The later, and more general method has been to punch holes, or cast the plate with rectangular depressions, and then to fill up these hollows with litharge in negative plates, and with red oxide of lead in positive. The contact between the lead grid and the paste is mechanical only. After continued use, or during heavy discharges, such plates disintegrate; small fragments of lead and oxide fall between the plate, causing short circuits, buckling, and sulphating.

In the chloride battery the active material is not pasted into or against the plates, but is obtained by a strictly chemical process. Lead chloride is mixed with a proportion of zinc chloride, fused and cast in small squares (about ¾ in. square and $\frac{5}{16}$ in. thick). The product is white, vitreous, and brittle. The lozenges used for the positives have a bevelled V shaped periphery. They are placed in a suitable mould, and a molten mixture of lead and antimony is cast about them by a special process under high pressure, thus fixing them securely in a firm lead framing of somewhat more than usual density. The frames containing the lozenges are placed in a suitable bath, and by a simple electro-chemical process the chlorine of the lead chloride is removed (and also the zinc chloride), leaving lozenges of spongy lead within the dense framing. The plates are then "formed" in the usual manner. The spongy lead thus obtained is crystalline, the crystals being uniformly arranged with their axes perpendicular to the surface of the plate. The connection of the lozenges with the framing is exceedingly good and sound, and their porosity and crystalline structure present the maximum obtainable surface for a given mass. Thus the battery has a very large capacity for a given weight. Very heavy discharges can also be taken from it without mechanical violence to the structure of the plate. To guard against the effects of any possible disintegration, a thin sheet of acid-proof woven asbestos cloth is introduced between each pair of plates. In spite of this, the internal resistance is not appreciably higher than that of other lead cells. Fig. 1 shows clearly the appearance and shape of the plates. Fig. 2 shows two cells with a portion of the tank broken away to exhibit the disposition of the parts. In the original paper curves are given showing the capacity and efficiency. The "ampère efficiency" is given as 96·7 per cent., and the "watt efficiency" as 81·9 per cent. The battery has been used continuously on public lighting circuits with very satisfactory results. The cells here reported on have been investigated for several months, during which a number of them have been placed upon a regular working circuit.

Fig. 1.

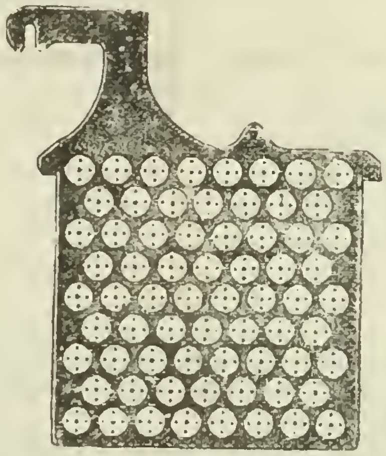
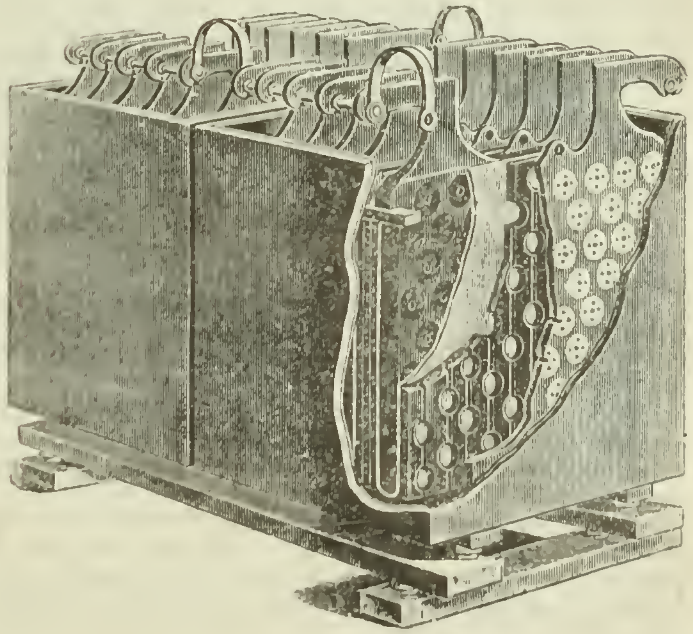


Fig. 2.



The committee report that the battery embodies features of construction which prove it to be a distinct improvement over hitherto known forms of storage batteries; and the Institute recommends the award of the John Scott legacy premium and medal to Clement Payen, the inventor.

—D. E. J.

### *Improvements in Storage Batteries.* M. Barnett. Eng. and Mining J. 1894, 582—584.

Accumulators are largely used in France, and in Paris alone, some 120,000 lamps are run from storage cells. Hence it is not surprising that the recipient of the medal recently awarded by the Franklin Institute of Philadelphia for improvements in storage cells should be a Frenchman. A description of M. Clement Payen's chloride electrical storage cell is given in this Journal, 1890, 742, but more especially the preceding abstract. It is interesting to compare the capacity of this cell with that of other well-known types. H. A. Earle has compiled a table giving the comparative capacities per pound of positive and negative plates. The Crompton-Howell is the English type and the Tudor the German type.

| — | Capacity in Ampère-Hours at varying Rates of Discharge. | | | |
|---|---|---|---|---|
| | Small. | Normal. | Strong. | Maximum. |
| Chloride (Payen-cell) . | 8·1 | 6·7 | 5·8 | 4·0 |
| Crompton-Howell..... | .. | 2·8 | 2·34 | 1·17 |
| Tudor ................ | 2·2 | 1·9 | 1·7 | 1·48 |

—D. E. J.

### *The Practical Applications of Ozone, prepared by Electrolytical Means.* O. Fröhlich. Ber. d. Deutsch. Elektrochem. Ges. 1894, 30—39.

The methods here described have been for the most part investigated by the firm of Siemens and Halske with apparatus of their own construction. The well-known Siemens' ozone-tube has been retained as the basis of most forms of apparatus, but has been modified to suit practical requirements. The form which requires the smallest supply of electrical energy is the mica ozone-tube. This consists of an inner metal tube covered with mica, and an outer mica tube entirely covered with a metallic layer. Between these two tubes passes the air which is to be ozonised. This apparatus can be easily taken to pieces and put together again. Another form which is well adapted for use on a small scale is the glass ozone-tube in which the metallic coatings of the ordinary Siemens' tube are replaced by water.

Ozone is produced by the silent discharge of a high-potential alternating current between the inner and outer tubes. In place of the old induction-coil, a transformer is used to raise the potential of a current from an alternating dynamo. It is found advisable to use alternators of special design. In most technical applications of electricity the effect produced depends upon the amount of electrical energy supplied; in the production of ozone the efficiency is largely dependent upon the form (*e.g.*, the frequency and the nature of the current-curve). As the efficiency is improved it is observed that the di-electric (mica or glass) becomes heated under the action of the discharge and the mica ozone-tube requires continuous cooling by circulating water.

For chemical reaction ozone may be used either by itself or in combination with chlorine, turpentine, or ammonia. In the former case the ozone may be allowed to act in the gaseous state upon the substance to be ozonised; or a solution or emulsion of the substance may be made with water, and the ozone blown through this. In general, the action is much more prolonged when ozone is used in combination with another agent, such as chlorine. Among the practical applications described by the author are the following:—

*Sterilisation.*—Ozone destroys bacilli, such as those of cholera, typhus, anthrax, &c. When the liquid to be sterilised contains other oxidisable matter, the ozone is first absorbed in oxidising this, after which the destruction of the bacilli follows almost instantaneously. When a water-supply is fairly pure, but becomes contaminated on occasion with bacilli, ozone may be used with advantage. Ozone does not act powerfully upon bacilli in air.

*Wood.*—A pianoforte manufacturer (Consul René) in Stettin has used ozone since 1881 for the artificial ageing of wood, especially resonance wood. For the latter purpose it is usual to select wood which is old, and has been exposed as much as possible to the air. Herr René is satisfied that the process is greatly accelerated by the use of ozonised air. The wood is placed in a closed, warm room, into which ozonised air is introduced, and is left there for 12—24 hours. This treatment seasons the wood and also improves its resonant qualities.

*Bleaching of Linen, &c.*—Grass-bleaching of linen can be replaced by indoor-bleaching with ozone. It is not advisable to use ozone alone; it acts best in combination with bleaching powder, or after the material has been treated with weak acid, turpentine, or ammonia.

*Starch Derivatives.*—The most important of the technical applications of ozone is in the preparation of pure starch-derivatives from common starch (potato-starch). Among such derivatives are refined starch, soluble starch, dextrin, and crystal gum. These are already prepared from starch in other ways; but much superior products can be obtained by the ozone method. Soluble starch is prepared from ordinary starch, slightly acidified, by exposing it for a considerable time to a suitable temperature and then washing away all acid from the transformed product. Dextrin is prepared from ordinary or soluble starch by roasting it at 100°—200° C. Crystal-gum is prepared from dextrin by dissolving it in water and evaporating to dryness. The ozone method consists in purifying the material in each of the above operations,—but especially the crude starch itself,—by means of ozone, the effect of which is to remove the impurities which impart to the substance a dark colour and disagreeable smell and taste.—D. E. J.

### *On the Conversion of the Chemical Energy of Carbon into Electrical Energy.* W. Borchers. Ber. d. Deutsch. Elektrochem. Ges. 1894, 24—30; Chem. Industrie, **17**, 502—505.

Those who have had to deal with the analysis of furnace gases know that solutions of cuprous chloride absorb carbon monoxide almost as well as they absorb oxygen. A compound having the composition $Cu_2.CO.Cl_2$ is formed, and this, in presence of water, tends to decompose as follows:—

$$Cu_2COCl_2 + H_2O = Cu_2 + 2HCl + CO_2$$

On the other hand, oxygen tends to oxidise cuprous chloride thus—

$$Cu_2Cl_2 + 2HCl + O = 2CuCl_2 + H_2O.$$

These facts suggest a method of constructing a gas battery, using air in place of oxygen, producer-gas for carbon monoxide, and solution of cuprous chloride as the electrolyte. The net electro-chemical effect of the above simultaneous reactions would be to reproduce cuprous chloride—

$$CuCl_2 + Cu = Cu_2Cl_2,$$

so that the electrolyte would practically remain unaltered. The author states that, although the idea is one that naturally suggests itself, he has sought in vain for any reference to it in scientific literature; and in the present paper he describes a series of preliminary experiments towards its practical realisation. He first made double cells (*i.e.*, cells divided into two compartments, not double-fluid cells) with such glass vessels and porous cells as were at hand. The poles were of carbon and the electrolyte was cuprous chloride in ammoniacal or acid solution. When air was led into one compartment and carbon monoxide into the other, a weak current was produced when the poles were connected. This became stronger when the cells were partly filled with fragments of coke, so as to increase the surface of contact between the gas and liquid. Now carbon monoxide precipitates copper from solutions of cuprous salts; hence it appeared possible to make one of the poles (that at which the carbon monoxide goes into solution) of copper. If the absorption of the two gases were so regulated that the oxygen absorbed would only suffice for the oxidation of the carbon monoxide, no copper could go into solution; it would thus be possible to make the containing vessel of copper, which would improve the conductivity. To test this the author divided a glass cell into three compartments. In the two outer compartments were suspended copper tubes through which the carbon monoxide could be conducted; in the inner compartment hung a bell-shaped piece of carbon into which air was led. The electrolyte was a solution of cuprous chloride. In place of carbon monoxide it was now found more convenient to use coal-gas, which contains at least 5 per cent. of the former gas. In no case did the copper tubes show any loss of weight. Acid solutions of cuprous chloride gave a better effect than alkaline solutions. The current varied from 0·5 ampère (with an internal resistance of 0·1 ohm and an E.M.F. of 0·05 volt) to 0·008 ampère (with an internal resistance of 50 ohms and an E.M.F. of 0·4 volt). These results were obtained with carbon monoxide gas admixed with much carbonic acid. Using a mixture similar to producer-gas and filling the outer vessel with scrap copper (so as to expedite the absorption of carbon monoxide) the results were somewhat improved, the maximum current on closed circuit being 0·64 ampère and the maximum E.M.F. (with increased external resistance) equal to 0·56 volt.

The author observes that if we neglect all secondary reactions and assume that we have to deal only with the reaction $CO + O = CO_2$, a theoretical E.M.F. of 1·47 volts should be possible. These preliminary experiments show that it is already possible to convert 27 per cent. of the energy of the combustible material into electrical energy; a result which, if we compare it with the 10 per cent. efficiency of the best steam-engines, is decidedly encouraging.

After repeated trials Dr. Borchers has come to the conclusion that the most suitable form of gas cell is that shown in Figs. 1 and 2. The outer vessel A is of copper and the inner vessel of stoneware or porous material. The stoneware vessel consists of three parts: the containing vessel proper, which is a long narrow trough; an inner vessel open at top and bottom; and a cover provided with two tubulures. The walls of both stoneware vessels are pierced with holes, and if necessary the space between them may be filled with porous material. Through the interior of the vessel air passes; and the vessel is filled with coke or retort-carbon so as to increase the surface of contact between the air and the liquid. At the bottom lies a carbon plate K, which serves as the cathode, and to this is connected a carbon rod *k*, which passes through the cover. The copper vessel A is both the anode and the vessel for containing the liquid; it is partly filled with scrap copper. This latter can be economised by laying it on perforated sheet or gauze placed just beneath the surface of the liquid. The electrolyte is introduced through a channel in the cover of the cell in such a way as to trickle over the scrap copper at the same time that it is brought into contact with the carbon monoxide, or generator-gas.

Fig. 1.

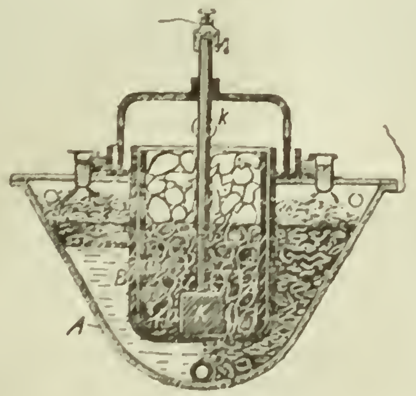
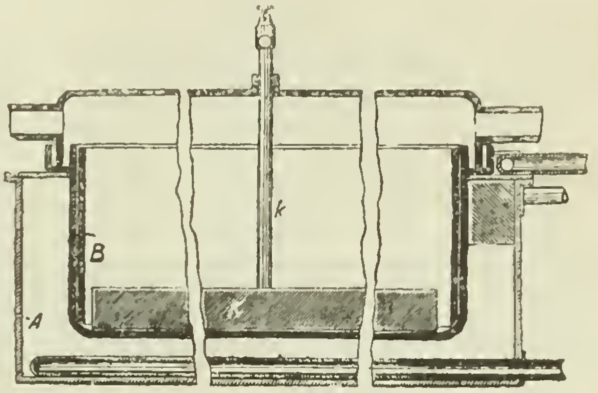


Fig. 2.



Both gas and liquid may be made to flow from one cell into another and so through a battery of any size. In the choice of an electrolyte which will act as an oxygen carrier we are not confined to salts of copper; compounds of iron, manganese, cobalt, or lead and strong sulphuric acid might be utilised. Dr. Borchers has also experimented on the direct oxidation of solid coal in a cell without the intermediate process of converting the carbon into carbon monoxide. Such a cell might be expected to give a higher electromotive force (about 2 volts) than the gas cell, but hitherto the results have not been so encouraging. The highest E.M.F. attained (with an external resistance of 50 ohms) was 0·3 volt, and the maximum current (with an external resistance of 0·1 ohm) was 0·4 ampère. This is about 15 per cent. of the energy theoretically obtainable. Even when the liquid is vigorously and continuously stirred the current soon falls off, which is not the case when gas is used. Furthermore, the gradual accumulation of impurities in the liquid interferes with the action of the cell, so that for the present the direct electrolytic combustion of coal does not offer such a promising outlook as the combustion of its gaseous products. If success in this direction is to be attained, it must be by keeping the powdered coal in rapid and continuous motion without allowing it to subside. For this purpose the flow of the liquid in the cell must be from below upwards, instead of from above downwards. This could be done by altering the arrangement of the copper anode-vessel, allowing the liquid to enter by a slit or channel in the bottom, and to escape by an overflow-pipe.

During the past year Prof. Ostwald has drawn attention to the possibility of constructing a carbon element in which the oxygen of the air might be used directly as the oxidising agent, and has pointed out the great importance of the practical results which might ensue from this. The above experiments are of great interest as showing that electrical energy can be certainly and continuously obtained by the "cold combustion" of familiar gaseous products obtained from coal.—D. E. J.

*A Source of Current for Electro-Chemical Analysis.* C. Heim. Ber. d. Deutsch. Elektrochem. Ges. 1894, 50—53.

It is now admitted that a secondary battery is by far the most suitable source of current for electro-chemical analysis, and when a dynamo is at hand it is also the most convenient. Even where the laboratory has no dynamo, there is often an electric lighting station in the town at which the accumulators can be charged. But where this fails, the chemist has to fall back upon Bunsen cells. Daniell's cells are much simpler and cleaner to manage and they give a steadier current, but the internal resistance of a Daniell's cell of ordinary size is so great that only a small current is obtained even when several such cells are used. A Daniell's cell of the type used in the (German) Imperial Post gives only a maximum current of 0·2 ampère when short-circuited. But this small current, if used continuously, would suffice for charging accumulators such as are used for electro-chemical analysis in small laboratories. For electro-deposition an E.M.F. such as is given by two secondary cells in series, is generally sufficient. For analyses carried out according to Classen's method, and with the size of electrode recommended by him, a current of not more than 0·5 ampère is required. Assuming that not more than three analyses are to be carried on simultaneously, a battery giving a discharge current of from 1 to 2 ampères will suffice. The secondary cells used in the German Imperial Post have a capacity of 15 ampère-hours, and give a discharge current of 1 to 2 ampères; they can be bought at about 9*s.* each. The author recommends that two such cells be kept charged day and night (excepting when in use) by a dozen Daniell's cells, which would give a charging current of 0·1—0·2 ampères. Daniell's cells of the postal type can be purchased at 12*s.* to 15*s.* a dozen. Assuming that about 1,000 ampère-hours are required in the course of the year for electro-deposition, the author calculates that the cost of materials for the primary cells would be 75*s.* for copper sulphate and 10*s.* for zinc, or 85*s.* per annum.—D. E. J.

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### *The Limits of Electrolysis.* M. Le Blanc. Ber. d. Deutsch. Elektrochem. Ges. 1894, 41—50.

A lengthy paper in which objections are raised against the usual method of deducing the electromotive force of a cell (or the E.M.F. required for electrolysis) from known thermo-chemical data. This method is due to Thomson, and assumes that the chemical energy which disappears in a cell re-appears entirely in the form of electrical energy. Knowing the heats of formation and solution of the various substances which take part in an electro-chemical reaction, *e.g.*, in a cell, we can calculate the resulting E.M.F. Conversely, it is assumed that in any electrolytic process the electrical energy which disappears in the electrolytic cell reappears entirely in the form of energy of chemical separation. Thus let E denote the minimum E.M.F. required for the electrolysis. Suppose a current C to flow for a time $t$. The work done by the electric current is $Ct \times E$. Expressed in heat units this is $JCtE$, when J is Joule's equivalent. If H denotes the thermal value of the electro-chemical reactions produced, then $H = JCtE$, from which E can be calculated when the necessary heats of formation, decomposition, &c., are known. Now the cases to which Thomson's rule was first applied gave quite satisfactory results. The theoretical calculation gave 1·08 volt as the E.M.F. of a Daniell's cell, and 1·7 volt as the minimum E.M.F. required for the electrolysis of water under ordinary conditions, and experiment confirmed these results. But cases were gradually discovered in which the agreement between theory and experiment was not so satisfactory, in which the observed E.M.F. was sometimes less and sometimes greater than that deduced by calculation. The rule, in fact, only holds good for cells of which the E.M.F. is independent of temperature. The Daniell's cell happens to be one of these, but there are comparatively few of them. The equation given above can be modified so as to take into account the change of temperature. Let $\frac{dE}{dT}$ be the temperature coefficient of the cell, *i.e.*, the rate at which the E.M.F. varies with temperature. Then, as Helmholtz has shown, the above equation becomes $H = JCtE - JCtT\frac{dE}{dT}$. This equation, again, assumes that the pressure remains constant, *e.g.*, it is known that a smaller E.M.F. than 1·7 volt will suffice for the electrolysis of water below the atmospheric pressure. But as most electrolytic work is carried out under atmospheric pressure, the small variations of E.M.F. due to changes of pressure are not of any practical importance.

The remainder of the paper is devoted to a discussion in terms of the dissociation theory, of special cases of electrolysis (especially with electromotive forces near the minimum).
—D. E. J.

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### *Electrolytic Separations.* E. F. Smith and H. E. Spencer. J. Amer. Chem. Soc. **16**, 420.

*See under* XXIII., *page* 190.

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### *A Substitute for Platinum in Incandescent Glow-Lamps.* W. Bolton. Ber. d. deutsch. Elektrochem. Ges. 1894, 58.

*See under* II., *page* 136.

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## PATENTS.

### *Improvements in Electric Batteries.* C. J. Wollaston, London. Eng. Pat. 669, January 11, 1894.

The improvements herein described are applicable to portable cells of the chloride of silver type, and especially to that described in Eng. Pat. 13,344, August 25, 1890 (this Journal, 1890, 1136). The outer case is preferably composed of sheet zinc pressed into a corrugated form, and the element of the battery is chloride of silver fused on to a silver wire, which forms one terminal. This chloride of silver is covered with some fibrous material, such as muslin, and is suitably insulated from the zinc. The interspace is filled with the excitant consisting of wood-flour or its equivalent, saturated with a solution of Irish moss in chloride of ammonium, or the like.—G. H. R.

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### *Improvements in the Construction of Electrolytic Apparatus and in the Application thereof in Oxidising, Chlorinating, and Analogous Processes.* J. Hargreaves and T. Bird, Liverpool. Eng. Pat. 835, January 13, 1894.

This invention embraces the employment of electrical apparatus described in Eng. Pat. 18,871, October 21, 1892 (this Journal, 1894, 256), but modified in various ways to the particular use to which it is to be applied. The walls of the cells are formed wholly or in part of permeable material, as previously described, and are divided into flow and return compartments by the anodes, which are preferably of carbon. These cells may be contained in an outer chamber through which either cold or hot air or steam is caused to circulate. Apparatus for the bleaching of cloth and similar fabrics is described, and there are four claims for special arrangements for effecting the oxidation, chlorination, and similar treatment of sewage, paper pulp, and other matters.
—G. H. R.

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### *Improvements in Electric Batteries.* H. T. Barnett, London. Eng. Pat. 4113, Feb. 27, 1894.

This battery is of the zinc carbon type, the exciting fluid being a solution of chloride of zinc, and the depolariser the oxygen in the air. The negative element, which is preferably prepared by the carbonisation of a textile fabric, such as velvet impregnated with a solution of chloride of platinum, rests on a porous support, and is situated wholly in the air, but has a considerable portion of its surface in contact with the electrolyte.—G. H. R.

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### *Improvements in the Electro-deposition of Aluminium.* A. H. Harris, Birmingham. Eng. Pat. 4325, March 1, 1894.

The improvements consist in the use of double aluminium electrodes in a bath composed of one part nitrate of aluminium to 30 or 40 times its bulk of a saturated solution of bisulphite of soda. The whole is then rendered alkaline with ammonia. Cyanide of potassium may be added in the proportion of two or three ounces to 30 or 40 gallons of the solution.—G. H. R.

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*Improvements in Electric Batteries.* R. McL. McDonald and A. McDonald, Dumbartonshire, Scotland. Eng. Pat. 8808, May 3, 1894.

This battery consists of an outer jar containing a copper spiral embedded in coke, or similar carbonaceous material, saturated with a solution of copper sulphate. In the inner porous pot is placed the zinc, which is immersed in a solution of sodium chloride.—G. H. R.

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*Improvements in Electrolytic Vessels for Primary and Secondary Batteries or Accumulators, and other Processes of Electrolytic Decomposition and Electrolytic Action, such as for the Extraction of Metals from their Ores, Electro-depositions, and the like.* P. Schoop, Zurich, Switzerland. Eng. Pat. 23,669, August 27, 1894.

The object of this invention is to provide means for maintaining the density of the electrolyte constant. This is effected by transferring portions of the upper layer of the electrolyte to the bottom of the vessel, either by means of a lateral chamber through which it is conducted to the bottom, or by one or more passages extending from the upper to the lower part of the vessel, and communicating therewith at both ends. These serve to receive periodically at the upper end a portion of the upper layer of the electrolyte, and may or may not be provided with floating valves to prevent a return flow of the liquid. In the case of accumulators used in tramcars or boats no especial means are required for providing the necessary agitation of the vessels, but in other cases any suitable means may be employed.
—G. H. R.

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*Improvements in and connected with Galvanic Batteries.* J. C. Fuller and G. Fuller, London. Eng. Pat. 23,441, December 3, 1894.

According to this invention, connection is made with the carbon element by means of a strip of platinum or other non-oxidisable metal inserted into it. A lead cap is cast over the projecting platinum, and to this the binding screw or its equivalent is attached. The carbon thus prepared stands in a porous cell, and is surrounded with a mixture of powdered carbon and manganese saturated with a solution of chloride of zinc and sal-ammoniac. The porous cell stands in a cylinder of zinc, the interspace being filled with plaster of Paris saturated with a solution of sal ammoniac and chloride of zinc. The outside of the zinc is covered with coatings of fabric or paper impregnated with an insulating material, such as india-rubber.—G. H. R.

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## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Villon's Purification Method for Mineral Oils.* J. J. Ellin. Zap. bak. otd. imp. russk. techn. obschtsch. 1894, **9**, 28.

The author has investigated this proposed process. He points out that the reagent described by Villon is really chromyl chloride and not chloro-chromic acid. In accordance with Villon's directions 300 grms. of a lubricating oil distillate were thrice treated with 3 grms. of chromyl chloride. Each drop of the reagent caused a burst of flame, the temperature of the oil being raised from 30° to 70° C. A blackish-brown liquid was produced in which particles of coke were noticeable. The reaction is much more violent and local than that with sulphuric acid, and the results are unsatisfactory. With petroleum each drop of chromyl chloride causes ignition of the material and not a mere local outburst of flame. The cost of the reagent is also at least 10 to 12 times as great as that of the sulphuric acid now used, so that for industrial purposes the process is also on that account useless.—L. T. T.

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*Gantter's Process for Determining the Iodine Value of Fats.* P. C. McIlhiney. J. Amer. Chem. Soc. **16**, 372.

*See under* XXIII., *page* 197.

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### PATENTS.

*Improvements relating to the Purification of the Residues or Cakes obtained from Fatty Substances, Oleaginous Fruits, or Grains.* H. H. Lake, London. From La Société Anonyme des parfums naturels de Cannes, Paris. Eng. Pat. 16,552, September 29, 1891.

This is an amended specification of Eng. Pat. 9431, 1891 (see this Journal, 1892, 536). It consists in the employment, firstly, of a current of superheated vapour of the solvent, and, secondly, of a current of dry steam, whereby a dry cake, free from the odour of the solvent and unaltered, is obtained.—J. J. K.

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*Improvements in Compounds for Oiling or Similarly Treating Wool.* W. E. Heys, Manchester. From E. Godahaux, Paris. Eng. Pat. 21,976, November 17, 1893.

This relates to the production of a new product termed "Soluble Neoline" for the purpose of oiling wool in the process of manufacture. In Patent 10,729, June 1, 1893, a mixture of soluble soap, water, glycerin, and potassium carbonate is employed. To preserve the nature of this compound more effectually and to provide against the coagulation of the soap, a non-volatile hydrocarbon or the heavy oil of petroleum is added to the compound, and forms a homogeneous mixture. This is said to preserve the humidity of the glycerin and salt, and to diminish the evaporation of the water in the compound. The proportions are: water, 100 parts; soap, 15 parts; heavy oil of petroleum, 30 parts; potassium carbonate, 8 parts; and glycerin, 25 parts.—J. J. K.

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*Improvements in the Acid Saponification of Fatty Bodies and in Apparatus employed therein.* E. Petit, St. Denis, France. Eng. Pat. 2132, January 31, 1894.

The improvement consists in atomising or converting the sulphuric acid into a mist, before its contact with the fatty body, which is said to effect a more complete decomposition. The apparatus resembles the centrifugal machine used in sugar refineries. While it is in motion, the acid and fat are fed through separate pipes into the revolving trays, in which they are thoroughly mixed, and fall to the bottom part of the vessel.—J. J. K.

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*Improvements in the Method of and Machinery or Apparatus for Extracting Oil from Seeds and the like, and for forming Cakes from such or other suitable Substances.* H. Lambert, Leeds. Eng. Pat. 3197, February 11, 1894.

*See under* I., *page* 131.

*Improvements in or connected with the Manufacture of Fluorescent Soaps.* S. Neumann, Budapest, Hungary. Eng. Pat. 16,040, August 23, 1894.

Ordinary opaque soap is capable of taking up during its manufacture, fluorescent bodies, but when finished has lost the quality of fluorescence. But when to each kilo. of a transparent soap, 1 to 2 mgrms. of a fluorescent body, such as fluorescein or its derivatives, eosin, phloxin, erythrosin, safranine, esculin, rhodamine, azoresorcinol, azoresorufin, is added and the mixture stirred, a fluorescent soap is produced. The addition of ammoniacal salts is said to increase the fluorescence.—J. J. K.

*An Improved Lubricant for the Lubrication of Hydraulic Rams, Cylinders, Pumps, and all Surfaces liable to Corrosion, and Effects of Friction in Water or other Liquids.* W. A. Entwistle, Manchester. Eng. Pat. 16,292, August 27, 1894.

Fifty parts of stearin or tallow, 20 parts of soapstone or powdered mica, 2 parts of graphite, 10 parts of neatsfoot or other oil, 10 parts of powdered zinc, lead, copper, or other soft metal, and 10 parts of oil of tar, are thoroughly incorporated.—J. J. K.

*An Improved Saponaceous Compound.* H. Whitbread, London. Eng. Pat. 19,968, October 19, 1894.

This soap is composed of the following ingredients: 2½ cwt. of caustic potash, 8½ cwt. of olein oil, 8 cwt. 3 qr. 16 lb. of water, and 2 qr. 8 lb. of potassium carbonate, and is intended for washing heavy and delicate fabrics, especially crape.—J. J. K.

*Improvements in Dry Soap.* H. Heaton, Bradford. Eng. Pat. 23,054, November 28, 1894.

This relates to the production of a dry soap containing ammoniacal salts. About 10 per cent. of mineral oil is mixed with ordinary dry soap, and 5 to 10 per cent. of ammonium sulphate is added. The mineral oil is said to prevent the volatilisation of the ammonia before the soap is used.—J. J. K.

# XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

## (*A.*)—PIGMENTS, PAINTS.

*Water- and Oil-Colours for Artists.* M. Lotter. Chem. Zeit. 18, 1894, 1696.

The quality of these colours depends, in the first instance, upon the judicious selection of the pigments, their degree of fineness, and the vehicles or cements with which they are prepared. The pigments must be as pure as it is possible to prepare them, free from any admixtures, and should be brought to the highest possible degree of subdivision. The cementitious substances used for water-colours are gum arabic, gum sandarac and British gum; but sugar-candy and glycerin are usual additions. The employment of honey, gelatin, or isinglass as cementitious agents is obsolete. The pigments are mixed with the aqueous solution of one of the above-named cements in porcelain dishes, and the resulting paste is passed four or five times through a granite roller-mill. Suitable proportions are—

| Carmine Lake. | | | Zinc White. | | |
|---|---|---|---|---|---|
| 375 | grms. of | dry carmine lake. | 1,500 | grms. of | zinc white. |
| 3,000 | „ | gum sandar. (sol. 1 : 2). | 750 | „ | British gum. |
| 84 | „ | sugar. | 55 | „ | sugar. |
| 70 | „ | glycerin. | 20 | „ | glycerin. |
| **Vermilion.** | | | **Prussian Blue.** | | |
| 1,500 | grms. of | dark vermilion. | 1,000 | grms. of | "still" or pale blue. |
| 1,500 | „ | gum arabic (sol. 1 : 2). | 2,500 | „ | gum sandar. (sol. 1 : 2). |
| 59 | „ | sugar. | 67 | „ | sugar. |
| 5 | „ | glycerin. | 100 | „ | glycerin. |

The colour-paste is thickened by pouring it upon lithographic stones, which are heated on a sand-bath. No lumps must form in the paste, which is continually stirred and kneaded. The paste, as soon as sufficiently concentrated, is ready for conversion into the usual tablets. Round tablets are produced by first rolling the paste between polished steel rollers until it forms a sheet of the required thickness and perfectly smooth surface. From these sheets the round tablets are obtained by means of punches. After allowing the tablets to dry superficially, the desired inscriptions are impressed upon them in presses by means of steel stamps. They are then completely dried. Square tablets are produced by pressing the paste through an orifice of the desired section, and cutting the bands thus obtained into pieces of the desired length. These tablets are first completely dried; they are then placed in a moist atmosphere, and after being thereby again superficially softened, receive the desired impression, and are then finally dried. Moist water-colours are prepared in essentially the same manner as the tablet colours, but they receive a larger proportion of glycerin, to prevent their drying. Oil-colours in tubes are prepared by grinding the pigments with a suitable oil as fine as possible. Excepting gamboge, asphaltum, and a few others, all pigments can be mixed with the oily vehicles without any special preparation. For lake pigments, poppy-seed oil is used which has been converted into a varnish by boiling in a tinned copper pan for three hours a mixture of 9 kilos. of poppy-seed oil, 12 kilos. of water, and 1,100 grms. of salt. Suitable proportions of oil and pigment are: for Garnet lake, 20 grms. of the lake and 17 grms. of poppy-seed oil varnish; for Indian yellow, 50 grms. of the lake and 33 grms. of the same varnish. The proportions of pigment and oil used are different for each pigment. They cannot be fixed arbitrarily, but are the results of practical experiments and observation. A mixture in equal volumes of bleached poppy-seed oil and bleached poppy-seed oil varnish is exclusively used for white pigments. Both oil and varnish should be "sun-bleached." Suitable proportions are: for Chemnitz white, 2,000 grms. of pigment, 220 grms. of poppy-seed oil, 220 grms. of poppy-seed oil varnish. For Prussian blue, sienna, umber, &c., unbleached but bright poppy-seed oil is used. For most pigments, however, wax oil is used, which is obtained by fusing gum mastic and Japan wax in a copper pan, and dissolving the mixture in poppy-seed oil. This mixture is used for those pigments the high specific gravity of which renders them liable to separate from the oil. Suitable proportions are: for chrome yellow, 400 grms. of pigment, 133 grms. of wax oil; for vermilion, 200 grms. of pigment, 42 grms. of wax oil; for Guignet's green, 30 grms. of pigment, 33 grms. of wax oil. All black pigments are ground with linseed-oil varnish. For bone-black ("ivory-black"), 250 grms. of black and 166·6 grms. of linseed-oil varnish are used; for vegetable black ("lamp-black"), 200 grms. of black and 145 grms. of varnish. The finished oil-colours are filled into the tubes by means of machinery.—C. O. W.

### PATENT.

*Impermeable Paint for Mirrors.* G. Phillips, Brussels. Eng. Pat. 19,858, October 18, 1894.

The object of the invention is to produce a paint for protecting the metallic coating of mirrors, the said material being unaffected by air and capable of resisting the passage of air through its pores. The material is termed "Monopole," and is formed of the following materials, which may be in the proportions given below:—

For producing 1 kilo. after boiling—

| | |
|---|---|
| 720 grms. of | turpentine. |
| 150 ,, | Damar gum. |
| 90 ,, | China clay. |
| 100 ,, | pure graphite.—V. C. |

## (*B.*)—RESINS, VARNISHES.

*Turpentine from Finland.* O. Aschan and E. Hjelt. Chem. Zeit. **18**, 1894, 1566.

The oil of turpentine is obtained from the trunks and roots of *pinus sylvestris* and *pinus abies.* The distillation is carried out at a high temperature. The crude oil is freed from acetic acid and tarry matters by distillation over lime. The examination of three different samples of Finland turpentine gave the following numbers:—

1. *Oil of Turpentine from South Finland.*—Fractional distillation yielded 7·1 per cent., boiling at from 155° to 160° C.; 30·2 per cent., boiling at from 160° to 165° C.; 22·6 per cent., boiling at from 165° to 170° C.; and 20·1 per cent., boiling at from 170° to 175° C. The first fraction consists chiefly of pinene, the higher fractions chiefly of sylvestrene and dipentene. This turpentine oil is therefore identical in composition with Swedish and Prussian oils.

2. *Oil of Turpentine from North Finland.*—The bulk of this oil distils between 170° and 178° C. The lower boiling portions consist chiefly of pinene, but the larger proportion of the oil consists of dipentene with scarcely any sylvestrene.

3. *Turpentine Oil obtained by distilling Resinous Wood with Steam.*—The chief fraction distils between 155° and 160° C., and contains much pinene. In the higher fractions sylvestrene, but no dipentene, was observed. From this it must be concluded that whilst sylvestrene occurs ready formed in the resin of the northern coniferous trees, dipentene is not a natural product, but is formed by the superheating of the pinene during the process of distillation.
—C. O. W.

## (*C.*)—INDIA-RUBBER, &c.

*The Analysis of India-Rubber Articles.* C. A. Lobry de Bruyn. Chem. Zeit. **18**, 1894, 1566, 1618.

*See under* XXIII., *page* 198.

### PATENTS.

*Improvements in Materials or Compounds adapted for Use as Varnishes, as Substitutes for India-Rubber, Gutta-Percha, and like Substances, and for other Purposes, and the Process for their Production.* C. U. King, Balham, Surrey, and R. V. Jellicoe, Streatham, Surrey. Eng. Pat. 24,695, December 22, 1893.

The solvent consists of dried methylated spirit containing 5 per cent. or more of methylated ether or benzene. Tungstate of soda is added to make the material fireproof, and the covering part of the material is provided by a celluloid substance, such as cotton wool, cotton waste, or esparto grass. If flexibility is desired, castor oil, or gum copal with castor oil, may be added. Dry pigments or other colouring matters can be added if required.—V. C.

*Improvements in the Manufacture of Coloured or Patterned Waterproof Fabrics, and in the Means or Apparatus Employed therein.* T. Birnbaum, Bow, Middlesex. Eng. Pat. 561, January 10, 1894.

*See under* VI., *page* 151.

*Improvements in Mills for Mixing India-Rubber and other like Materials.* A. G. Brookes, London. From J. E. Davis, Lynn, Mass., U.S.A. Eng. Pat. 23,483, December 4, 1894.

Mixing mills for rubber, commonly have two cylindrical rollers which revolve at different speeds. The crude rubber clings to "the slower roller." An endless travelling apron brings back to the rollers that part of the foreign material which has escaped unmixed from between the rollers. In the improved mill, the apron is in contact with the slower roller instead of with the faster one as heretofore, and this effects a saving in the time required for incorporating the foreign material of about one quarter of the whole time required. The distance between the rollers in the improved mill is also capable of adjustment to accommodate changes in the position of the apron.—V. C.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### PATENTS.

*Improvements in the Treatment of Leather.* H. Neil, London. Eng. Pat. 24,098, December 14, 1893.

Inferior leather may be improved by this process, inasmuch as its spongy character can be removed and its toughness or strength and durability enhanced. Leather thus treated is quite waterproof.

As an example of the treatment the following recipe, designed for good English or foreign butts, may be quoted:—

| | |
|---|---|
| Resin | 4 lb. |
| Castor oil | 1 lb. |
| Russian tallow or wax | 1 lb. |
| Benzoline | 1 gall. |
| French chalk | ½ lb. |

The resin is dissolved in part of the benzoline and the castor oil is added, the mixture being stirred until the materials are thoroughly combined. In a separate vessel the Russian tallow or wax is dissolved in the rest of the benzoline and the mixture stirred until it assumes the appearance of milk. To this solution the French chalk is added and the two solutions are mixed. When this liquor has remained at rest for some time, the butts are soaked in it for 15 minutes, during which time the dissolved resin and oleaginous constituents of the mixture will be absorbed into the fibres of the leather.—A. G. B.

*Improvements in the Manufacture of Artificial Leather or Leather Boards for Glazing Paper and for other Purposes.* H. R. Minns, Maidenhead, Berkshire. Eng. Pat. 2221, February 1, 1894.

The fibrous materials employed are reduced to a pulp, and chalk or whiting is added to cleanse the fibre, and by its adhesion to the same, to cause it to quickly absorb the colouring or sizing ingredients, which may then be added. The pulp is then passed to moulds and made into sheets or boards which, when sufficiently dry, are glazed with a solution consisting of starch, gelatin, and 10 per cent. of turpentine.

Sole-leather cuttings or other scraps are frayed into fine threads and impregnated with whiting in the manner indicated. When thoroughly dry they are mixed with linseed or other oils containing about 20 per cent. of turpentine. The whole is then pulverised as required, and rolled or moulded into the desired shape. —A. G. B.

*Improvements in the Treatment of Leather.* W. H. Jeansson, Hamburg, Germany. Eng. Pat. 2517, February 5, 1894.

Heretofore "horse crup" leather has been finished black in order to mask the spotty appearance which the natural russet-coloured leather possesses. According to this invention, the leather is to be kept from direct contact with the air during the tanning process, and to be dried in the open air as soon as it is removed from the tan-pit. In this way the spotty appearance is avoided and the leather is of an even russet colour, fit to be used either in this natural colour or dyed with any other shade than black. If the leather is too hard it is "stuffed" with grease.
—A. G. B.

*An Improved Substitute for Leather, applicable for Belting and other Purposes.* G. E. Stead, Leeds, Yorkshire. Eng. Pat. 18,231, September 26, 1894.

Textile driving belts have hitherto been made from grey or white yarns in their natural state, and have been afterwards impregnated or coated with oil or paint. By the present invention, the belt is woven of tanned yarn and impregnated with resinous pitch; such belts are impervious to water and do not fray.

The resinous pitch employed is a residuum from the distillation of crude resins, mixed with some softening agent—*e.g.*, beeswax, brown grease and stearin, tallow, or their equivalents—until the fatty acids have been volatilised or decomposed. The textile fabric to be impregnated, is immersed in this pitch whilst it is molten and then passed through calendering rollers.

The same material will serve as a substitute for leather used for various other purposes.—A. G. B.

*Improved Means for Removing Lime from Skins and Hides.* J. Hauff, Feuerbach, Stuttgart, Germany. Eng. Pat. 22,546, November 21, 1894.

For removing the lime from skins and hides, and for plumping them, the inventor uses a sulphonic acid or a mixture of sulphonic acids. The claim covers the sulphonic acids of benzene, toluene, xylene, naphthalene, anthracene, and phenanthrene; of phenol, cresols, xylols, naphthols, hydroxyanthracenes and hydroxyphenanthrenes; of benzoic acid, phthalic acid, salicylic acid, cresotinic acids, and hydroxynaphthoic acids; of aniline, toluidines, xylidines, and naphthylamines.

One part of the sulphonic acid may be dissolved in 500 parts of water and the skins kept agitated in this at a temperature of about 30° C. for 1—2 hours according to the weight of the skins. All the lime will then have been extracted. (Compare this Journal, 1891, 714; 1892, 48.)

If the skins have not been previously scraped after liming, a small quantity of free sulphuric acid is advantageously employed in addition to the sulphonic acid. Plumping may be effected after the removal of the lime by passing the skins through a second bath of the sulphonic acid (1:500). Loss of weight is much diminished by the use of the sulphonic acids, since these are without solvent action on skin.

To obtain a cheap sulphonic acid, 100 kilos. of cresol, such as is obtained as a by-product in the manufacture of carbolic acid, and 200 kilos. of 96 per cent. sulphuric acid are heated to a temperature of 100° C. in a water bath for a few days, and then diluted with 300 litres of water. After settling, the liquor is ready for use.—A. G. B.

## XV.—MANURES, Etc.

### *The Solubility of Basic Slag.*

In a paper read before the Cleveland Institute of Engineers, January 14, 1895, C. H. Ridsdale discusses certain statements published as Professor Wagner's, and current impressions, relating to the "fertilising activity" of various makes of basic slag as measured by the citrate solubility of the phosphoric acid, some of which, particularly the third, were, in his opinion, misleading.

1. That this solubility represented or was closely parallel to the availability for plant life under actual agricultural conditions.
2. That the more soluble slags were also generally higher in silica.
3. The slags having a higher "percentage solubility" were more valuable than those with a low percentage, though the former might contain only 10 per cent. or 12 per cent. total phosphoric acid, as against 17 per cent. or 18 per cent. in the latter.

An instance of the third proposition cited was in a pamphlet, which was a translation of a paper by Professor Wagner, published presumably for farmers, in which were tables giving numerical values to slags of different makes, which as printed were altogether incorrect, a slag having 8·44 per cent. soluble phosphoric acid, being valued at 100, whilst one having 14·48 per cent., nearly twice as much, was only valued at 81, simply because only this percentage of the total phosphoric acid was soluble. These values held good per unit, but this had not been mentioned, and in consequence of such statements entirely false impressions had been created, which it was important to remove, as they might be most serious to makers and farmers.

He had carefully examined the six crystalline constituents of basic slag, three of them phosphoric, and three non-phosphoric, some of which Mr. Stead and himself had discovered and described for the first time to the Chemical Society and Iron and Steel Institute early in 1887.

He had also examined a number of basic slags, including three of the North Eastern Steel Company's make (which gave very good results), and a number of other British makes, all of a degree of fineness as put on the market, as well as siliceous cinders for comparison. Of these he had determined the "citrate solubility" by Professor Wagner's method, together with the effect of friction on the same, the composition, and the carbonic acid water solubility. He had also drawn up a number of tables and diagrams illustrating the results.

He showed that that portion of the phosphoric acid not soluble in the first treatment by the "citrate" test as conducted, is not necessarily unavailable for plant life, even during the first year, as extended conditions such as—

1. More solvent.
2. Greater degree of fineness.
3. Longer time.
4. Friction such as may take place between the earth and the slag, &c. may render it all soluble.

That pure tetrabasic phosphate of lime, whether natural (as in the transparent plates) or artificial (as prepared synthetically by Mr. Stead) are completely soluble, and as readily so as the blue crystalline variety, if the citrate used be proportioned to the phosphoric acid present.

That increased quantities of poorer slags, containing the same quantity of soluble phosphoric acid as richer varieties, and which should, when treated with fixed quantities of solvent (as would under actual agricultural conditions be the case) yield an equal amount, do not do so, but on the contrary, yield much less.

He dissented strongly from the expression of results in terms of "percentage solubility," and drew many comparisons between this and the absolute solubility.

His earlier experiments showed the alleged close relations between the silica content and the "percentage solubility" to have almost as many exceptions to as examples of, the rule, and that there was a point beyond which the higher the silica the less would be the solubility. He contended that only practical tests extending over years could show the real value of slags of different degrees of solubility, and that next to this would come carbonic acid water tests.

He therefore sought further for the principles governing this, and after determining what bodies the citrate solution dissolved preferentially, as well as from a close study of the behaviour of whole series of samples, and of other evidence adduced, he felt there was good ground for the following conclusions:—

The "percentage solubility" depends on—

1. The actual content of phosphoric acid, varying inversely to it.

2. The neutrality or freedom from excess of lime (and possibly certain other bases).

3. That silica does not *per se* increase this, but only—
   - *a.* When it combines with and thus neutralises excess of lime, and possibly certain other bases.
   - *b.* When as a condition of the presence of a large quantity of silicate of lime (which silicate appears not to interfere with the solubility in the quantities in which it is generally present) there is only a low total percentage of phosphoric acid present.

4. That silica decreases this when present in quantities greater than are required in 3, or sufficiently large to bring about the formation of silicates of iron or manganese.

5. That excess of oxides of iron and manganese have a very small effect, almost negligible when compared with that of lime, the actual solubility being the resultant of the inter-action of such of these conditions as are present.

The absolute solubility or actual amount dissolved, depends on:—

The actual content of phosphoric acid, varying directly with it, and in other respects following 2, 3, 4 and 5.

From these conclusions he showed that if any maker's slag have a poor solubility, it is necessary, in the first place, to determine to which of these causes this is due, in order to decide what remedy to adopt, if any be practicable.

*Some Sources of Error in our Methods of Determining Potash in Fertilisers and German Potash Salts.* N. Robinson. Reporter on Potash for the National Association of Agricultural Chemists for 1893. J. Amer. Chem. Soc. **16**, 364.

*See under* XXIII., *page* 189.

*The Determination of Phosphoric Acid.* S. W. Johnson. J. Amer. Chem. Soc., **16**, 462.

*See under* XXIII., *page* 189.

PATENTS.

*Improvements relating to the Manufacture of Artificial Manure.* A. R. O. Pieper, Hamburg. Eng. Pat. 24,465, December 19, 1893.

This relates to the manufacture of a manure in which the phosphoric acid exists as bibasic calcium phosphate, produced by the simultaneous employment of lime and soda for the decomposition of aluminium and iron phosphates. Burnt lime is slaked in caustic soda lye to a thick pulpy consistence, and finely ground aluminium or iron phosphate is added, the mixture being agitated till a homogeneous mass is formed. The action may be regarded as taking place in two stages, in which an alkaline phosphate is first formed, which is then decomposed by the lime, with liberation of the alkali (which comes into operation again). The reactions are said to be—

$$FePO_4 + 2KOH + H_2O = K_2HPO_4 + FeO_3H_2.$$

$$K_2HPO_4 + CaO_2H_2 = CaHPO_4 + 2KOH.$$

This bibasic phosphate is soluble in ammonium citrate, and is easily assimilable by plants.—J. J. K.

*Improvements in the Manufacture of Manure and Fertilisers.* M. C. Ginster, Erdington. Eng. Pat. 792, January 13, 1894.

This patent relates to the production of manures rich in ammonia and phosphates from animal matter, without machinery.

To obtain an ammoniacal manure, strained blood is to be mixed for 5 minutes with 20 to 25 lb. B.O.V., "155 strong," or 20 to 25 lb. "white oil of vitriol" (R.O.V.) to the ton, then raked together, heaped up, and after 5 hours again mixed, re-heaped, and left to drain some hours, being finally dried by means of steam pipes. To obtain a manure rich both in ammonia and phosphates, fish is to be broken up and treated in a similar manner with 35 to 40 lb. B.O.V. or 25 to 30 lb. R.O.V.; for the preparation of a phosphatic manure, 1 ton of bones, broken small or steeped in water, and 16 lb. of R.O.V. are employed; similar proportions are taken in the treatment of horns and hoofs. Night soil is treated with 150 lb. of B.O.V. per ton, to yield an ammoniacal manure. The manures may be employed separately or mixed to suit requirements.—D. A. L.

## XVI.—SUGAR, STARCH, GUM, Etc.

*A Gravimeter for Sugar Analysis.* W. K. Gird. J. Amer. Chem. Soc. 1894, **16**, 677.

*See under* XXIII., *page* 188.

*The Estimation of Water in Raw Sugars.* Gunning and Alberda. Sucr. Belge, 1894, **23**, 108.

*See under* XXIII., *page* 198.

*Quantitative Estimation of Starch.* J. Krieger. Der. Amer. Bierbrauer, 1894, **27**, 580.

*See under* XXIII., *page* 199.

PATENTS.

*Improvements in the Manufacture of Sugar and Machinery therefore.* S. Touyarou, Paris. Eng. Pat. 24,718, December 22, 1893.

According to the inventor's mode of working, sugar refining is effected directly and by the aid of steam alone in the ordinary centrifugal machine. When high grade sugars are being dealt with they may be treated at once in the machine; but if of inferior quality they are dissolved, the syrups clarified, and a grain crystal obtained which, after being moulded into blocks to fit the drum of the centrifugal machine, is treated just as when a high grade sugar is commenced with.

In each case the refining consists in blowing in steam during the revolution of the machine, until the liquid thrown off is white and hot, then the grains are put into a consolidating machine for the production of ingots, cubes, or slabs, which are declared to be of a purity exceeding 99 per cent. The consolidating machine referred to, comprises a jacketed hopper with feed wheels for supplying the grain sugar to the moulds as each one is passed in turn beneath the delivery shoot. The moulds are of bronze and have various partitions according to the required finished form of the sugar; they are supported and carried along by an endless chain which brings each in turn under the hopper, and subsequently beneath a plunger which applies a heavy pressure to the contents. The opening and closing of the hopper is automatically controlled by the adjustment of each mould beneath it. The endless chain has an intermittent motion, the length of each movement being such as to withdraw one mould from beneath the hopper and bring another forward in its place, and at the same time a pressed mould is withdrawn from beneath the plunger and another is brought forward to receive pressure. Hand labour is required for placing the empty moulds on the endless chain at one end and removing them filled and pressed at the other end of the machine.—G. W. A. T.

### *An Improved Evaporator for Saccharine or other Liquids.* J. McNeil, Govan, N.B. Eng. Pat. 4433, March 2, 1894.

The intention of the inventor is to improve the construction and increase the efficiency of apparatus for evaporating saccharine or other liquids, whilst in transit through the apparatus. The invention described, comprises an open tank provided with an inlet and an outlet for the liquid to be evaporated, and is fitted with a number of vertical partitions having passages across at alternate ends, so that the liquid may flow between the partitions in opposite directions alternately. The tank is thus divided into compartments, in the lower part of each of which is a group of horizontal tubes for the passage of steam to heat the liquid; each group of tubes is fixed in end boxes, the box at one end being divided by a partition into two compartments, one of which communicates with an outlet or drainage pipe; the box at the other end is without partitions and the steam from the inlet traverses one half of the group of tubes in one direction and passing through the further box to the other half of the tubes, returns through them in the opposite direction. The boxes at the inlet and outlet end are fixed, and are fitted in connection with passages formed in the bottom of the tank in a manner permitting the pipe attachments to be conveniently made externally; the boxes at the opposite ends of the partitions are free to move according to the expansion and contraction of the tubes. The outlet for the liquid undergoing evaporation is placed at such a level as to maintain a suitable depth of liquid over the steam pipes.—G. W. A. T.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### *Maize as Brewing Material.* C. Schubert. Allgem. Zeits. f. Bierbr. u. Malzfab. 1894, 22, 861.

The extensive use of maize for brewing in America and the attempts of the Americans to dispose of their surplus production of this cereal to the German and Austrian breweries has led the author practically to test the suitability of it for the brewing of lager beer. A coarse American maize flour was used, containing 14·27 per cent. of water and 1·67 per cent. of oil. A laboratory experiment showed that saccharification remains incomplete when a proportion of 3 of maize to 2 of malt is reached. In the trials on the large scale the maize was added in 2 portions to the first and second thick mash, 32 per cent. being used. The wort obtained showed a strength of 14·5 per cent. (Balling). The yield of extract from the maize amounted to 80 per cent., that from the malt to 64 per cent. The analysis of the finished beer proved that its composition was perfectly identical with that of normal lager beer. In spite of this and the possibility of effecting economy in the cost of production, the author thinks that in consequence of the peculiar, somewhat raw taste of this beer, the first named advantages will be more than counterbalanced by this latter disadvantage, and the adoption of the use of maize in the brewing of better class German beers cannot be considered a step in the direction of improvement.—F. M.

### *Schizosaccharomyces Octosporus.* Beijerinck. Wochenschr. f. Brauerei, 1894, **11**, 1081—2. From Centrbl. f. Bacter. u. Parasitenkunde, **16**, No. 2.

The author describes a new species of the genus Schizosaccharomyces (Lindner), which differs from Lindner's *Sch. pombus* in its prolific spore formation, and the pretty regular occurrence of eight-spore cells. This yeast was found on currants from Zante. When cultivated in wort-gelatin these cells formed colonies similar to those from ordinary yeast. On continued growth the original budding cells, which are about the same size as those of ordinary yeast, become almost entirely replaced by spore-forming cells. These somewhat oval asci, which generally develop eight ascospores, form caps and grow to a diameter of 12—20 μ before liberating the spores. When cultivated in wort without free access of air the growth remains very similar to that of ordinary yeast, but as soon as air is allowed free access the size of the cells begins to vary greatly, and the formation of the large asci takes place. The spores and also the cells produced by budding, often remain for some time joined together into groups.

The *S. octosporus* grows well in the natural nitrogenous extracts of malt, currants, &c., but hardly shows any growth when the nitrogen is supplied as ammonium salts, asparagine, peptone, &c. Of the carbohydrates, glucose, levulose, and maltose produce vigorous growth; mannite and glycerin feeble growth; whilst cane sugar, erythrite, lactose, raffinose, dulcite, quercite, arabinose, and inosite do not support its growth at all. Octosporus is the first yeast which has been observed to be unable to utilise cane sugar for its growth.

In its relation to oxygen, octosporus resembles the moulds, requiring more oxygen stored up in its cells in order to allow it to cause fermentation in media free from oxygen, than ordinary yeast does. As an aërobic ferment cultivated in malt wort octosporus yields in pressed yeast (containing 75 per cent. of water) about 30 per cent. of the weight of malt used, whilst under like conditions ordinary yeast never yields more than 22 per cent. Fermentation is, however, slower by about 12 hours than that of ordinary beer or wine yeast, and the attenuation of a 10° Balling wort can with difficulty be brought below 4° B., the percentage of alcohol not exceeding about 0·7 of the fermenting liquid. When the pressed yeast is used for baking purposes the evolution of carbonic acid per unit of time is only about 60 per cent. of that produced by good ordinary pressure yeast.

Beijerinck has also found on currants (*a.*) A yeast forming acetic ether (*S. acetatethylicus*) and (*b.*) A new pure yeast of very great density. When grown as an aërobe in wort the density of this yeast is further increased, but when cultivated in gelatin it is very soon diminished. From stoneless currants the author also obtained a yeast (*S. passularum*), which in gelatin produces almost solely spore-cells, in wort a large proportion of spore cells.

The author has observed the formation of asci containing 4 to 6 spores, with *S. apiculatus*, with which yeast spore formation has not previously been observed.—L. T. T.

### *Bearing of the Acetic Ferment on Brewing.* E. C. Hansen. Wochenschr. f. Brauerei, 1894, **11**, 1282.

The author's researches show that this ferment is only active in brewing when the fermenting temperature is high and there is free access of air to the wort. Thus, where bottom fermentation is employed there should be little fear of harmful acetic fermentation. When bottom fermentation lager beer was inoculated, either before or after primary fermentation, with *Bacterium aceti* and *B. pasteurianum*, these bacteria were still present and living in the finished beer, but they had not noticeably influenced either the primary or after fermentations. The beer, only became sour in badly corked bottles subjected to favourable temperatures. When exposed to higher temperatures the beer in well corked bottles remained sound, and even when inoculated in bottle with vigorous *B. aceti* or *B. pasteurianum*, and kept in the dark at the ordinary room temperature for 14 days, the beer (if the air was rigorously excluded) showed no signs of becoming sour.

As regards beer brewed by bottom and cold fermentation, little difficulty from acetic fermentation is to be feared if care be taken to have the casks and bottles well sealed and fully filled, so that the ferments can obtain no aëration.
—L. T. T.

### *Development of Spores in Saccharomyces Membranæfaciens, Sacch. Ludwigii, and Anomalus.*

J. C. Nielsen. Wochenschr. f. Brauerei, 1894, **11**, 1082—1083.

The author has carefully examined the action of these species at various temperatures.

*Sacch. Memb.*—At 2·5°—3° C. no spore formation occurs, at 6·5°—8·5° spore formation is very slow (4½ to 7 days), at 25°—33·5° it is rapid (17—21 hours), and at 35° it again ceases.

*S. Ludw.*—At 2·5°—3° C. none, at 6·5°—8·5° very slow (7 to 14 days), at 25°—32·5° rapid (17—21 hours), and at 34° none.

*S. Anomalus.*—At 2·5°—3° C. none, at 6°—8·5° very slow (7—14 days), at 25°—32·5° very rapid (17—21 hours), and at 34° none.—L. T. T.

### *The Influence of Mashing Conditions on the Degree of Fermentation obtained.*

Wochenschr. f. Brauerei, **11**, 1894, 1240—1241.

It is customary to mash at a higher or lower temperature according to whether it is desired to obtain a wort richer or poorer in fermentable sugars, that is, a wort of low or of high attenuating capacity.

The author contends, however, that in the decoction system of mashing, the desired result is often not obtained, because of the difficulty which exists in regulating the temperature in the copper in a range extending from 50°—52° R. to 56°—58° R., since the temperature at the edge of the vessel may vary by more than six degrees from that at the centre. It is advisable, therefore, to replace the chain-rakes by paddle-rakes, when these differences may be removed. Even then, owing to the small bulk of the mash, the composition of the resulting wort cannot be regulated as readily through the agency of temperature as in the infusion process, and it is consequently very necessary to pay careful attention to the temperature in the mash-tun after the addition of the first, and especially after the addition of the second "Dickmaische."—T. A. G.

### *The Influence of the Mashing Process on Attenuation.*

C. Cabanis. Wochenschr. f. Brauerei, 1894, **11**, 968—970.

This paper is largely a reply to the papers of Reischböck (Wochenschr. f. Brauerei, 1894, No. 27), C. D. (*ibid.* 1894, No. 22), and Windisch (this Journal, 1894, 967). The author considers as a bad malt one having too high a percentage of glassy and mouldy corns, showing bad solubility, slow conversion, bad racking, &c., but that a malt with the proportion of maltose to non-maltose as 1 : 0·3, is just as good, for its proper uses, as one having the proportion 1 : 0·6. The author lays stress on a knowledge of the history of the malt, on careful examination of its external characteristics, and on making a trial mash. Whilst he admits that the barley varies much from year to year, and consequently the treatment during malting must vary to neutralise this variation, his experience is that the varying quality of the barley does not have very great influence on the attenuating properties of the malt mashes. The author maintains his statement that whilst the mashing temperature of 151°—167° F. is generally a suitable one, a reduction of this temperature, if the attenuation with any special malt be low, to 140°—145° F., or even lower, will increase the attenuation. In some cases where the malt has been dried at too high a temperature, no variation in temperature be able to produce satisfactory attenuation. This is probably due to a weakening of the diastase by the high-drying, which also causes a tendency to insufficient conversion and to clouding.—L. T. T.

### *The Influence of the Mashing Process on Attenuation.*

X. Reischböck. Wochenschr. f. Brauerei, 1894, **11**, 1055—1057.

This is a reply to Cabanis (see preceding abstract). The author insists on the importance of chemical analysis of the malt, in conjunction with its physical examination. He considers the use of trial mashes inconvenient and uncertain, yielding less reliable results than careful analysis of the malt. It is impossible, and indeed unnecessary, for the brewer to know the history of all the malt he uses. He maintains that the original quality of the barley has a great influence on the ultimate attenuation, &c., and is not by any means neutralised in the malting process. Barley from the same place varies greatly in different years, and the malts made therefrom also differ much and cause very considerable variations in the degree of attenuation of their extracts. The author admits that variations in the mashing process cause great variations in the degree of attenuation attainable, but does not admit that a lowering of the mashing temperature by a few degrees has such a very great influence on the attenuation as Cabanis ascribes to it.
—L. T. T.

### *The Use of Lime and of Sulphurous Acid for the Prevention of Mould Formation during Malting.*

Wochenschr. f. Brauerei, 1894, **11**, 1172.

If lime be added to the first steep-liquor, the barley should not be kept in contact therewith for more than an hour. The liquor should then be drained off, fresh water added and drained off, and this repeated till the water no longer causes an instant and marked blueing of litmus paper. If the barley be left too long to the action of the lime, the growth is retarded and the quality of the resulting malt deteriorated.

The use of sulphurous acid, as recommended by Kukla (This Journal, 1894, 968), is said to give good results.
—L. T. T.

### *Note on Foaming Fermentations.*

O. Knackfuss. Zeits. für Spiritusind. 1894, **17**, 242—243.

A detailed account of practical experiences in the above connection (*i.e.*, relating to the excessive production of froth during fermentation, and the consequent loss of wort), gained in various distilleries, &c. The author is inclined to the opinion that the cause of the trouble resides chiefly in the potato itself, depending on climatic conditions of growth, nature of the soil, kind of manure used, &c. The artificial manures frequently employed convey to the potato various salts having an accelerating action on yeast; and, according to the author, potatoes grown without the aid of such manures seldom give rise to foaming fermentations. Other factors which favour the production of froth are, excessive agitation and aëration of the wort during mashing, cooling, &c., too high a degree of saccharification, and also, possibly to a great extent, the use of yeast possessing high fermentative power. As regards means of combating the evil, steaming the potatoes under a very high pressure is often effective, but, on the other hand, sometimes induces poor, incomplete fermentations. Other means consist in the addition of some kind of ground grain (oats) to the preliminary mash, or to the pitching yeast, or to both. Again, oil or petroleum may be added to the fermenting mash. The latter is more effective, especially at higher temperatures, but is objectionable on account of the flavour it imparts to the spirit. In any case, the action of oil, &c. is only temporary, and repeated addition of fresh quantities is necessary to keep the foam down.—H. T. P.

### *Foaming Fermentations and Pure Yeast.* Zeits. für Spiritusind. 1894, **17**, 250.

A REPRODUCTION of a lecture delivered by Siegler before the "Märkische Brennerei - Verwalter Verein." Hesse's observation is thoroughly confirmed, that foaming fermentations, when due to excessive activity of the yeast, may be avoided by so regulating the proportion of malt employed during mashing, that the production of an excessive amount of maltose is prevented. In practice, when foaming fermentations occur, it suffices to reduce the malt-rate or the time of saccharification, or both. Or a larger proportion of the total malt used may be added during the preliminary mashing stage.—H. T. P.

### *Microbiological Notes on the Manufacture of Arrack in Batavia.* E. Eijkmann. Centralblatt für Bakt. und Parasitenkunde, No. 3, 1894; and Zeits. für Spiritusind. 1894, **17**, 273—274.

THE raw material used in the production of arrack in Batavia consists of the molasses—otherwise almost valueless—obtained from cane-sugar manufactories. In the process employed, the first step is the preparation of the ferment material. For this purpose finely-powdered Chinese yeast is ground up with boiled and cooled rice, and the mass allowed to stand in an open tub fitted with a perforated bottom. By the next day the grains of rice are already completely overgrown with a white mould mycelium, and possess a sour-sweet flavour and sweetish-mouldy odour; at the end of two days the mass is converted into a juicy pulp, the juice containing 26—30 per cent. of sugar. In this condition, the mass (weighing about 30 kilos., and locally termed "tapej") is ready for use and is floated on a vat (2—3 hl.) of already fermenting molasses solution. Next day the tapej is broken up and the contents of the vat transferred to a larger vessel half filled with molasses solution (1 in 3). From this the original vessel is refilled and started with a fresh tapej. The remaining liquid is distributed among several vats, and further quantities of molasses added from time to time. Fermentation is practically complete after 8—9 days. The liquid is then filled into a series of earthenware pots (15 l. capacity), in which a slight after-fermentation takes place and a deposit separates; and finally, after another period of eight days, distilled. The spirit obtained contains about 50 per cent. of alcohol, is comparatively free from fusel oil, and differs from all rice-arrack in having a sweetish-burnt flavour derived from the molasses. The yield of alcohol is very poor, and is equal to about 20 per cent. of the sugar fermented.

*Micro-organisms of the Rice and Molasses Fermentations.*—During the rice fermentation the predominant organism is the mould-fungus mentioned above. It secretes a diastatic enzyme and possesses to a high degree the power of converting starch into dextrin, maltose, and finally dextrose. (Lactic acid is also formed.) In pure cultivation it closely resembles *Amylomyces Rouxii*, which Calmette isolated from Chinese yeast; and, according to the author, is undoubtedly a species of *Mucor*. Besides the above, other organisms occur, the most important being yeasts of which two varieties secrete diastase. In the molasses fermentation, however, these yeasts only play a secondary part. The predominant organism during the whole course of fermentation is a rod-shaped alcoholic ferment (thickness, 0·005 to 0·006 mm.; length, 0·02 to 0·04 mm.), which could not be detected either in Chinese yeast or in the tapej mass, and is probably derived from the molasses, or the water used. Multiplication takes place by fission, the daughter-cells usually adhering together in the form of characteristic V-shaped rods. The microbe may readily be cultivated on solid media, especially those containing sugar or starch. It inverts cane-sugar, and when grown in sterilised molasses produces active fermentation. The fermented liquid, when distilled, yields a spirit resembling good arrack in all respects.—H. T. P.

### *Note on the Unreliable Nature of the Sulphuric Acid Test for the Detection and Estimation of Fusel-Oil in Spirit.* M. Glasenapp. Zeits. für Spiritusind. 1894, **17**, 344—345.

OWING to its simplicity the colorimetric test with sulphuric acid for the detection of impurities in spirit, is still largely, even officially, employed. From a theoretical point of view the method, if reliable, should yield, under identical conditions, the same depth of colour with all the different constituents of fusel oil. That this, however, is very far from being the case, has been shown by various observers, and is fully demonstrated in the present paper. Solutions of the higher alcohols, &c. in highly-purified spirit were prepared and tested in the usual way. The following are the results:—

| No. | — | Relative Tint. |
|---|---|---|
| 1 | Perrier fine spirit, no addition except sulphuric acid. | 1<br>(pale yellow.) |
| | Per Cent. by Vol. | |
| 2 | „ „ + 0·01 of amyl alcohol.. | 1 |
| 3 | „ „ + 0·02 „ „ | 1 |
| 4 | „ „ + 0·03 „ „ | 2 |
| 5 | „ „ + 0·01 of isobutyl alcohol | 1·5 |
| 6 | „ „ + 0·02 „ „ | 3 |
| 7 | „ „ + 0·05 „ „ | 7·5<br>(wine-yellow.) |
| 8 | „ „ + 0·01 of pseudo-butyl alcohol. | 3·5 |
| 9 | „ „ + 0·02 „ „ | 7·5 |
| 10 | „ „ + 0·05 „ „ | 17·5<br>(dark wine-yellow.) |
| 11 | „ „ + 0·02 of normal propyl alcohol. | 1 |
| 12 | „ „ + 0·04 „ „ | 1 |
| 13 | „ „ + 0·10 „ „ | 1 |
| 14 | „ „ + 0·01 of isopropyl alcohol. | 1 |
| 15 | „ „ + 0·02 „ „ | 1 |
| 16 | „ „ + 0·05 „ „ | 1 |
| 17 | „ „ + 0·01 of aldehyde ..... | 5 |
| 18 | „ „ + 0·02 „ ..... | 10 |
| 19 | „ „ + 0·05 „ ..... | 30 |
| 20 | „ „ + 0·01 of furfurol....... | 30 |
| 21 | „ „ + 0·02 „ ....... | 60 |
| 22 | „ „ + 0·05 „ ....... | 150<br>(dark violet-brown.) |

Since fusel-oil consists mainly of the higher alcohols, amyl alcohol being the chief constituent, it will readily be seen that a spirit containing as sole impurity a negligible amount of aldehyde, or especially furfurol, might be classed as inferior to another spirit free from this impurity, but in reality contaminated to a far greater extent by higher alcohols. The author therefore recommends the adoption of a more accurate process, preferably the volumetric extraction method of Röse. (See this Journal, 1886, 393 and 498.)
—H. T. P.

### *Some Characteristics of California Wines.* W. H. Krug. J. Amer. Chem. Soc. 1894, **16**, 597—617.

THE author has very fully analysed a large number of Californian wines representing all the important districts of that State, the details of the processes employed for the various determinations being given *in extenso*.

TYPE OF WINE.

| ——— | Rhenish. | | Sauterne. | Claret. | | Medoc. |
|---|---|---|---|---|---|---|
| | Riesling. | Gutedel. | | Zinfandel. | Claret. | |
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Alcohol, by weight | 8·45—11·67 | 9·67—11·16 | 8·43—12·18 | 9·15—10·50 | 9·16—11·23 | 11·75—12·4 |
| Extract | 1·66—2·61 | 1·67—2·34 | 1·70—4·03 | 2·28—3·37 | 2·35—3·34 | 2·33—2·92 |
| Acidity (as tartaric acid) | 0·478—0·658 | 0·467—0·662 | 0·422—0·641 | 0·635—0·871 | 0·601—0·783 | 0·614—0·824 |
| Reducing sugar (as dextrose) | .. | .. | .. | .. | .. | .. |
| Glycerol | 0·591—0·932 | .. | 0·178—0·850 | 0·446 0·634 | 0·484—0·620 | 0·371—0·556 |
| Ash | .. | .. | .. | .. | .. | 0·304—0·386 |

| ——— | Burgundy. | Mataro. | Sherry. | Port. | Muscatel. |
|---|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Alcohol, by weight | Average.<br>12·57 by vol. | Average.<br>12·38 by vol. | 14·38—17·57 | 11·97—17·40 | 10·45—15·50 |
| Extract | 2·79 | 2·79 | 3·33—9·38 | 8·52—16·51 | 17·01—18·62 |
| Acidity (as tartaric acid) | 0·674 | 0·673 | 0·378—0·797 | 0·412—0·674 | 0·317—0·495 |
| Reducing sugar (as dextrose) | .. | .. | 1·20—6·17 | 5·16—13·00 | 43·18 (?)—16·30 |
| Glycerol | 0·551 | 0·553 | 0·325—0·722 | 0·161—0·688 | 0·866—1·014 |
| Ash | 0·283 | 0·278 | 0·211—0·420 | .. | 0·148—0·192 |

Californian wine-producers grow European types almost exclusively, and, in general, aim to follow these types, as regards quality, &c., as closely as possible. A few of the white wines examined were considerably deeper in colour than the corresponding European types. By far the greater number, however, were perfectly clear and brilliant, and obviously carefully matured. This was especially true of the red wines. The analytical results are given in the accompanying table. The most striking point about them is the smallness of the alcohol-glycerol ratio as compared with the ratio accepted in Europe (7 to 14 : 1).

Concerning evidence of the presence of foreign bodies in the wines, it was found that all the sweet wines possessed, after fermentation, a distinct dextro-rotatory power, pointing to the addition of starch-glucose. As it is, however, known that this material is not employed in California, the author considers this proof as not necessarily conclusive. Unfermented cane-sugar was detected in 23 samples. On the other hand, it appears that plastering is not practised to any excessive extent, since only three of the wines contained potassium sulphate in excess of the German standard (2 grms. per litre). As regards antiseptics, salicylic acid was detected in four wines, but sulphurous acid was found in excessively large amounts in numerous samples. Of 87 specimens examined, 33 contained over 0·08 grm. of $SO_2$ per litre. Of these, 2 contained over 0·3 grm., 9 over 0·20 grm., and 29 over 0·1 grm.

In conclusion, the author remarks:—"On the whole, it is evident that the Californian dry wines are fully equal to the European wines, and the red wines are in every respect superior to the young French clarets. The sweet wines are to be unconditionally preferred to the European southern wines containing the same amount of alcohol and extract, and not being plastered."—H. T. P.

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*Action of Diastase on Starch.* A. R. Ling and J. L. Baker. Proc. Chem. Soc. 1895 [146], 3—4.

THE authors have carried out numerous experiments in order to prove the existence or otherwise of Lintner's so-called isomaltose, which is said to be one of the products of the hydrolysis of starch (Ber. 26, 2538). As the result of a study of the action of precipitated diastase (prepared from low dried distillers' malt by Lintner's method) on starch, they have isolated a very hygroscopic substance having, roughly speaking, the same properties as Lintner's supposed compound, thus :—$[\alpha]_D$ 143, and R (= per cent. of maltose) = 81·5. This substance gave numbers on analysis agreeing with the formula $C_{12}H_{22}O_{11}$. It was found to ferment but slowly with ordinary beer yeast, the unfermented residue being unaltered in properties. The authors suggest tentatively, that the substance may possibly contain the simple dextrin $C_{12}H_{20}O_{10} + H_2O$, a view which derives some support from the fact that the specific gravity of a solution remains unaltered after being submitted to the action of diastase.

When starch paste is treated at 70° with the diastase obtained from pale brewers' malt, which is dried at a much higher temperature than that manufactured for distillers, the alcoholic extract of the product yields, on treatment with phenylhydrazine, a small quantity of glucosazone, and an osazone which, when repeatedly recrystallised from hot water, has all the properties of Lintner's so-called isomaltosazone.

The authors are inclined to believe that a triose, $C_{18}H_{32}O_{16}$, is one of the products of the action of diastase on starch, and are attempting its isolation.

ERRATA.—This Journal, 1894, 1089. Line 21 from top of col. 2, for "5 tons," read "*2·5 tons.*" Line 27 from top, for "7·75 lb. of steam, and 2·5 sq. ft.," read "*15 lb. of steam per hour and 5 sq. ft.*"

## PATENTS.

*Improvements relating to the Preservation of Yeast and other Vegetable and Animal Substances.* Auguste Collette, Séclin, France. Eng. Pat. 23,224, December 2, 1893.

THE inventor discards the use of antiseptics, and resorts to the application of more or less thorough desiccation, by mixing these substances with dehydrated starch possessing great affinity for water, that obtained from potatoes being recommended, though it may be replaced by other moisture-absorbing material, *e.g.*, starch and its substitutes, cellulose, &c.

This principle may be variously applied, thus :—Pure pressed yeast is rapidly pulverised and mixed with four to five times its weight of dried starch, which not only removes the moisture of the yeast itself, but protects it against that of the surrounding atmosphere.

An alternative mode is to enclose the powdered yeast in envelopes or bags of cloth or paper, which are then to be surrounded with more or less dehydrated starch, it being optional to use a certain proportion of hydrated starch, containing 20 per cent. of moisture, so as to render the desiccation slower and more regular.

Another means, consists in incorporating pressed yeast in a weak solution of gelatin or agar-agar, which is hardened by cooling, the resulting cake being cut into thin slices, which are dried as before, by disposal amongst dehydrated starch. Thus treated, yeast may be kept in a state so as to preserve its reproductive and fermentative properties for several months, thereby offering the advantage of dispensing with daily supplies, as it may then be sent to consumers at long intervals and in large quantities.—G. W. A. T.

*An External Mashing Apparatus for the Use of Brewers and others, in Mashing Malt with Water, or Raw Grain Liquor in Brewing or Distilling.* W. R. Reffell, Bexley Kent. Eng. Pat. 2966, February 10, 1894.

A D-shaped shutter in a vertical grain-feed, regulates the thickness of a broad, thin stream of malt or other substance, which in falling is met transversely, broadside to broadside, by a broad, thin stream of water or other liquor proceeding from a horizontal orifice, the thickness of which is regulated by a sliding valve.—J. G. W.

*Improvements in and relating to Continuous-working Spirit Stills.* D. A. Blair, Glasgow. Eng. Pat. 3076, February 13, 1894.

These improvements consist in the use, within the vertical column of the continuous-working still, of a series of transverse trays furnished with spiral strips, which effect a circulation of the wash-liquor on the tray before it passes down the overflow feed-pipe to the tray next beneath. The trays are also provided with a spiral series of apertures and deflecting hoods, which cause the ascending alcohol vapours to pass through the wash-liquor on the tray. By these means an increased surface for distillation is obtained. The vertical column is connected with a couple of wash-liquor heating vessels, the alcoholic vapours from the former passing through these, and there, being sufficiently cooled to condense the heavier alcohols, at the same time heating the wash-liquor which is supplied to the vertical column. The vapours which escape condensation in these vessels pass to an ordinary worm, while the condensed heavier alcohols pass again into the vertical column, there to be again distilled.—J. G. W.

*Apparatus to Prevent Waste when Fining or Refining Ale and Beer in Casks.* C. P. Hendy, London. Eng. Pat. 4078, February 26, 1894.

The apparatus is designed to prevent the return, after fining, of any superfluous matter to the casks thus making the contained ale or beer impure. The object is to fix a vessel to the bung hole of the cask, then to fill the said vessel with the right quantity of ale or beer, so that the working and fermentation will rise in the vessel to the surface, the ale or beer descending into the cask till the fining and fermenting action is complete. Then by closing a valve constructed at the bottom of the said vessel, it can be removed from the cask with all the superfluities, leaving the ale or beer in the cask, pure.

Thus the waste and mess attending the operation of cask-fining, are said to be avoided, and in this connection the patentee claims the adoption of the above valves, and any other form of valve, working immediately above or below the connecting branch.—G. W. A. T.

*Improvements in the Manufacture of Brewing Syrup.* L. I. N. Norman, London. Eng. Pat. 17,744, September 18, 1894.

This invention has for its object the manufacture of a brewing syrup containing a large proportion of dextrin—approximately 15 per cent.—together with directly fermentable carbohydrates, free, or practically so, from the non-fermentable material known as gallisin.

The process invented, consists in mixing liquid starch sugar with good raw sugar syrup containing crystallisable (cane) sugar in proper proportion; the best ratio is stated to be two-thirds by weight of such a starch sugar with one-third by weight of crystallisable sugar. The mixture is melted, diluted with water, and filtered through animal charcoal to decolorise. To the purified mixed syrup is then added sufficient sulphuric acid to invert the cane sugar present, a small excess of acid is added, and the inversion slightly prolonged, so as to destroy the gallisin by converting it into dextrose. After neutralising, the mixture is then roused, filtered through the char cisterns in the usual way, and the product evaporated *in vacuô* to the required consistency.—G. W. A. T.

*Improvements in and connected with the Fermentation of Beer.* P. Kropf and A. Gruell, Chicago. Eng. Pat. 20,796, October 30, 1894.

In this invention, which relates solely to lager beer brewing, it is claimed that the "after-fermentation," which in the ordinary way takes place in the storage casks and requires from six to ten weeks for its completion, can be effected in a few hours by subjecting the beer, either in cask or when passing through a pipe, to the action of an electric current, at a temperature of 36° F.—J. G. W.

*Improvements in the Method of and in Means and Appliances for Testing Yeast and Barm.* Antonin Čečetka, Vinohrady, Bohemia. Eng. Pat. 21,440, December 8, 1894.

*See under* XXIII., *page* 199.

Errata.—This Journal, 1895, 54, col. 2, line 16 from top, for "*Monilii,*" read "*Monilia.*" Line 20 from top, for "high," read "*low.*"

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

*The Influence of Alum, Aluminium Hydroxide, and Aluminium Phosphate, on the Digestibility of Bread.* W. D. Bigelow and C. C. Hamilton. J. Amer. Chem. Soc. 1894, **16**, 587—597.

After considering some of the literature bearing on the subject, the authors describe and give the results of a series of "digestion" experiments with bread containing known amounts of the above aluminium compounds. The digestibility in pepsin solution, and also in pepsin and pancreatin solutions (used consecutively), was determined, the albuminoids remaining undissolved being estimated by Kjeldahl's method. It appears that the influence of aluminium hydrate on the digestibility of bread is about the same as that of an equivalent amount of alum. The action of aluminium phosphate is, however, very marked. In spite of the supposed insolubility of this salt, 10—12 per cent. of the albuminoids—digested in presence of aluminium hydrate or alum—remain undissolved when the aluminium exists as phosphate. In general, the amount of albuminoids dissolved by pepsin is distinctly smaller (*i.e.*, in presence of aluminium compounds) than that dissolved by pepsin and pancreatin together. It is therefore evident that methods involving the use of pepsin alone will yield unsatisfactory results.
—H. T. P.

*Brullé's Method for Testing Butter.* C. A. Lobry de Bruyn. Chem. Zeit. **18**, 1341.

*See under* XXIII., *page* 199.

*The Determination of Volatile and Insoluble Fatty Acids in Butter Fat.* W. H. Beal. J. Amer. Chem. Soc. 1894, **16**, 673.

*See under* XXIII., *page* 197.

*Simple Method for the Detection of Foreign Fats in Butter.* C. Killing. Chem. Zeit. Rep. 1894, **18**, 314.

*See under* XXIII., *page* 198.

## PATENTS.

*Improvements relating to the Production of Cheese and to Apparatus therefor.* P. Schach, Freimersheim, Germany. Eng. Pat. 2063, January 30, 1894.

The inventor claims that his apparatus produces soft cheese rapidly, by forcing the whey from the coagulated milk, which is placed upon perforated plates. The apparatus consists of an outer rotary frame, holding two movable plates. On the lower rests a cylinder containing the cheese-moulds, which are surrounded by hot water to hasten coagulation of the milk. Above are placed the sieves, and the whole is secured by screwing down the upper movable plate. When the milk becomes too thick to pass through the sieves, the moulds are turned upside down and compressed air is admitted by a tap, so as to force the whey downwards through the sieves. Water is excluded from the cheese moulds by providing them with a projecting edge at the base and a compressed elastic ring at the top. —L. de K.

*An Improved Food Compound, having for its base Milk.* A. L. Lebret, Crevecœur-en-Ange, France. Eng. Pat. 4049, February 26, 1894.

One hundred litres of milk are evaporated in a vacuum-pan with addition of the extract of 5 kilos. of roasted coffee. Towards the last, 12 kilos. of sugar and 2 kilos. of brown sugar are added. The sugar has been previously flavoured with coffee.—L. de K.

*An Improved Food Compound, having for its base Milk.* A. L. Lebret, Crevecœur-en-Ange, France. Eng. Pat. 4050, February 26, 1894.

Six kilos. of ground cocoa, partially deprived of fat, and 12 kilos. of sugar, are boiled with water, mixed with 100 litres of milk, and the whole evaporated to a syrupy paste. —L. de K.

*Method of Producing Condensed Milk.* H. E. Hansen, St. Paul, Minnesota, U.S. Eng. Pat. 9626, May 16, 1894.

Milk is deprived of its cream by means of a separator, and the cream is kept cold. The skimmed milk is heated to 60°, and the casein is coagulated by addition of acid. The whey is removed by opening a hole in the vessel. After rinsing the curd with cold water, it is pressed gently in a cheese-press and passed through a sieve of galvanised iron wire. It is then put back into the cheese vessel and mixed with a weak solution of potash. After the lapse of about 42 hours it is gently heated with constant stirring, until it has turned to a thick fluid, to which is then gradually added the cream. The mixture forms the condensed milk, which is then cooled and put into tins.

After hermetically closing, the tins are placed in an iron basket, which is placed in an iron vessel or iron boiler, provided with double wells and containing a little water, whereupon the whole is closed with a tight iron lid provided with a thermometer and a tap. The tins are now heated to a temperature of 118°—124° for about an hour, when they are at once cooled.

The claims of the inventor are:—I. The preparation of condensed milk without addition of sugar. II. The thorough sterilisation of the same by the employment of a high temperature, without deterioration.—L. de K.

*Improvements in the Method of and in Means and Appliances for Testing Yeast and Barm.* A. Čečetka, Vinohrady, Bohemia. Eng. Pat. 21,410, November 7, 1894.

*See under* XXIII., *page* 199.

## (*B.*)—SANITARY CHEMISTRY.

*The Chromate Industry in Russia.* N. P. Wahlberg. Zap. imp. russk. techn. obszcz. 1894, **28**, 1.

*See under* VII., *page* 156.

## PATENTS.

*Improvements in and relating to the Overflow Arms of Precipitating Tanks and the like.* E. W. Ives, Derby. Eng. Pat. 789, January 13, 1894.

The overflow arms are constructed with a perforated inverted V- or dome-shaped cover, over which filter cloth is stretched to arrest floating suspended matter and prevent it from passing over on to the filter.—L. A.

*Improvements in Filtering Plant for the Purification of Water or other Fluids.* B. G. Martin and M. J. M'Mullin, Cork. Eng. Pat. 1135, January 18, 1894.

A closed vessel of sufficient strength, containing a suitable filtering material supported on a perforated partition, and provided with necessary manholes and doors for cleaning, is connected, between two valves, in a by-pass on the water main; the water can pass either through the main direct, or by opening the two valves and closing a valve in the main, it can be caused to pass through the filter.—L. A.

*Improvements in Filters specially designed for Treating Sewage or other Fouled Waters.* W. Ramsbottom, Accrington, Lancaster. Eng. Pat. 1703, January 26, 1894.

The filtering medium is placed upon wooden shelves, arranged above one another in tanks, so that the upper layers can be removed for cleansing or renewal without disturbing those beneath.—L. A.

*Improvements in Apparatus connected with Softening and Purifying Water.* C. H. Fitzmaurice, London. Eng. Pat. 2893, February 9, 1894.

The water to be treated, flows into a small measuring tank, and is automatically siphoned out when the tank has filled. When the tank is nearly full, a float rises, and when the tank is quite full, the float raises a lever and opens a valve in another tank containing the reagent; this joins the rush of water from the first tank and falls with it into the precipitation tank at a lower level.

By the emptying of the first tank, the float is released from contact with the lever, allowing the valve to close, so that only sufficient reagent is released to treat the water. The volume of reagent which has run out is replaced from a larger tank above.

The precipitation tank is large enough to allow time for precipitation; it is divided by a vertical partition, and the water falls on one side and rises on the other, through a filter, to a tap, from which it is drawn off as required. As the level of the water is thus lowered, a ball valve admits more hard water to the small measuring tank, and thus a continuous supply of softened water is maintained.—L. A.

*Improvements in the Purification of Sewage and other Foul Waters.* H. Lockwood, Manchester. Eng. Pat. 3969, February 24, 1894.

The patent relates to an improvement in the process of sewage purification described in Eng. Pat. 19,395, 1891, and consists in the substitution of acid sulphates, such as nitre-cake and salt-cake, for sulphuric acid when the difference in price warrants such substitution.—B. B.

*Improvements in Apparatus for Evaporating and Condensing Water.* A. Normandy, Surrey. Eng. Pat. 4350, March 1, 1894.

The evaporating apparatus consists of a double chamber, steam being passed into the inner chamber, and the water to be evaporated into the space between the two chambers. The inventor describes valves for automatically regulating the steam passing into the apparatus and from one part thereof to another, by means of one or more of such slide valves, so arranged that their positions are varied by variations in the steam-pressure above and below them; the object also being to obtain a constant rate of evaporation and a regular production of condensed water.

A valve for regulating the quantity of water in the evaporating chamber is also described; so that when the pressure of steam exceeds a certain amount, the valve is forced open and discharges some of the water, until, by the consequent reduction in the quantity of steam produced, the pressure falls again and the valve closes.—L. A.

*Improvements relating to the Manufacture or Regeneration of Carbonaceous Filtering Media.* J. Wetter, London. From M. Weinrich, St. Louis, Missouri, U.S.A. Eng. Pat. 4354, March 1, 1894.

"Spent" animal charcoal is caused to slowly pass through a revolving iron drum by means of an Archimedean screw, whilst a current of air, heated to any required temperature, is drawn through the drum in a reverse direction. In this way, any excess of carbon taken up during use, can be burned off quite evenly, below a red heat, and the black rendered again porous and fit for use.

Bone-black may also be regenerated by burning off the whole or most of the carbon, soaking the residue in a solution of organic matter, then drying and charring the product, and thus providing the mineral framework of the old black with a fresh coating of carbon. The inventor has previously described the use of animal matter for this purpose; he now finds that molasses, glucose, or a solution prepared by boiling starch or flour with hydrochloric acid and neutralising with lime, answer equally well. (See Eng. Pat. 5375, 1893.)—L. A.

*An Improved System and Apparatus for Purifying Sewage or other Foul or Waste Waters.* E. W. Ives, Derby. Eng. Pat. 20,744, October 30, 1894.

The apparatus patented consists essentially of a precipitating tank such as that described in Eng. Pat. 13,411, 1893 (this Journal, 1894, 832), used in conjunction with upward filter beds. The sewage to be purified, flows into a screening chamber in which the solid matter in suspension is broken up, then past a point where precipitants are added, and through a race provided with baffle-plates, into a precipitating tank, which is gradually filled, the sludge settling in the conical bottom of the vessel and the moderately clear liquid passing through overflow channels into a conduit, serving as a rough filter, and finally through filter beds composed of such materials as coke, sand, gravel, pebbles, broken brick, or oxide of iron. The sewage is aerated at various points of its course, and the sludge which settles in the conical portion of the precipitating tank is pumped up into a small separate settling tank, and there freed from the bulk of its water by the use of overflow holes at regulated heights fitted with the removable plugs.—B. B.

## (C.)—DISINFECTANTS.

*The "Lysoles" of Commerce.* W. Reuss. Pharm. Z. 1894, **39**, 525.

The composition of two different samples of the disinfectant known as lysol (consisting of cresol rendered soluble by the addition of certain kinds of soap in definite proportions) was as follows:—

| —— | No. I. | | No. II. | |
|---|---|---|---|---|
| | Per Cent. | | Per Cent. | |
| Pure cresols | 44·58 | | 49·20 | |
| Impurities | 4·40 | | 0·76 | |
| (Crude cresols | .. | 48·98 | .. | 49·96) |
| Potassium linolate | 27·83 | | 19·80 | |
| Glycerin, natural | 3·48 | | 2·13 | |
| (Soap, anhydrous | .. | 31·31 | .. | 21·93) |
| Glycerin added | 4·12 | | .. | |
| Ash | 7·17 | | 6·51 | |
| Water | 9·32 | | 21·34 | |
| | 100·90 | | 99·74 | |

—F. M.

*The Practical Applications of Ozone.* O. Fröhlich. Ber. d. deutsch. Elektrochem. Ges. 1894, 30.

*See under* XI., *page* 164.

## PATENTS.

*Improved Apparatus for Use in Sterilising and for Closing Bottles containing Sterilised Material.* K. Flaack, Brunswick, Germany. Eng. Pat. 2218, February 1, 1894.

The apparatus consists of a sterilising chamber heated by steam and provided with a trolly carrying the bottles containing the liquid to be sterilised, and fitted with a door having in front of it a rail capable of actuating the closing devices attached to the necks of the bottles. The rail is operated in a vertical direction by levers placed on each side of the sterilising chamber, and fitted with springs, which raise the rail to its original position when the levers are released. The bottles are preferably closed by the usual system, consisting of two stout wire loops so connected that the downward thrust of one of these loops towards the neck of the bottle, closes the stopper, over which the other loop passes.—B. B.

*Improvements in Pasteurising Apparatus.* C. N. Ramstedt, Tranbygge, Sweden. Eng. Pat. 17,309, September 11, 1894. (Under International Convention.)

The apparatus patented has for its object the rapid interchange of heat between the liquid to be sterilised and the surfaces of the heating portions of the apparatus. The heating parts of the apparatus are fixed horizontally upon a vertical rotating shaft, the whole being enclosed in a vertical cylindrical vessel. The circulation of the liquid to be pasteurised is caused to take place in a systematic manner by the disposition of the heating discs, which are so arranged that the liquid cannot pass directly in a vertical flow from the bottom of the vessel to the top. The use of internal diaphragms, which may be horizontal, helicoidal, or scroll-shaped, in the heating discs, similarly ensures the systematic circulation of the steam or water used as a source of heat. Brushes may also be interposed between adjacent heating surfaces with the view of favouring intimate contact between these surfaces and the liquid, and also with that of preventing the formation of deposits upon the heating surfaces. Various modifications in structural detail are described.—B. B.

*Process for the Manufacture of a Solution for Destroying Vermin.* A. B. F. Wegemund, Rostock, Mecklenburg. Eng. Pat. 21,815, November 12, 1894.

One part of alcohol is moderately warmed, and to it are successively added 1 part of aniseed oil, 3 of warmed olive oil, 3 of rape oil, 1 of castor oil, 1 of linseed oil, and 1 of almond oil. The rape oil before being mixed "is heated to boiling point and finely-chopped onion is added to it in the proportion of 1 litre of rape-seed oil to 1 large onion," the product being filtered before admixture. The composition is used for application to fowls and domestic mammalia for the destruction of parasites. Previous to use, it may be diluted with alcohol.—B. B.

## XIX.—PAPER, PASTEBOARD, Etc.

*Pyroxylin, its Manufacture and Applications.* W. D. Field. J. Amer. Chem. Soc. 16, 487—498. Part II. (For part I., see this Journal, 1893, 708.)

*Nitration of the Fibre.*—Paper composed of cotton and flax fibre, and having a thickness of $\frac{2 \text{ to } 3}{1,000}$ths of an inch, is cut into 1-inch squares or into long strips 1 inch wide; the former being used for nitration by the Celluloid Manufacturing Company, while the Zylonite Company employ the strips. The Celluloid Company introduce the paper into the mixed acids by means of the arrangement shown in Fig. 1, H, which is a rapidly revolving tube "*flared*" at the lower end and immersed in the acid. The centrifugal force throws the paper towards the sides of the vessel G, thus leaving space in the centre of the vessel for fresh paper. After the paper is nitrated the excess of acid is removed by

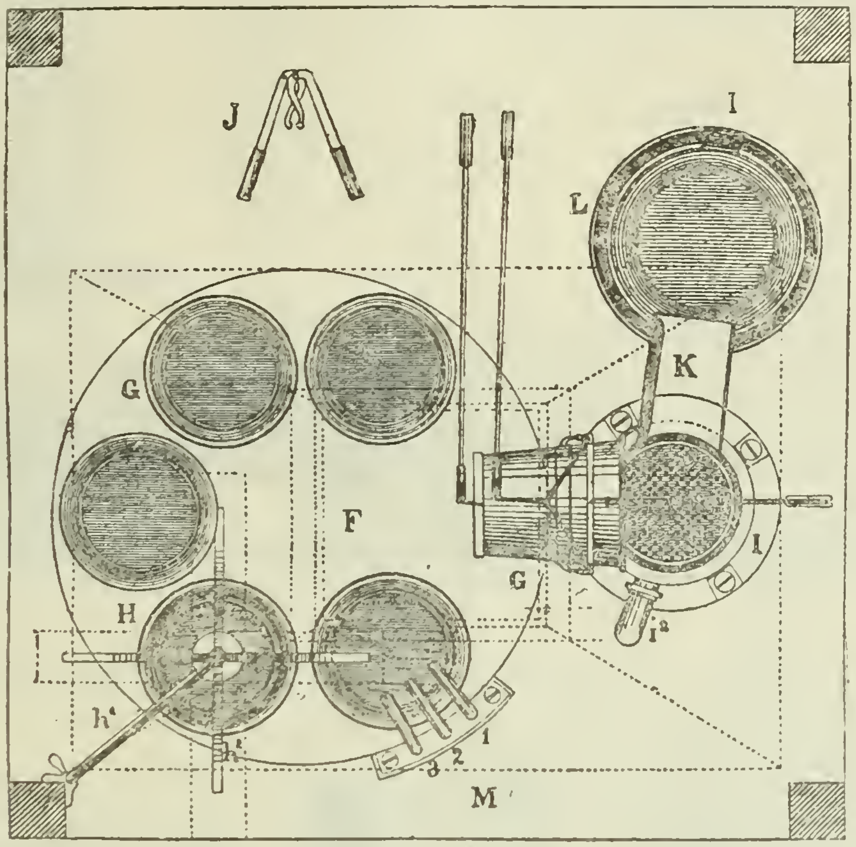

Fig. 1.

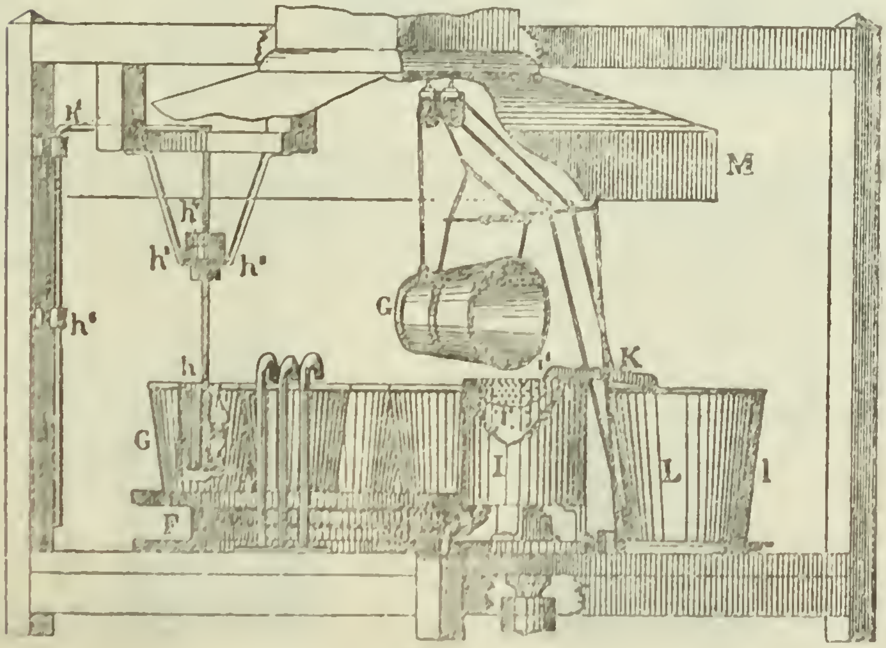

Fig. 2.

the arrangement shown in Figs. 1 and 2, G and 1. The strips of paper used by the Zylonite Company were placed in the acid by means of forks, and the vessels were cylindrical in form and divided into a number of sections, the whole revolving like a turntable to allow each batch of paper to be successively nitrated. After nitration the product was thrown into water without removing the excess of acid, which, by this process, was lost. Some manufacturers of pyroxylin use earthenware vessels and glass or steel rods hooked at one end to separate the fibres and protected at the other end by rubber hose to prevent the hand slipping. Fig. 3 shows the form of vessel generally used, the capacity being sufficient to nitrate 1 lb. of cotton.

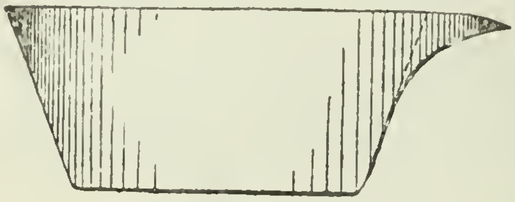
Fig. 3.

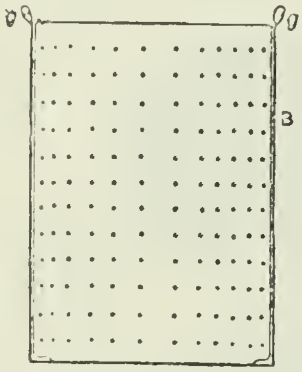

Fig. 4.

The nitrating apparatus of Tribouillet and de Besaucele (Eng. Pat. 5057, 1878) is figured. The author considers this apparatus somewhat unsuitable. In working by hand it is usual to protect the workmen from the acid fumes by a hood, which is exhausted by a fan or blower, and the hands are covered with white rubber gloves. During the winter the nitrating room is kept at a temperature of about 70° F. The nitrating apparatus of White and Schupphous (U.S. Pat. 418,237, 1889) is novel and practical, and it is claimed that no stirring is requisite during nitration, which may be the case with paper or even cotton when the temperature is from 30° to 35° C., but not when the temperature reaches to 50° or 55° C. The mode of procedure is as follows:—The paper is nitrated in the cage B, Fig. 4, the bottom of which is formed by the flanged plate c, attached to the bottom of the internal cylinder B, Fig. 5. After nitration the cage is carried to the wringer E, Fig. 6, of which it forms the basket, and the acids removed.

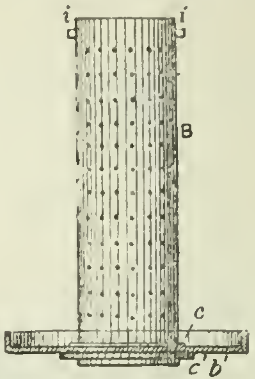

Fig. 5.

Finally the cage is taken to the plunge tank F, where the paper is removed from the cage by simply pulling out the perforated cylinder B. Fig. 7 shows the automatic cover of the nitrating pot, and Fig. 8 the plan and section of the plunge tank.

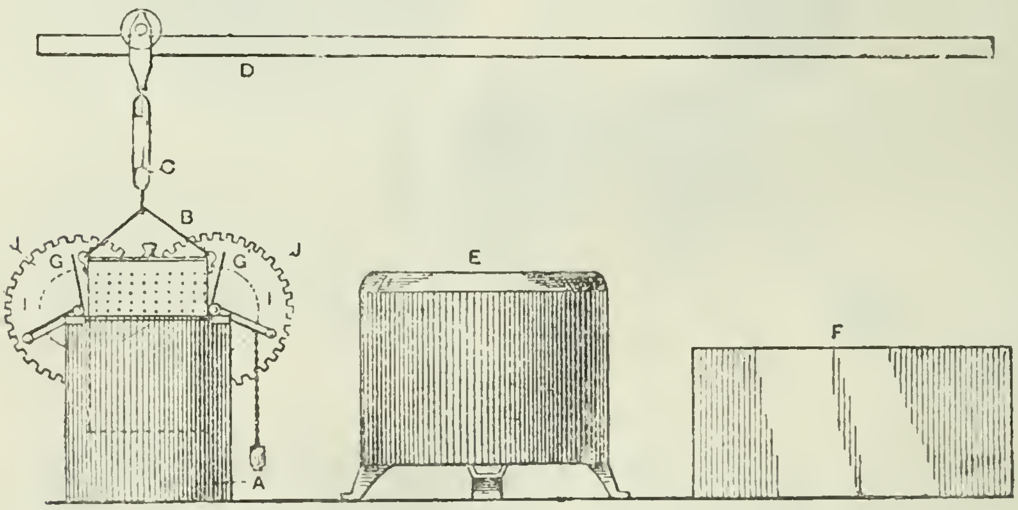

Fig. 6.

This apparatus appears to be the only patented method suitable for nitrating cotton fibre in bulk at high or low temperatures. By the method patented by Mowbray (U.S. Pat. 434,287, 1890), it is proposed to nitrate the paper in continuous lengths, but it has not yet been tried. The paper loops shown in the sectional drawing, Fig. 9, are imaginary, as the paper web would certainly settle down to the bottom of the acid tank (15). The paper web is allowed to remain in the nitrating tank (15) from 12 to 20 minutes. The patentee claims to be able to

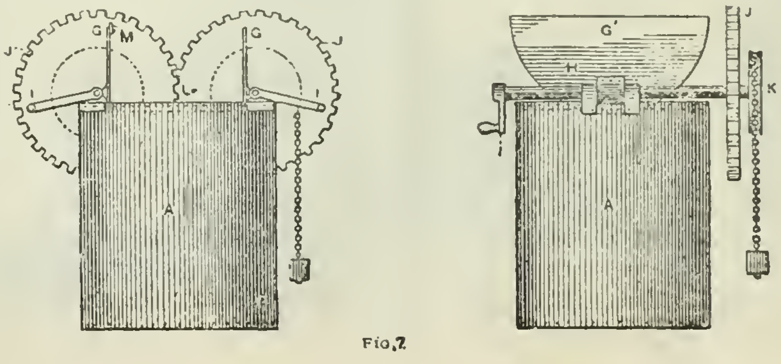

Fig. 7

maintain the strength of the acid in the nitrating tank by the methods described in U.S. Pat. 350,497 and 350,498, but these are no better than that of Hyatt (210,611). Steel is considered the best material for constructing the nitrating vessels. Mowbray claims the use of homogeneous metal, or Bessemer steel plates, for constructing the acid vessels, also *steeled* cast-iron pots. Fig. 10 shows the construction of a vessel for holding the waste acids from the nitrating pots, A being an inner earthenware pot having a capacity of from 100 to 500 gallons, and B a vessel of boiler steel with a flanged top E F. The pipe D is connected with compressed air, and C conducts the acid to where desired. According to Hyatt's patent (U.S. Pat. 299,388), the tanks for holding the mixed acids are preferably constructed of wrought iron, and protected by acid-proof coatings. Steel drums are suitable, provided air and moisture be excluded, and wrought iron answers equally well under similar conditions. The nitrating and storing tanks are made for an acid mixture of the following strength :—

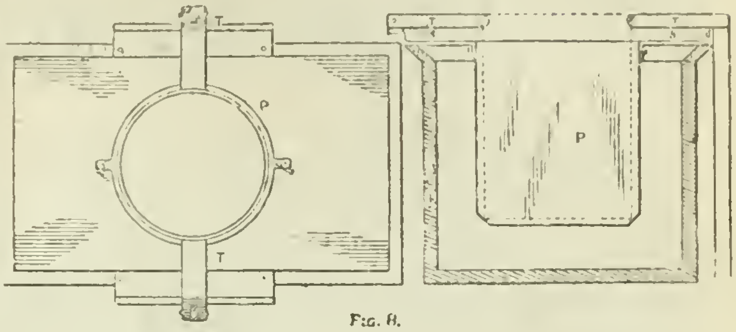

Fig. 8.

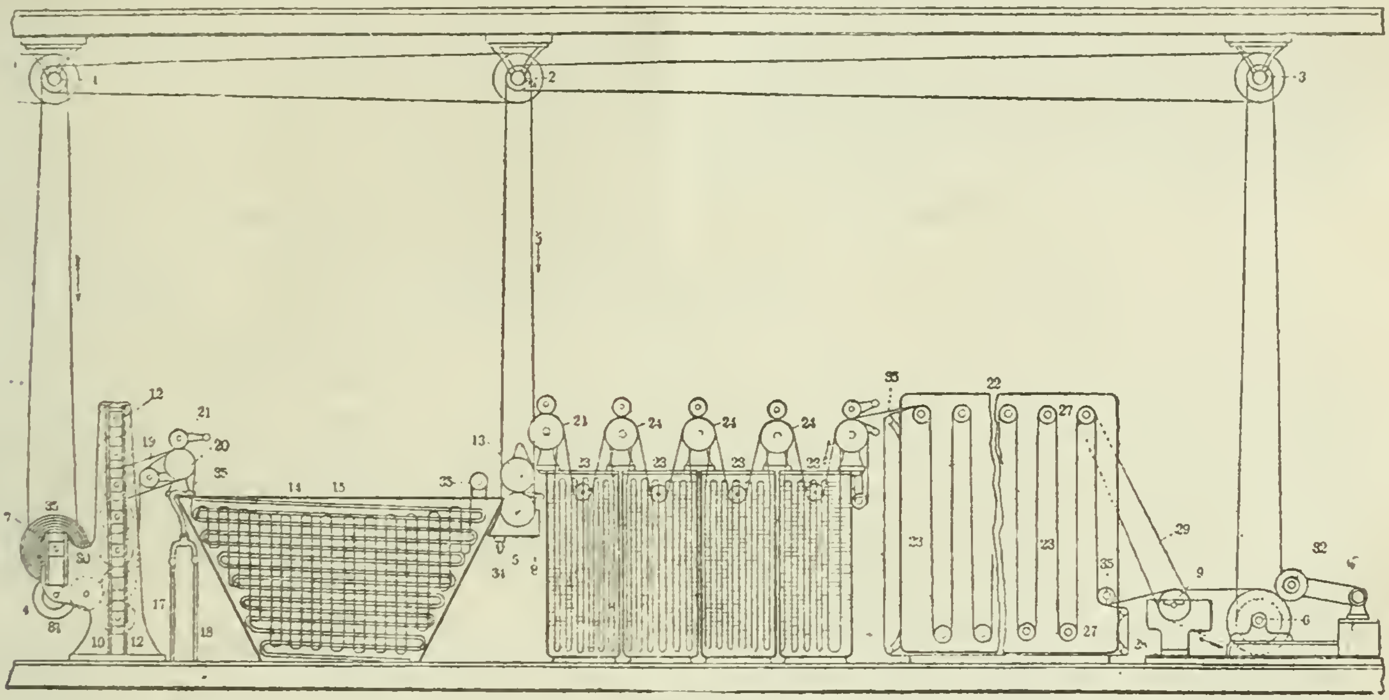

Fig. 9.

| | Parts (absolute). |
|---|---|
| Sulphuric acid | 66 |
| Nitric acid | 17 |
| Water acid | 17 |

and used at a temperature of 30° C. The arrangement of the plant described by Mowbray in U.S. Pat. 350,496 and in U.S. Pat. 299,388, by Hyatt, Pool, Everding, Stevens, and Wood, could not be used with the following mixture of acids :—Sulphuric, 62 parts (absolute); nitric, 24 parts (absolute); water, 14 parts; and at a temperature of 60° C. for immersion.

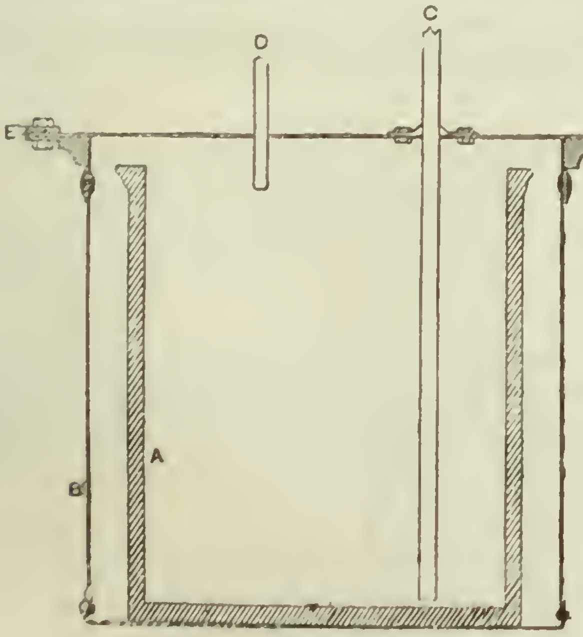

Fig. 10.

The nitrating apparatus of Schupphous, Mowbray, and Hyatt were designed for using tissue paper, and that of the former might also be used for cotton at low temperatures, although inconvenient on account of the length of time (5 to 6 hours) required for nitrating. It is thus apparent that both the cellulose material and the method of nitrating control the construction of the plant. No plant has yet been devised for nitrating cotton fibre in its natural form at high temperatures and using more than 1 lb. of cotton at an immersion.

*The Acid Mixture.*—At the present time not more than three different formulæ are in use by manufacturers of soluble nitrocellulose in America: the one used by the celluloid manufacturers; a second, in which the cotton is nitrated at high temperatures; and a third, in which the temperature is low and the time of nitration about 6 hours. This last method is considered the best: immersion at low temperature and the reaction allowed to proceed in pots holding from 5 to 10 lb. of cotton. The following formula is essentially that used by the celluloid manufacturers for the production of low nitrated forms :—

| | Parts by Weight. |
|---|---|
| Sulphuric acid | 66 |
| Nitric acid | 17 |
| Water | 17 |

the temperature of the acids at immersion 30° C., and the time of immersion 20 to 30 minutes; cellulose in the form of tissue paper about $\frac{1}{1000}$ths of an inch thick, and 1 lb to 100 of acid mixture. The nitrocellulose produced by the formula is very insoluble in the compound ethers and other solvents of pyroxylin, and is apparently only converted or gelatinised by the action of the solvent.

The following formula produces a mixture of tetra- and penta-nitrocelluloses, hardly soluble in methyl alcohol (free from acetone), but very soluble in anhydrous compound ethers, ketones, and aldehydes :—

| | |
|---|---|
| Nitric acid, sp. gr. 1·435 | 8 lb. |
| Sulphuric acid, sp. gr. 1·83 | 15¾ lb. |
| Cotton | 14 oz. |
| Time of the immersion | 45 min. |

temperature of immersion 60° C. (which is developed by mixing the acids together). The cotton is allowed to remain in the acid until it feels *short* to the rod. The following is the temperature record of a batch (made in the form of a bowl given in Fig. 1) during the time of nitration :—4 to 5 minutes were required to immerse 14 ounces of cotton, and then the temperature had risen to 60° to 65° C. In 10 minutes the temperature at the top was 63½° C., and at the bottom of the bowl, 66° C. The batch was then turned over, and in another 10 minutes the temperature at the top was 59° C., and at the bottom, 62° C. After 30 minutes the top was still 59° C., and the bottom, 60° C., and during the remaining hour and ten minutes the top of the acid ranged from 53° to 56° C., and from 64° to 67° C. at the bottom. A large proportion of the pyroxylin thus produced was insoluble in compound ethers. It will be noticed that there were two periods in which the temperature rose, and two distinct reactions took place. Had the temperature during the first 30 minutes gone up to 70° C., the cotton would have been finished inside of 45 minutes, and the pyroxylin produced would have been soluble in anhydrous ethers. These observations have been verified frequently.

The table given below is a careful record, which plainly shows the great variation in the time of the immersion and the temperature by apparently slight causes. The table extends over 14 working days, during four of which it rained. The formula used is the last of these given above, except that the specific gravity of the nitric acid was somewhat lower. The pyroxylin produced differs only from that produced by using nitric acid of sp. gr. 1·43 in being soluble in methyl alcohol. From 30 to 35 lb. of pyroxylin were produced on each of the 14 days.

| Weather. | Specific Gravity. | | Time. | | | | Temperature. | | Percentage. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sulphuric. | Nitric. | Hours. | Minutes. | Hours. | Minutes. | From | To | Increase. | Loss. |
| | | | | | | | ° C. | ° C. | | |
| 1. Clear | 1·838 | 1·4249 | .. | 20 | 4 | .. | 57 | 62 | 31 | .. |
| 2. „ | 1·837 | 1·4249 | .. | 20 | 2 | .. | 60 | 62 | 18 | .. |
| 3. Cloudy | 1·837 | 1·4226 | .. | 45 | 2 | .. | 60 | 62 | 7 | .. |
| 4. Rain | 1·837 | 1·4200 | .. | 20 | 1 | 20 | 60 | 63 | 0 | 0 |
| 5. Clear | 1·8377 | 1·4200 | 1 | 15 | 2 | .. | 58 | 62 | 15 | .. |
| 6. Rainy | 1·8391 | 1·422 | .. | 35 | 1 | 40 | 58 | 62 | .. | 2 |
| 7. Cloudy | 1·835 | 1·4226 | .. | 20 | .. | 35 | 62 | 64 | .. | 10 |
| 8. Clear | 1·835 | 1·4222 | .. | 35 | 1 | 10 | 60 | 62 | 5 | .. |
| 9. Partly clear | 1·824 | 1·4271 | .. | 20 | 1 | .. | 50 | 60 | .. | 3 |
| 10. „ | 1·83 | 1·4271 | .. | 10 | .. | 25 | 58 | 60 | .. | 10 |
| 11. Cloudy | 1·832 | 1·425 | .. | 10 | .. | 50 | 58 | 60 | 8 | .. |
| 12. Rainy | 1·822 | 1·425 | .. | 10 | .. | 20 | 58 | 60 | .. | 10 |
| 13. Partly clear | 1·8378 | 1·4257 | .. | 50 | 1 | 40 | 50 | 58 | 20 | .. |
| 14. Cloudy | 1·837 | 1·4257 | 1 | 56 | 4 | 40 | 50 | 60 | 16 | .. |

It will be seen that the increase in yield varies from 31 per cent. to nothing, and the loss amounts to as high as 10 per cent., although care was taken to make the product uniform in quality. On rainy days there was a loss, probably due to the cotton absorbing moisture, and when immersed in the acids, the latter in contact with the fibre was weakened, and produced what is known as *burning* or dissolution of the fibre. One perceives from this table how very difficult it is to nitrate cellulose in small quantities and get uniform results when the nitration is performed at high temperatures. The following are the condensed results of a month's work with the above formula :—

| | Lb. | Oz. |
|---|---|---|
| Cotton (scoured, upland) | 416 | 12 |
| Nitric acid, sp. gr. 1·42—1·425 (water white) | 4,957 | 0 |
| Sulphuric acid, sp. gr. 1·83—1·837 | 9,803 | 0 |
| Product | 513 | 6 |

—S. P. E.

*Paper Tiles.* Thonindustrie Zeit. 1894, **18**, 511.

In order to make pressed paper-pulp tiles (for roofs, walls and floors) impervious to moisture, they are impregnated with water-glass.—L. T. T.

## PATENTS.

*Treatment of Wood for the Manufacture of Cellulose and other Products.* C. F. Cross, London. Eng. Pat. 409, January 8, 1894.

By this invention, 1 part of wood in the form of chips is treated with 3 parts of 10 per cent. nitric acid solution, and heated to a temperature of 80° C. The pulp thus produced is freed of the spent liquor by pressing, and may be further purified by boiling with a solution of soda ash and washed. The spent liquor from the nitric acid treatment, as well as that of the soda treatment contain oxalic and acetic acid, the quantity of which may be further increased by neutralising the mixed waste liquors with caustic alkali, and evaporating down to a 30—40 per cent. solution. The thick liquor is run into open tanks, and caustic soda (equal in quantity to the organic matter dissolved) stirred into it and heated to 250° to 300° C. The brownish mass produced, is boiled with water from which oxalate, carbonate, and acetate of soda may be obtained by fractional crystallisation.—S. P. E.

*Improvements in and connected with Linings for Wood-Pulp Digesters.* R. Preston and T. Thornley, Bury. Eng. Pat. 2743, February 8, 1894.

The improvement relates to digesters lined with acid-resisting tiles, and consists of a method of securing these tiles to the shell without the aid of cement or lead. The tiles are fixed in position and the joints made between them by means of a plastic mass or paste, composed of asbestos and silicate of soda, the latter preferably of about 100° Tw. —S. P. E.

*Improvements in or connected with the Process of Bleaching Fibrous Material in the Manufacture of Paper.* B. Cawthorn, Hylton, and J. Cornett, Claxheugh. Eng. Pat. 2923, February 10, 1894.

By this improvement the pulp, after being beaten and the water drained off, is conveyed to a chest provided with an agitator, and a suitable outlet at the bottom. Into this chest the requisite bleaching solution is introduced, which, together with the pulp, is pumped into any one of a series of bleaching tanks. (The bleaching engine preferred is that described by the patentee in a former patent of his—Eng. Pat. 14,191 of 1893; this Journal, 1893, 859.) A pair of chests may be employed and any convenient number of bleaching tanks, and by a suitable arrangement of pipes, pumps, and troughs the pulp and bleach may be transferred from the chest to the first of the series of tanks, thence to the second, and so on throughout the series. As all the outlets of the tanks open into a common main, and the inlets from a common trough, with a pump in the circuit, the pulp may be transferred from any one tank to any other as often as desired.—S. P. E.

*Improvements in the Manufacture of Fabrics from Wood and like Fibre.* E. de Pass. (Communicated from J. C. McLauchlin and A. A. Hand, Brooklyn.) Eng. Pat. 4605, March 5, 1894.

The invention consists in treating fabrics made of chemical wood fibre with gelatin or paraffin dissolved in gasoline (petroleum spirit), and then in a crumpled, gathered, or twisted condition passing them between smooth rollers. The latter operation may be repeated several times, so as to vary the direction of the creases, and render the fabrics soft and flexible, after which they are smoothed by passing between heated surfaces.—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*The Basic Bismuth Nitrates of Commerce.* P. Carles. Journ. Pharm. Chim. 1894, 5 Sér. **30**, 202.

The lighter qualities of commercial basic bismuth nitrate found in the French market are generally preferred to the heavier ones for medicinal purposes. This prefersnce is shown to be unjustifiable, inasmuch as the lower specific gravity is merely owing to the presence of carbonate, which in fact is depreciative of the value of the product.—F. M.

*Behaviour of a Mixture of Iodoform and Calomel.* O. Schweissinger. Pharm. Central-H. N.F. 1894, **15**, 455.

A quantity of this frequently prescribed mixture which had been put into a stoppered bottle, was, after a few months' keeping, found to be converted into a red crystalline mass, in which, by means of the microscope, none of the original constituents could be distinguished. A mixture of mercuric chloride and iodide, together with a little chloroform had been formed by mutual decomposition, the odour of the latter substance being plainly perceptible on opening the bottle.—F. M.

*Bismuthum Subgallicum.* A. Hartz. Pharm. Rundsch. 1894, **12**, 182.

The following is a good method of preparing this product ("Dermatol"):—306 grms. of basic bismuth nitrate are dissolved in 328 grms. of nitric acid of 38° B. and 200 grms. of water. After filtration through glass-wool the solution is evaporated to 600 grms. The crystals separating out after the lapse of five or six hours are freed from mother-liquor and dissolved in 980 grms. of glacial acetic acid. To this solution, previously mixed with 8 litres of water at the ordinary temperature, is added, with continual stirring, a hot solution of 188 grms. of crystallised gallic acid in 8 litres of water. The sulphur-yellow precipitate, after having been washed five or six times with hot water, is pressed and dried on a porous plate at a temperature not exceeding 80° C.—F. M.

*Localisation of the Alkaloids in some Seeds.* G. Clautriau. Ann. Soc. belge de microsc. 1894, **18**, 35.

The localisation of the alkaloids in the seeds varies considerably with different species of plants. Thus, in the case of *Atropa belladonna*, *Datura stramonium*, and *Hyoscyamus niger* they are found exclusively in the cellular tissue immediately surrounding the endosperm. In *Conium maculatum* the coniine is contained in large quantities in the same tissue, and in lesser quantities in that of the pericarp. The alkaloids of *Aconitum napellus* and of *Delphinium staphisagria* are confined to the endosperm, while those of *Strychnos nux vomica* occur also in the embryo, but are missing in the hairy covering enclosing the seed.

In the germination of the seeds and the development of the plant the alkaloids play no part of physiological importance. *Datura stramonium* seed, from which all alkaloids had been removed, germinated in a perfectly normal manner. The seedlings after a short period again contained alkaloids, which therefore appear to be formed as by-products in the distribution of the proteid reserve-substances.—F. M.

*The Testing of Zinc Oxide.* Th. Salzer. Pharm. Zeit. 1894, **39**, 553.

*See under* XXIII., *page* 188.

*Estimation of Antipyrine.* M. F. Schaack. Amer. J. Pharm. 1894, **66**, 321.

*See under* XXIII., *page* 199.

*Lactophenine.* H. Thoms. Pharm. Ges. Ber. 1894, **4**, 161.

*See under* XXIII., *page* 196.

*Di-acetyl Tannin ("Tannigene"), a new Astringent.* H. Mayer. D. med. Wochenschr. 1894, **20**, 626.

*See under* XXIII., *page* 195.

*Detection of Free Benzoic Acid in Benzonaphthol.* G. Griggi. Boll. Chim. Farmac. 1894, **32**, 481.

*See under* XXIII., *page* 195.

*Different Behaviour of Atrophine and of Strychnine in Vitali's Reaction.* D. Vitali. Boll. Chim. Farmac. 1894, **33**, 449.

*See under* XXIII., *page* 196.

PATENTS.

*Improvements in the Preparation of Acetic and Oxalic Acids.* H. Plater-Syberg, Paris. Eng. Pat. 23,682, December 8, 1893.

*See under* VII., *page* 157.

*Improvement in the Method and Apparatus employed in the Production of Ozone.* C. T. Yarnold, London. Eng. Pat. 2488, February 5, 1894.

This invention consists in passing cooled oxygen through a box or condenser containing a series of glass sheets coated with gold foil to prevent oxidation, and connected with a source of alternating currents of electricity. The author has found 125 alternations per second and a potential of 50 volts very serviceable. The oxygen, in its passage through the narrow passages between the glass plates, is subjected to the influence of the alternating currents and light simultaneously.—J. S.

*The Treatment of Ergot of Rye and the Production therefrom of the Substance which Imparts to it its Valuable Properties.* J. Y. Johnson, London. From C. F. Boehringer and Söhne, Waldhof, Mannheim. Eng. Pat. 4097, February 26, 1894.

The substance which imparts to ergot of rye its valuable properties is a weak acid, and is obtained in the form of a dried yellow powder, which is almost insoluble in water, benzine, ligroïn, petroleum ether, petroleum, &c., soluble in acetic acid, alcohol, chloroform, benzene, toluene, and ether. It is soluble in its own weight of ether, and this property is of value in identifying and separating it from other substances.

The method of preparation is to extract the pulverised ergot of rye with cold ether, to distil off the ether, and then precipitate with petroleum ether boiling between 36°—42° C. By redissolving, precipitating, and subsequent drying, the substance is obtained in the pure condition and free from oil. Instead of the above method, the oil may first be extracted by means of petroleum ether. The active substance is then dissolved out by ether, from which it may be obtained by shaking with a weak alkaline solution, and then precipitation with acids, all the operations being conducted at as low a temperature as possible.—J. S.

*Improvements in or relating to the Preservation of Lime and Lemon Juices.* J. B. Rose, London. Eng. Pat. 4391, March 2, 1894.

The juice is evaporated at a temperature of 120° F. to one fifth of its bulk, in pans constructed of materials unacted upon by acids. When required for use, the concentrated juice is mixed with the required amount of water and sugar if preferred.

The inventor's claim is the preparing of concentrated lemon juice without the addition of antiseptics.—L. de K.

*Improvements in the Development or Preparation of High-Percentage and of Chemically Pure Superoxide of Hydrogen.* R. Wolffenstein, Berlin. Eng. Pat. 4423, March 2, 1894.

The improvements relate, firstly, to the concentration of dilute hydrogen peroxide solution by evaporation in air or in a vacuum aided by heat; and, secondly, to the preparation of chemically pure hydrogen peroxide by distilling the above concentrated solution in a vacuum at a moderate temperature (84° C.), and then purifying the distillate by pouring it into a solvent such as ether. The pure substance is then obtained by treating the ethereal extract with water or by evaporating off the ether and distilling in a vacuum. If free from foreign substances, especially basic substances, and suspended matter, the concentrated solution of hydrogen peroxide is not subject to decomposition on long keeping. —J. S.

*Manufacture of Bismuthoxyiodide Gallate.* F. Lüdy, Bâle, Switzerland. Eng. Pat. 22,902, November 26, 1894.

This compound is prepared by the action of hydriodic acid on bismuth subgallate, or of gallic acid on bismuth-oxyiodide.

Bismuthoxyiodide, separated in the known manner from 9·5 parts by weight of crystallised bismuth nitrate, is well washed, and whilst moist is stirred up with water. 3·4 parts of gallic acid are added, and the mixture is heated on the water bath until the red colour has been completely changed to dark greyish-green. The precipitate is collected and then dried at a moderate heat.

An alternative method is to heat 10 parts by weight of bismuth gallate ("dermatol") with 3·1 parts of hydriodic acid ("iodide of hydrogen"), until the yellow colour has been entirely converted into a greyish-green. It is then well washed, and dried at a moderate heat.—J. S.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*The Estimation of Nitrogen in Nitrocellulose.* D. Stanojewitsch. Zeits. angew. Chem. 1894, 676.

*See under* XXIII., *page* 199.

PATENTS.

*Improvements in the Manufacture of Photographic Plates.* A. Zimmermann, London. From The Chemische Fabrik auf Actien vorm. E. Schering, Berlin, Germany. Eng. Pat. 3477, February 17, 1894.

A small quantity of formic aldehyde is added to the light- or colour-sensitive gelatin emulsion before pouring it upon the plate, whereby, after drying, the film is rendered insoluble in water. Or a compound film is formed by first employing a gelatin film rendered insoluble by formic aldehyde (Eng. Pat. 2036, 1894; this Journal, 1895, 65), and pouring upon this the emulsion described above; the compound film thus produced may, if required, be stripped off its support. These films may be rendered colour-sensitive by dipping them into a colour-sensitive solution. —J. C. C.

*Improvements in Apparatus for Drying Photographic Plates, Films, and Papers, and such like Articles.* F. Iles, Birmingham. Eng. Pat. 3605, February 20, 1894.

This apparatus consists in a hub or pulley capable of being rotated at a high speed, by any convenient means, attached to which are radial arms, preferably of a flat form so as to produce air currents when revolved; these arms carry movable pins or projections which can be adjusted and locked upon the arms at certain positions. These pins may be covered with rubber to prevent vibration. The articles to be dried are placed upon the radial arms and are retained by the pins during the necessary rotation, the superfluous moisture being driven off by centrifugal force and is collected in a pan, within which the apparatus revolves. The radial arms may be replaced by a disc, to which fans or wings may be attached to create air currents. —J. C. C.

*Improvements in the Manufacture of Sensitive Plates and Films for Photographic Purposes.* C. E. Pettitt, Torquay. Eng. Pat. 4606, March 5, 1894.

In order to prevent or diminish halation, a substratum or coating containing a fluorescent substance is interposed between the sensitive emulsion and its support. As suitable fluorescent substances cinchonine and quinine are instanced.—J. C. C.

## XXII.—EXPLOSIVES, MATCHES, Etc.

"*Researches on Explosives.*" *Preliminary Note.* Capt. Sir A. Noble. Proc. Roy. Soc. 56, 205—221.

The author has carried out many experiments to determine the transformation during explosion, and the pressure developed, when guncotton, and those modern explosives of which guncotton forms a principal ingredient, are fired in a closed vessel. Ballistic results were also studied in a 6-inch gun of 100 calibres in length. Experiments were also made to test the possibility of detonating some of the explosives, chiefly cordite, and the author has not yet succeeded in causing this explosive to detonate. The erosive effect of different powders was studied, and the conclusion is drawn that the principal factors determining its amount are: (1.) The actual temperature of the products of combustion. (2.) The motion of these products; and the experiments have shown that where the heat developed is low, the erosive effect also is low.

It is pointed out, however, that while the erosion produced by cordite appears to consist in a simple washing away of the surface of the steel barrel, that due to ordinary gunpowder gives rise to large holes and long, rough grooves which often develop into cracks. The following tables show the effect of pressure on the composition of the resulting gases when W.A. guncotton was fired under different conditions, the amount of $CO_2$ increasing with the pressure:—

Table I.—Results in Volumes of the Analyses of the Permanent Gases generated by the Explosion of Strand Guncotton, arranged according to ascending Pressures.

| Under Pressure of Gas. | Tons per Square Inch. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1·5 | 2·5 | 8·0 | 8·0 | 12·0 | 12·3 | 18·0 | 20·0 | 45·0 ? | 48·0 ? | 50·0 ? |
| $CO_2$ .......... (vols.) | 26·49 | 29·62 | 30·95 | 31·00 | 32·23 | 32·70 | 33·63 | 33·01 | 34·70 | 34·77 | 36·18 |
| CO ........... „ | 36·66 | 35·03 | 32·27 | 32·76 | 30·65 | 31·36 | 31·20 | 30·32 | 28·60 | 28·66 | 27·57 |
| H ............ „ | 19·68 | 17·13 | 19·10 | 18·80 | 20·38 | 19·23 | 17·99 | 18·25 | 16·56 | 17·48 | 16·76 |
| N............. „ | 16·85 | 18·18 | 17·20 | 16·90 | 16·43 | 16·25 | 16·23 | 16·60 | 16·83 | 16·05 | 16·15 |
| $CH_4$ .......... „ | 0·32 | 0·04 | 0·48 | 0·54 | 0·31 | 0·46 | 0·95 | 1·82 | 3·31 | 3·04 | 3·34 |

Table II.—Similar Analyses for Pellet Guncotton.

| Under Pressure of Gas. | Tons per Square Inch. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1·0 | 1·5 | 6·5 | 11·0 | 14·0 | 15·0 | 17·0 | 17·0 | 25·0 | 30·0 |
| $CO_2$.......... (vols.) | 21·50 | 25·03 | 25·61 | 26·68 | 27·41 | 25·75 | 28·54 | 28·39 | 28·24 | 28·88 |
| CO ........... „ | 39·70 | 36·85 | 39·51 | 36·97 | 37·23 | 38·00 | 35·52 | 36·41 | 34·94 | 35·64 |
| H............. „ | 22·83 | 21·00 | 18·80 | 19·59 | 19·37 | 19·71 | 18·47 | 19·64 | 20·30 | 20·50 |
| N............. „ | 15·58 | 15·88 | 15·97 | 15·91 | 15·35 | 15·26 | 16·08 | 14·90 | 15·59 | 14·98 |
| $CH_4$ .......... „ | 0·39 | 1·24 | 0·11 | 0·85 | 0·64 | 1·28 | 1·39 | 0·66 | 0·93 | .. |

Table III.—Results of the Analyses of Strand Guncotton when Fired in a Close Vessel by Detonation.

| —— | Pressure* per Square Inch. | |
|---|---|---|
| | 1 Ton. | 3 Tons. |
| $CO_2$ ............. (vols.) | 19·21 | 29·08 |
| CO ............... „ | 41·25 | 32·88 |
| H ............... „ | 23·07 | 20·14 |
| N............... „ | 16·21 | 17·50 |
| $CH_4$ ............. „ | 0·26 | 0·75 |

Table IV.—Similar Results for Pellet Guncotton.

| —— | Pressure per Square Inch. | |
|---|---|---|
| | 3 Tons. | 10 Tons. |
| $CO_2$.............. (vols.) | 25·76 | 26·50 |
| CO ............... „ | 39·34 | 37·48 |
| H ............... „ | 18·71 | 20·97 |
| N ............... „ | 16·19 | 15·05 |
| $CH_4$............. „ | Nil | Nil |

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* The pressures given are those due to the gravimetric density of the charge.

TABLE V.—RESULTS of ANALYSES of SATURATED PELLET GUNCOTTON FIRED in a CLOSE VESSEL by DETONATION.

| — | Pressure per Square Inch. | | | |
|---|---|---|---|---|
| | Under 10 Tons. | 10·5 Tons. | 16 Tons. | 16·5 Tons. |
| $CO_2$.. (vols.) | 32·14 | 33·25 | 32·93 | 35·60 |
| CO .. „ | 27·04 | 25·90 | 27·25 | 23·43 |
| H.... „ | 36·80 | 26·53 | 25·76 | 21·22 |
| N.... „ | 13·83 | 14·32 | 14·06 | 15·25 |
| $CH_4$. „ | 0·19 | Nil | Nil | 1·50 |

Under a pressure of about 10 tons per square inch strand guncotton developed 1,068 calories (water fluid) 689 cc. of permanent gas, and 162·6 cc. of aqueous vapour, per gram., at 0° and 760 mm. Table VI. shows the composition of the permanent gases from cordite. The first four analyses were made from experiments with the earlier samples of cordite which contained tannin; in the second four the cordite consisted of 37 per cent. guncotton, 58 per cent. nitroglycerin and 5 per cent. vaselin.

The 0·255 cordite generated 1,284 cals. (water fluid) 692 c.cs. of permanent gas, and 194 cc. aqueous vapour per gram. A sample of ballistite composed of 50 per cent. of nitroglycerin and 50 per cent. of nitrocellulose gave permanent gases of the following composition under pressures of 6 and 12 tons per square inch respectively:—

| | | |
|---|---|---|
| $CO_2$.................... | 37·3 | 38·49 |
| CO .................... | 27·8 | 28·35 |
| H .................... | 19·1 | 19·83 |
| N .................... | 15·8 | 13·32 |
| $CH_4$ .................... | Traces | Traces |

Heat generated 1,365 calories (water fluid) 610 cc. permanent gas, and 197 cc. aqueous vapour per gram. at 0° and 760 mm.

The following table shows some of the ballistic results obtained with various powders.

TABLE showing the VELOCITIES and ENERGIES realised in a 6-inch GUN with the under-mentioned EXPLOSIVES.

| Nature of Explosive and Weight of Charge. | Length of Bore, 40 Calibres. | | Length of Bore, 50 Calibres. | | Length of Bore, 75 Calibres. | | Length of Bore, 100 Calibres. | |
|---|---|---|---|---|---|---|---|---|
| | Velocity. | Energy. | Velocity. | Energy. | Velocity. | Energy. | Velocity. | Energy. |
| Cordite, 0·4″ dia., 27·5 lb. ............ | 2794 | 5413 | 2940 | 5994 | 3166 | 6950 | 3284 | 7478 |
| Cordite, 0·35″ dia., 22 lb. ............ | 2414 | 4142 | 2583 | 4626 | 2798 | 5429 | 2915 | 5892 |
| Cordite, 0·3″ dia., 20 lb. ............ | 2495 | 4316 | 2632 | 4804 | 2821 | 5518 | 2914 | 5888 |
| Ballistite, 0·3″ cubes, 20 lb. .......... | 2416 | 4047 | 2537 | 4463 | 2713 | 5104 | 2806 | 5460 |
| French B.N., 25 lb. .................. | 2422 | 4068 | 2530 | 4438 | 2700 | 5055 | 2786 | 5382 |
| Amide Prismatic, 32 lb. ............ | 2225 | 3433 | 2331 | 3768 | 2486 | 4285 | 2566 | 4566 |
| R.L.G.$_2$, 23 lb. ...................... | 1533 | 1630 | 1592 | 1757 | 1668 | 1929 | 1705 | 2016 |

TABLE VI.

| — | Pressure per Square Inch. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0·048 Cordite. | | | | 0·255 Cordite. | | | |
| | 2·5 Tons. | 6 Tons. | 10 Tons. | 14 Tons. | 10 Tons. | 12 Tons. | 11 Tons. | 14 Tons. |
| $CO_2$.................. | 29·9 | 30·4 | 32·0 | 31·6 | 27·0 | 28·4 | 23·9 | 26·3 |
| CO .................. | 28·3 | 30·7 | 32·9 | 32·1 | 34·2 | 33·8 | 37·2 | 35·8 |
| H .................. | 19 3 | 20·0 | 18·0 | 21·6 | 26·9 | 24·4 | 28·4 | 26·1 |
| N.................. | 22·5 | 18·9 | 17·1 | 14·8 | 12·0 | 13·4 | 10·4 | 11·8 |
| $CH_4$ .................. | Traces | Traces | Traces | Traces | Traces | Traces | Traces | Traces |

—W. M.

*Pyroxylin, its Manufacture and Applications.* W. D. Field. J. Amer. Chem. Soc. 16, 487.

*See under* XIX., *page* 179.

*The Estimation of Nitrogen in Nitro - Cellulose.* D. Stanojewitsch. Zeits. ang. Chem. 1894, 676.

*See under* XXIII., *page* 199.

*Elimination of Potassium Perchlorate from Saltpetre.* V. Panastovic. Chem. Zeit. 18, 1894, 1567.

*See under* VII., *page* 157.

## PATENTS.

*Improvements in or connected with the Manufacture of Guncotton or other Manufactures in which Cooling Water liable to become Acidulated is employed.* E. Hesketh and A. Marcet, London. Eng. Pat. 3773, February 21, 1894.

The claim is, "In the manufacture of guncotton or other manufactures in which cooling water liable to become acidulated is employed, the use of alkali and blue litmus or the like, with the said water"—so that after cooling, the same water may be used over and over again without injury to the pipes through which it passes.—W. M.

*Improvements in and connected with Signal Lights, Roman Candles, Ships' Rockets, and other Fireworks.* G. Pinder and G. Ford, both of Newark, Nottingham. Eng. Pat. 10,568, May 31, 1894.

Two devices are described for keeping the frictional igniting parts separated from the firework composition until the moment of using; one consisting in having a reversible cap, the frictional igniting arrangement being kept in the upper part and separated from the firework composition by a diaphragm. When required for use the cap is reversed, thus bringing the frictional igniting arrangement directly on top of the firework composition. The other device consists in interposing a metal slide between the frictional igniting arrangement and the firework composition, and which is withdrawn before use.

—W. M.

*Improvements in Pyroxylin Compounds, and in the Processes for Manufacturing the same.* R. C. Schupphaus, Brooklyn, U.S.A. Eng. Pat. 21,331, November 6, 1894.

The inventor proposes to replace the camphor at present used in the manufacture of solid and liquid pyroxylin compounds by alkyl derivatives of the aromatic amines and their substitution products.

Among others, the following are employed:—

Formanilide,
Ortho-acetphenetidine,
Ortho-acetotoluide,
Para-acetphenetidine,
Para acetotoluide,
Benzanilide,

and likewise the bromo- and nitro-derivatives of such compounds.—W. M.

*Improvements in High-Power Explosives.* H. H. Lake, London. From C. S. Randall, New Bedford, Mass., U.S.A. Eng. Pat. 23,007, November 27, 1894.

This invention consists essentially in mixing together a suitable hydrocarbon derivative, an oxidising agent, and a suitable material for rendering the mixture sufficiently sensitive, to be detonated or exploded.

The following examples of mixtures are given:—

I.

| | Per Cent. |
|---|---|
| Nitronaphthalenes | 8 |
| Nitrate of soda | 76 |
| Nitrophenols | 13 |

II.

| | Per Cent. |
|---|---|
| Nitronaphthalenes | 8 |
| Nitrate of soda | 58 |
| Nitrophenols | 34 |

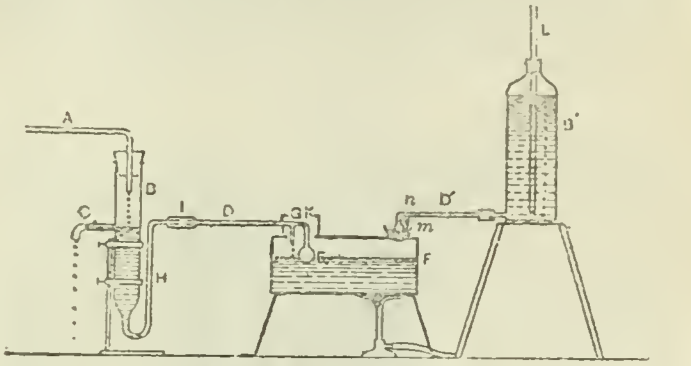
—W. M.

# XXIII.—ANALYTICAL CHEMISTRY.

## *APPARATUS, ETC.*

*A Constant-Level Apparatus.* F. C. Robinson. J. Amer. Chem. Soc. 16, 405—406.

The apparatus shown in the figure consists of two parts. That on the left is for maintaining the level of water in the bath.



A Constant-Level Apparatus.

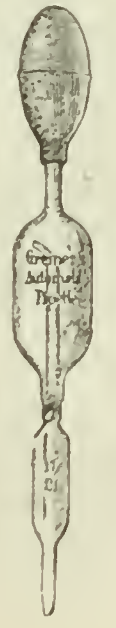
B is a glass tube about 2·5 cm. diameter, into which the water-supply flows through the narrow tube A. The excess of water overflows by the tube C, which is of larger bore than A, and discharges into a sink. Connected to the tube H by the flexible connection I, is a tube D, of equal bore and about 25 cm. long; this tube has a bulb E, 5 cm. in diameter at one end, and is sealed at K; it also has a branch at G. The bulb E floats upon the water. If B is clamped so that C and D are on a level, and the tap is opened so that water flows into B through A, it will run out of both C and D; but soon D will float up so high that no water can run out of G, and all will discharge at C. When the water-level falls again, D will fall with it, and water will again flow into the bath. The tube D moves up and down in a slot in the side of a copper cylinder fixed on the top of the bath; of course it might be made to work in a tube soldered to the side of the bath with water connection.

The apparatus to the right hand shows the same idea applied to the constant feeding of a platinum dish, in which a large volume of water or other liquid is being evaporated. In this case, the tube D is very small, so that the bulb, which is only 1·5 cm. diameter, can support it. The same apparatus can be used for washing large precipitates.

—L. A.

*A New Automatic Pipette.* E. Greiner. J. Amer. Chem. Soc. 1894, 16, 643.

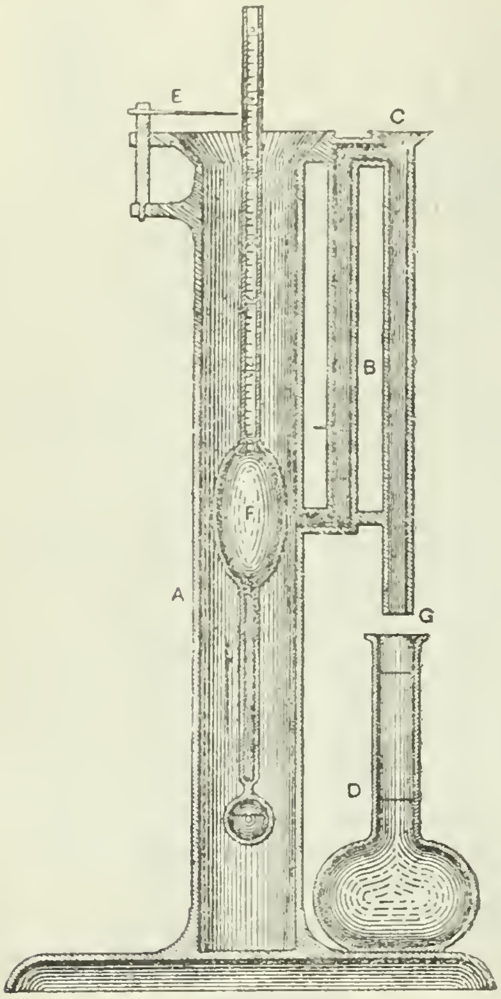
By means of the pipette, shown in the accompanying drawing, successive equal volumes of any given liquid may be rapidly measured out, almost automatically. It can be made in all sizes up to 50 cc.



It is particularly useful, when aspirating a great number of samples in succession of similar volumes of the same liquid.—H. T. P.

### *A Gravimeter for Sugar Analysis.* W. K. Gird. J. Amer. Chem. Soc. 1894, **16**, 677—678.

In using this apparatus, the hydrometer F being removed, one finger is placed on the open mouth of the tube G; the empty tube A is filled to the brim with the saccharine solution, foam is struck off the top, and the finger is removed from G. In this way the tube C G is rinsed with the solution; but owing to the ingress of air at C it cannot act as a siphon. The graduated flask D being placed in the position indicated, the saccharometer, which weighs 26·048 grms., is introduced into A. Thus a definite weight of liquid, equal to that of the hydrometer, is discharged through B and G into the flask; and the last drop of solution must be caught. The instrument is unaffected by changes of temperature, as the displacement is determined by the weight of the saccharometer, which is constant. The movable index E is arranged, for sake of convenience, 5° above the surface of the liquid; a corresponding deduction must therefore be made from the observed graduation on the stem of the saccharometer. In a later form of the instrument, a thermometer carrying the usual graduations, and a table for correction due to differences in temperature, are permanently attached.—W. G. M.



### *A Source of Current for Electrochemical Analysis.* C. Heim. Ber. d. deutsch. Elektrochem. Ges. 1894, 50.

*See under* XI., *page* 165.

## *INORGANIC CHEMISTRY.—QUALITATIVE.*

### *The Testing of Zinc Oxide.* T. Salzer. Pharm. Zeit. 1894, **39**, 553.

The present method of examination, according to the German Pharmacopœia III., consists in dissolving 1 part of zinc oxide in 10 parts of dilute acetic acid, and adding ammonia in excess, whereupon neither ammonium phosphate nor ammonium oxalate should produce a precipitate in the solution. Owing, however, to the high degree of concentration, even the addition of water leads to the formation of a precipitate of zinc hydroxide, whilst, if more than a drop or two of the two last-named reagents are used, precipitation also takes place. The right proportions for the zinc solution are: 1 part of zinc oxide and 6 parts of dilute acetic acid. After solution 30 parts of water are added, and thereafter 18 parts of ammonia.—F. M.

### *The Microscopical Analysis of Steel.* Eng. and Mining J., January 26, 1895, 79.

At a recent conference held under the auspices of the French Society for the Encouragement of National Industry, N. Osmond described a method for the microscopical analysis of steel, which he believes is capable of practical application in almost every manufactory. The method proposed comprises, in addition to the preliminary process of preparing the polished surface, three operations: 1. Polishing in bas-relief on parchment with a very small quantity of English rouge mixed with water; 2. Etching and polishing on parchment with a mixture of calcium sulphate, in precipitate, in a suitable vehicle; and 3. Etching with tincture of iodine or nitric acid. These three operations enable one to recognise in the steel five constituents, of which two are already well-known; the third is known, but imperfectly understood; and the remaining two have not been recognised hitherto. To the first is given the name of Ferrite—that is to say, the iron itself, practically pure; the next is termed Cementite, a carburet of iron, corresponding to the formula $Fe_3C$; the third is known in Sorbite—it accompanies the Cementite, and represents carbon when the latter appears to be in the state known as the hardening carbon; to the fourth is given the name of Martensite—it is the principal constituent of hardened steel, and consists of crystal or iron containing the hardening carbon in solution; and the fifth, Troostite, is generally found at the edge of the Martensite in hardened steel. These five constituents, which one might sometimes find in a state of transition, are associated in multiple combinations—binary, ternary, or quarternary—to form the complex edifice of the structure of steel. M. Osmond has examined four types of steel, possessing a known proportion of carbon, to discover the manner in which these combinations varied: 1. With the temperature of heating; 2. With the temperature of hardening; and 3. With the rate of cooling. As a result of that investigation, M. Osmond states that the thermic treatment of the steel leaves in the structure of the metal, when cooled, characteristic indications sufficiently precise to form a useful guide in the manufacture of steel, and also to enable consumers to determine the quality of the metal supplied to them.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Estimation of the Arsenic in Concentrated Sulphuric Acid.* Stepanow and Miklaschewski. Zap. imp. russk. techn. obszcz. 1894, **28**, 182.

50 cc. of the sulphuric acid under examination are slowly added to a solution of 30 grms. of common salt in 250 cc. of water, a little sodium bisulphite added, and the arsenic precipitated by means of sulphuretted hydrogen. The precipitate is redissolved in hydrochloric acid and potassium chlorate, and the arsenic precipitated as penta-sulphide by Neher's method. (This Journal, 1893, 376.)—H. T. P.

*The Determination of Phosphoric Acid.* S. W. Johnson. J. Amer. Chem. Soc. **16**, 462—465.

The citrate method of determining phosphoric acid may give good results under certain conditions, the results being correct owing to a compensation of errors, the ammonium magnesium phosphate not precipitating all the phosphorus, but sufficient impurities to counterbalance the loss. Over 90 determinations were made on 40 different substances; the results agreed fairly well with those made by the molybdate method, but in a few cases considerable discrepancies appeared, which rendered the method untrustworthy for testing fertilisers. In 1889 Dr. T. B. Osborne investigated this method, and J. H. Vogel published details of the procedure, which when adopted gave results too low. By using more and stronger magnesium mixture and a larger quantity of ammonia, the discrepancy was overcome, and in 67 determinations on bone-dust superphosphates, cotton-hull ashes, phosphatic guano, &c., only three differed from the results obtained by the molybdate method by more than 0·3 per cent. The greatest discrepancy by the two methods was 0·41 per cent., while the average difference was 0·09 per cent. In 30 cases the citrate method averaged 0·117 per cent. more, in 33 cases 0·079 per cent. less than the molybdate method.

Comparative duplicate trials upon made-up solutions containing 18·93 per cent. $P_2O_5$, 20 per cent. $Fe_2O_3$, 4·72 per cent. $Al_2O_3$, and 5·09 per cent. MnO, gave by the original Sonnenschein method 18·92 and 18·94 per cent., while the United States official method gave 19·26 per cent. The author sums up by stating that the citrate method only gives good results by compensation of its errors and under exact conditions which must be determined. Although good for calcium phosphate, it is quite inapplicable to ferric and aluminium phosphate. The molybdate method, carried out rapidly at temperatures higher than 50° C., or as high as 65° C., in the presence of ferric iron, aluminium, or manganese, gives results too high, and in the presence of a great excess of nitric acid too low, unless the filtrates are further treated with molybdic solution and digested until no more precipitate is formed.—S. P. E.

*Some Sources of Error in our Methods of Determining Potash in Fertilisers and German Potash Salts.* N. Robinson, Reporter on Potash for the Nat. Assoc. of Agric. Chemists for 1893. J. Amer. Chem. Soc. **16**, 364—372.

The author has submitted to investigation the three following methods, viz.:—The official or Lindo-Gladding (Chem. News. **69**, 198), the alternate (*ibid.* **69**, 199), and the Stassfurt or Anhalt method (*ibid.* **66**, 263). He finds that all three methods fall short of accuracy owing to the retention of potassium salts by the precipitates, and sundry other slight losses shown in the table.

Results of Analysis of Mixed Fertilisers, with Estimates of Losses of Potash in Precipitates and "Washings."

| —— | Mixed Fertilizer, containing:— | | | | | Mixed Potash Salts. |
|---|---|---|---|---|---|---|
| | Bone, Blood, &c. | Bone, Blood, &c. | Bone, Blood, &c. | Bone, Blood, &c. | Phosphate Rock. | |
| | 1. | 2. | 3. | 4. | 5. | 6. |
| | Grm. | Grm. | Grm. | Grm. | Grm. | Grm. |
| Weight taken for analysis | 0·5 | 1·0 | 1·0 | 1·0 | 0·5 | 0·25 |
| A.—Lindo-Gladding Method. | | | | | | |
| Weight of $K_2PtCl_6$ precipitated— | | | | | | |
| 1. By the method | 0·3263 | 0·4040 | 0·2433 | 0·2114 | 0·3160 | 0·4884 |
| 2. Recovered from $(NH_4)_2C_2O_4$ precipitate | 0·0030 | 0·0041 | 0·0031 | 0·0028 | 0·0084 | 0·0031 |
| 2. Recovered from first alcohol washing | 0·0041 | 0·0034 | 0·0021 | 0·0031 | 0·0033 | 0·0042 |
| 2. Recovered from washing with $NH_4Cl$ solution and second alcohol washing. | 0·0051 | 0·0061 | 0·0033 | 0·0053 | 0·0018 | 0·0022 |
| Total recovered | 0·0122 | 0·0136 | 0·0085 | 0·0112 | 0·0135 | 0·0095 |
| Percentage of $K_2O$— | | | | | | |
| 1. By the method | 12·60 | 7·80 | 4·70 | 4·10 | 12·20 | 37·70 |
| 2. Including recovered losses | 13·07 | 8·06 | 4·86 | 4·32 | 12·72 | 38·43 |
| Percentage of loss | 0·47 | 0·26 | 0·16 | 0·22 | 0·52 | 0·73 |
| Average loss per each 1 per cent. $K_2O$, estimated by the Lindo-Gladding method = 0·029 per cent. | | | | | | |
| B. "Alternate" Method. | | | | | | |
| Weight of $K_2PtCl_6$ precipitated— | | | | | | |
| 1. By the method | 0·3268 | 0·3989 | 0·2331 | 0·2072 | 0·3056 | 0·4896 |
| 2. Recovered from $(NH_4)_2C_2O_4$ precipitate | 0·0021 | 0·0015 | 0·0024 | 0·0010 | 0·0022 | 0·0015 |
| 2. Recovered from $BaSO_4$ precipitate | 0·0061 | 0·0083 | 0·0063 | 0·0064 | 0·0073 | 0·0044 |
| 2. Recovered from alcohol washings | 0·0024 | 0·0036 | 0·0024 | 0·0033 | 0·0031 | 0·0038 |
| Total recovered | 0·0106 | 0·0124 | 0·0111 | 0·0107 | 0·0126 | 0·0097 |
| Percentage of $K_2O$ | | | | | | |
| 1. By the method | 12·63 | 7·70 | 4·50 | 4·00 | 11·80 | 37·81 |
| 2. Including recovered losses | 13·04 | 7·94 | 4·70 | 4·21 | 12·29 | 38·56 |
| Percentage of loss | 0·41 | 0·24 | 0·20 | 0·21 | 0·49 | 0·75 |

Average loss per each 1 per cent. $K_2O$, estimated by the alternate method = 0·29 per cent.

After considerable experience in its use, the author has come to prefer the Anhalt method, though it is subject to the same defect as the other two. Thus, in an analysis of a sample of mixed German potash salts, the potassium recovered from the barium sulphate precipitate amounted to 0·01288 grm. of $K_2PtCl_6$ for each 1 grm. of the sample taken, which is equivalent to nearly 0·25 per cent. of potash ($K_2O$).—L. A.

*Electrolytic Separations.* Edgar F. Smith and Henry E. Spencer. J. Amer. Chem. Soc. **16**, 420—425.

1. *Silver from Copper.*—Classen has described a method in which the silver is precipitated as oxalate, by adding ammonium oxalate, filtered off, dissolved in potassium cyanide, and the solution subjected to electrolysis. The copper is precipitated by electrolysis of the filtrate from the silver oxalate precipitate. No results are given, however. (*Quantitative Analyse durch Elektrolyse, dritte Auflage*, p. 124.) The authors have made a number of experiments by this method, on solutions made from copper sulphate and silver nitrate. The weight of copper obtained in three out of four experiments, which are detailed, was within 0·0002 grm. of the weight taken, and in the fourth experiment was only 0·0008 grm. too low; yet in every case, on dissolving the deposited copper and testing it, silver was found, the largest amount recorded being 0·0009 grm. silver in 0·1134 grm. of copper. The conclusion is, that silver oxalate is not perfectly insoluble under the conditions of the experiment, and that the method therefore fails to give accurate results; confirming Rüdorf (Zeits. angew. Chem. 1892, 696).

On the other hand, the method of Smith and Frankel (*Smith's Electrochemical Analysis*, p. 100), in which a solution of the double cyanides, containing an excess of potassium cyanide, is electrolysed, the silver being precipitated free from copper, gave good results, as Rüdorff found (*loc. cit.*). By working at 65°—70° the time factor can be much reduced. Thus, from a solution measuring 200 cc., containing 0·1 grm. of silver, 0·114 grm. of copper, and 1·8 grms. of potassium cyanide, the silver was completely precipitated in about three hours, temperature being 65° and the current 0·07 ampère; it weighed 0·0996 grm., and contained no copper. (See, however, this Journal, 1890, 656).

2. *Mercury from Copper.*—This separation is also effected by electrolysis of the double cyanide solution, and in this case also time may be saved by working at about 65°. Thus 200 cc. of a solution containing 0·2167 grm. mercury, 0·2156 grm. copper, and 2 grms. potassium cyanide, was heated to 65° and electrolysed with a current of 0·08 ampère. In 3½ hours the deposition of mercury was complete, 0·2168 grm. being obtained, free from copper.

3. *Silver from Cadmium.*—These metals may also be separated by electrolysis of the double cyanide solution, provided the solution be hot; in the cold solution, the silver will always be contaminated by cadmium. 200 cc. of a solution containing 0·1000 grm. silver, 0·1000 grm. cadmium, and 3 grms. potassium cyanide, was heated to 65° and electrolysed for 3½ hours, with a current of 0·04 ampère. The precipitated silver weighed 0·1004 grm., and was free from cadmium.—L. A.

*Note on the Determination of Silica in Blast-Furnace Slag.* P. W. Shimer. J. Amer. Chem. Soc. **16**, 501—502.

The author finds that *spinelle*, which is frequently present in slag, is not decomposed by the usual alkaline carbonate fusion, and it is consequently unsafe to omit the treatment of the silica with sulphuric and hydrofluoric acids. When fluxing aluminous ores with magnesian limestone, spinelle is likely to be found in the slag, especially when the latter is basic; the alumina in this case acting as an acid, combines with part of the magnesia to form aluminate of magnesia. In determining the silica in such a slag by fusion with an alkaline carbonate, the spinelle seems to be unattacked by the fusion and the subsequent evaporation with hydrochloric acid, and is weighed with the silica. In the case of one slag, the silica before purification was 34·25 per cent.; after purification with sulphuric and hydrofluoric acids, it was found to be 31·52 per cent. The bluish-coloured residue left after the sulphuric and hydrofluoric acid treatment was easily dissolved in potassium bisulphate, and contained alumina and magnesia in the proportion to form spinelle. By successive and repeated treatment of 100 grms. of powdered spinelle slag with hydrochloric and hydrofluoric acids and a boiling solution of sodium carbonate in a platinum dish, it was found possible to separate 1 grm. of microscopic crystals of spinelle, free from all impurities.
—S. P. E.

*Estimation of Sulphur in Pyrites.* T. S. Gladding. J. Amer. Chem. Soc. **16**, 398—404.

Experiments were made to ascertain the relative merits of the methods chiefly in use, and the precautions necessary for accuracy.

*The Fusion Method.*—This comprises fusion of the ore with a mixture of sodium carbonate and nitre, solution in water, filtration from iron hydroxide, and precipitation as barium sulphate. Systematic experiments with pure potassium sulphate showed that in the presence of nitric acid or potassium nitrate high results are obtained, but sodium chloride and potassium chloride are without influence on the results. As complete expulsion of the nitric acid is a very tedious operation, involving repeated evaporations to dryness with hydrochloric acid, the method is not to be recommended.

*The Aqua Regia Method.*—This involves solution of the ore in aqua regia, or in aqua regia and bromine, and subsequent precipitation as barium sulphate. Experiments showed that citric acid, which is frequently used to keep iron in solution, does not of itself exert a solvent action on the barium sulphate precipitate; but ferric sulphate, if present, is nevertheless dragged down in place of an equivalent amount of barium sulphate, and, on ignition, sulphuric anhydride is expelled, ferric oxide remains, and a low result is obtained. This is still the case, even if a large excess of hydrochloric acid be present in the liquid; and the loss is greater the more intensely the precipitate is ignited, until all ferric sulphate is decomposed. Lunge and Hurter precipitate the iron with ammonia, and add barium chloride to the filtrate. Most careful washing of the ferric hydroxide precipitate, however, fails to wash out all the sulphate, and unless the precipitate be dissolved and the sulphate recovered a loss of a milligramme or two of sulphur will result. The process which the author recommends is as follows:—

Place 1 grm. of the finely-powdered and dried ore in a beaker, cover with a watch-glass, add 10 cc. of bromine solution (made by dissolving 75 grms. potassium bromide in 50 cc. water, adding 50 cc. bromine, stirring, and diluting to 500 cc.), mix well, and allow to stand 10 minutes in the cold. Add 10 cc. nitric acid, mix, and allow to stand 10 minutes longer. Then heat on a water-bath, gently at first, and when action has ceased, remove the lid and evaporate to dryness. Add 10 cc. hydrochloric acid, cover up, and when quiet, again uncover and evaporate to dryness. Add 1 cc. strong hydrochloric acid and 50 cc. hot water, digest until solution is complete, filter, and wash with hot water. The filtrate, about 100 cc. in volume, is treated with ammonia in slight excess, and the red precipitate is filtered off and well washed with boiling water. The filtrate and washings are acidified with hydrochloric acid in slight excess, heated to boiling, and treated, while boiling, with 50 cc. of a 10 per cent. solution of barium chloride, added one drop per second. The ammonia precipitate is dissolved in hot dilute hydrochloric acid, and 10 cc. of barium chloride solution are added. After standing over night, both precipitates are collected on the same filter, ignited, and weighed.

The following results were obtained by the analysis of samples of pyrites by the three methods. They confirm the results obtained with pure potassium sulphate, showing that the fusion method, when nitric acid is not expelled, gives results which are much too high, and that the bromine or aqua regia method, when iron is not removed, gives results which are from 0·20 to 0·35 per cent. too low, the error varying with the intensity of ignition of the precipitate :—

| Sample No. | Fusion Method; Nitric Acid not expelled. | Bromine Method; Iron not precipitated; Citric Acid added. | The Method described above. |
|---|---|---|---|
| | Percentage of Sulphur. | | |
| 1 | 52·50 | 51·45 | 51·71 |
| 1 | 52·34 | 51·30 | 51·73 |
| 1 | 52·60 | 51·45 | 51·71 |
| 1 | .. | 51·34 | 51·71 |
| 1 | .. | 51·32 | 51·68 |
| 1 | .. | .. | 51·78 |
| 2 | 40·92 | .. | 40·50 |
| 3 | 39·90 | 39·25 | 39·60 |
| 4 | 40·90 | 39·72 | 40·00 |
| 5 | 41·25 | 40·05 | 40·40 |
| 6 | 41·80 | 40·90 | 41·10 |

—L. A.

Errata.—This Journal, 1895, 67, col. 2, 12 lines from bottom, for "Levoff" read *Lwoff;* five lines from bottom, for "are," read *is.*

## ORGANIC CHEMISTRY.—QUALITATIVE.

### *Investigations relating to Petroleum.* A. Riche and G. Halphen. J. Pharm. Chim. 1894, 30, 289.

The authors have endeavoured to find a method of distinguishing, on the one hand, American from Russian petroleum, and on the other, raw natural petroleum from artificial mixtures of refined oil with residues. Determinations of the density or refractive index of fractions of identical boiling points are frequently insufficient to throw light on the nature of the oils. The authors take advantage of the varying solubility of different petroleums in a mixture of chloroform and alcohol. Comparisons of different oils are made with the middle and higher fractions (of equal density). "The middle and heavy portions of American petroleum contain in a predominating degree saturated hydrocarbons of the methane series, whilst the corresponding fractions of Russian oils contain in a predominating degree hydrocarbons belonging to the hydrogenised benzene derivatives of the general formula $C_nH_{2n}$.

"It is reiterated that it is the middle and heavy portions only, of like density, that bear the discriminative comparison by means of the test given, since the higher boiling and the light (volatile) portions do not exhibit the solubility differences, these portions of both kinds of petroleums (American and Russian) consisting of hydrocarbons of the fatty series."

The differerence likewise of crude petroleum from artificial mixtures is discernible by means of the differences of solubility of the fractions of even or like density. Consequently, a mixture of refined petroleum with high boiling and the heaviest residues, to imitate a crude petroleum, could be detected by this test. In the case of crude petroleum, distillation is effected, the fractions of densities varying between 0·890 and 0·820 being chosen for the test.

The test is carried out by gradually adding a mixture of equal volumes of anhydrous chloroform and 93 per cent. alcohol to 4 grms. of the sample until solution is effected and the liquid becomes clear. Tables of results and curves are given.—H. T. P.

### *Detection of Free Benzoic Acid in Benzo-naphthol.* G. Griggi. Boll. Chim. Farmac. 1894, 32, 481.

A mixture of β-naphthol and benzoic acid is sometimes fraudulently substituted for benzo-β-naphthol, a substance considerably in use as an antiseptic. For the purpose of verifying the presence of free benzoic acid, 1 grm. of the original substance is washed with 5 cc. of alcohol. This takes up the benzoic acid, whilst the pure product remains almost entirely undissolved. If a solution of 0·415 grm. of potassium iodide and 0·107 grm. of potassium iodate in 5 cc. of distilled water be added to the alcoholic solution, iodine is liberated and may be separated by means of carbon bisulphide in the usual manner. The remaining alkaline solution contains sodium benzoate, and on addition of ferric chloride, yields the characteristic precipitate of ferric benzoate.—F. M.

### *Di-acetyl Tannin ("Tannigene"), a New Astringent.* H. Meyer. D. med. Wochenschr. 1894, 20, 626.

This substance appears as a yellowish-grey powder, odorless and tasteless, and scarcely hygroscopic. In a dry state it may be heated to 180° without decomposition. At 187°—190° it begins to melt, and, at the same time, turns brown, while when heated under water it becomes soft and tenacious at 50°. It is not perceptibly soluble in cold water or dilute acids, and very sparingly in hot water and ether. Dilute solutions of sodium phosphate, sodium carbonate, and borax, dissolve it readily with a yellowish-brown colour. On continued standing, or by boiling the alkaline solutions, tannigene is split up into acetic acid and gallic acid; ammonia alone regenerates tannin. With ferric salts it shows the characteristic reactions of tannin. "Tannigene," while being equally as effective as tannin for the treatment of chronic diarrhœa, possesses the advantage over the older remedy of not in any way affecting the stomach. It appears to be harmless even in large doses.—F. M.

### *Different Behaviour of Atropine and of Strychnine in Vitali's Reaction.* D. Vitali. Bull. Chim. Farmac. 1894, 33, 449.

Atropine oxidised with nitric acid, evaporated to dryness, and treated with an alcoholic solution of potash gives a red coloration (Vitali's reaction). Strychnine treated in the same manner gives a very similar reaction. The two bodies may be distinguished by noting the following points :—(1.) Atropine during the process of oxidation, and more especially immediately after evaporation of the acid, develops an agreeable odour of hawthorn blossom, whilst strychnine remains odourless. 2. Strychnine is coloured yellow by the oxidation, and remains yellow after evaporation of the acid ; atropine undergoes no change of colour. 3. In the case of atropine a violet residue is obtained on evaporation of the alcohol from the alcoholic potash added, the colour of which is intensified by the further addition of caustic potash. Strychnine, under the same conditions, yields a yellow or reddish-yellow residue, which, by a second treatment with caustic potash, is turned purple. 4. The addition of water to the mixture of the oxidation product of atropine and alcoholic potash, brings about decoloration, whereas the colour of the strychnine is changed to yellow. 5. The dry oxidation product of atropine, treated with ammonia, forms yellow drops, which with alcoholic potash produce a violet colour. The same treatment applied to strychnine gives rise to an orange coloration inclining to red, and changing on addition of caustic potash, first to a violet and immediately afterwards to an intense blood red. If, however, the ammoniacal solution of the oxidation product of atropine be shaken with chloroform, and the chloroform solution evaporated, an almost colourless residue is obtained, which, on addition of alcoholic potash, assumes a fine, permanent violet colour. Strychnine under the same circumstances forms a faintly yellow chloroform solution. The yellow residue left on evaporation of the latter yields with alcoholic potash an intense reddish-orange colour. (See this Journal, 1894, 981.)—F. M.

## DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (*Continued from pag 76.*)

A. Lehne and A. Rusterholz. Färber Zeit. 1891 *et seq.*

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| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 22.<br>Diamine-yellow N. [C.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre violet-grey; heated—violet. On addition of water—fibre dirty yellow.<br>*Dil.*:—Heated—fibre bright yellow; the original colour restored on rinsing. | *Conc.*:—Fibre and liquid reddish-violet. On addition of water—liquid yellow; near the fibre, red; fibre bright grey.<br>*Dil.*:—Fibre pale-violet, liquid reddish; heated—liquid bluish-red; with excess of ammonia—bright yellow. | *Conc.*:—Fibre dark violet. On addition of water—blue, then bright yellow; fibre dirty yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre redder; heated—fibre orange.<br>*Dil.*:—Fibre orange; heated—liquid faint reddish-yellow; on acidification, liquid decolorised. | Same as dilute soda-lye. | Cold—decolorised after some time. | Colouring matter extracted on boiling; solution becomes reddish-violet on addition of concentrated sulphuric acid; with soda-lye—orange. | .. .. |
| 23.<br>Thioflavine T. [C.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately decolorised. On addition of water—the original colour appears.<br>*Dil.*:—Heated—fibre decolorised; with excess of soda lye, liquid at first yellow, then red. Fibre rinsed in water becomes yellow again. | *Conc.*:—Fibre brighter; heated—fibre again intense yellow, liquid yellow. On addition of water—fibre again somewhat brighter.<br>*Dil.*:—Fibre immediately decolorised, the liquid only becoming yellow on heating. | *Conc.*:—Fibre bright olive.<br>*Dil.*:—Fibre decolorised on heating, | *Conc.*:—Heated—same as concentrated sulphuric acid. On addition of water—fibre brownish, liquid brick red, finally brownish-red.<br>*Dil.*:—Heated—fibre decolorised, liquid faint red. | .. .. | Immediately decolorised. | Colouring matter extracted on boiling. The solution decolorised on addition of concentrated sulphuric acid. | Ammonium acetate extracts the colouring matter; solution on addition of soda-lye—red. |
| 24.<br>Milling yellow [C.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark Bordeaux, liquid reddish. On addition of water—liquid yellow, fibre brown.<br>*Dil.*:—Heated—fibre brownish-yellow. | *Conc.*:—Fibre dark Bordeaux, liquid deep carmine-red; heated—liquid orange. On addition of water—liquid yellow, fibre orange, finally both yellow.<br>*Dil.*:—Fibre reddish-brown, liquid colourless; heated—fibre brown, liquid first carmine-red, then orange. With excess of ammonia—citron-yellow. | *Conc.*:—Fibre dark Bordeaux red, liquid bluish-red. On addition of water—liquid brownish, fibre dark red, finally both brown.<br>*Dil.*:—Heated—fibre reddish-brown, liquid colourless. On addition of concentrated nitric acid—reddish. | *Conc.*:—Heated—liquid yellow. On addition of water—deep yellow.<br>*Dil.*:—Heated—liquid intense golden-yellow. On addition of concentrated sulphuric acid—carmine-red. | On boiling—liquid intensely yellow; acidified—carmine-red. | Decolorised on warming. | Colouring matter extracted on boiling. On addition of nitric acid—solution reddish. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 25.<br>Diamond-yellow [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark orange to red, liquid yellow. On addition of water—fibre orange, liquid colourless.<br>*Dil.*:—Fibre orange; heated—fibre brighter, liquid colourless. With excess of soda-lye—yellow. | *Conc.*:—Fibre dark orange, liquid yellow; heated—liquid deep orange. On addition of water—fibre brighter.<br>*Dil.*:—Fibre reddish-orange; heated—bright yellow, liquid colourless. With excess of ammonia—yellow. | *Conc.*:—Fibre dark orange; heated—intense orange.<br>*Dil.*:—Fibre orange, liquid colourless. | *Conc.*:—Heated—fibre orange, liquid yellow.<br>*Dil.*:—Heated—fibre orange, liquid intensely yellow; on acidification, colourless. | .. .. | Warmed—fibre orange; on boiling—decolorised. | .. .. | Ammonium acetate extracts the colouring matter sparingly; solution on addition of soda-lye—deep yellow. |
| 26.<br>Anthracene-yellow [By.]<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre decolorised. On addition of water the original colour is not restored.<br>*Dil.*:—Heated—fibre decolorised. | *Conc.*:—Fibre olive; heated—liquid brownish.<br>*Dil.*:—Fibre somewhat redder. | *Conc.*:—Fibre olive; heated—fibre darker, liquid brownish-yellow. On addition of water—fibre almost decolorised.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid yellow.<br>*Dil.*:—No action. | .. .. | On heating—fibre bright yellow to colourless. | .. .. | .. .. |
| 27.<br>Alizarine-yellow G G. [M.]<br>(*Animal fibre.*) | *Conc.*:—After some time scarlet. On addition of water the original colour is restored.<br>*Dil.*:—Little or no action. | *Conc.*:—Fibre immediately scarlet, liquid orange. On addition of water original colour restored to the fibre; liquid colourless.<br>*Dil.*:—Heated—fibre reddish-orange and then bright yellow, liquid colourless. With excess of ammonia—yellow. | *Conc.*:—Fibre dark orange, liquid orange. On addition of water—liquid intense orange. After some time—liquid brick-red.<br>*Dil.*:—No action. | *Conc.*:—Heated—fibre dark orange, liquid orange.<br>*Dil.*:—Fibre and liquid orange. On acidification with sulphuric acid, at first colourless; by further addition of the reagent—yellow. | Some of the colouring matter extracted on boiling; the solution decolorised on acidification. | Fibre decolorised on warming. | .. .. | .. .. |
| 28.<br>Benzoflavine [O.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre orange, liquid yellow. On addition of water—fibre somewhat brighter.<br>*Dil*:—Fibre almost decolorised on boiling, liquid yellow. With excess of soda-lye—pale orange. | *Conc.*:—Fibre at first brownish-red, then poppy-red, liquid reddish. On addition of water—fibre bright yellow, liquid yellow.<br>*Dil.*:—Fibre at first orange, later almost colourless. Heated—fibre decolorised, liquid yellow. | *Conc.*:—Fibre at first bright grey, then olive green. On addition of water—liquid orange.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre olive-yellow, liquid pale rose. On addition of water—fibre yellowish-brown, liquid reddish.<br>*Dil.*:—Fibre orange; heated—fibre bright yellow; liquid yellow. | No action. | Fibre at first orange, then again brighter; heated—fibre colourless, liquid orange. | Extracts the colouring matter readily; solution greenish-yellow and strongly fluorescent. On addition of soda-lye—solution decolorised; with hydrochloric acid, bright yellow, the fluorescence disappearing. | Ammonium acetate extracts the colouring matter; solution fluorescent, and is decolorised by ammonia. |
| 29.<br>Cresotine-yellow [O.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately dark grey, the original colour being restored on addition of water.<br>*Dil.*:—Fibre brighter. | *Conc.*:—Fibre at once violet, liquid reddish. On addition of water—fibre bright greenish-yellow, liquid colourless.<br>*Dil.*:—Fibre almost decolorised (dirty); heated—bright yellow. | *Conc.*:—Fibre intensely dark violet. On addition of water—blue to green.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre orange; heated—fibre redder.<br>*Dil.*:—Fibre reddish-orange; liquid rose, colourless on acidification. | Fibre orange; liquid colourless. | Cold—fibre bright yellow; heated—colourless. | No action. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 30.<br>Nitrazine-yellow [O.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid faint yellow.<br>*Dil.*:—Heated—liquid yellow. | *Conc.*:—Heated—liquid yellow; on addition of water, colour of liquid intensified.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Liquid intensely yellow; on addition of water—fibre brighter.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid intensely yellow. | Extracts colouring matter on boiling. | Fibre decolorised on heating. | No action | .. .. |
| 31.<br>Wool-yellow [B.]<br>Patent Fustin.<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-brown, liquid colourless.<br>*Dil.*:—Heated—fibre brown, liquid pale yellow, decolorised by soda-lye. | *Conc.*:—Fibre reddish-brown, liquid colourless; heated—fibre and liquid orange.<br>*Dil.*:—Fibre brown, liquid yellow on boiling; on addition of excess of ammonia, intensely yellow. | *Conc.*:—Fibre dark reddish-brown, liquid reddish-brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre brown.<br>*Dil.*:—Fibre brown; liquid, on warming, yellow; acidified—liquid brighter. | Hardly any action | Fibre, on boiling, bright yellow; liquid yellowish. | No action | .. .. |
| 32.<br>Galloflavine [B.]<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre brighter, liquid yellowish.<br>*Dil.*:—Heated—fibre bright yellow, liquid pale yellow. | *Conc.*:—Fibre brown, liquid colourless; heated—fibre orange.<br>*Dil.*:—Fibre at first reddish-brown, "then becomes brighter." | *Conc.*:—Heated—fibre darker, liquid yellow; on addition of water, fibre and liquid bright yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid yellow.<br>*Dil.*:—Heated—liquid yellowish. | No action | Fibre brighter on boiling, liquid intensely yellow. | No action | Warmed with ferric chloride—fibre dirty olive-green. |
| 33.<br>Fustic.<br>(*Animal fibre.*) | *Conc.*:—Fibre brighter.<br>*Dil.*:—Fibre almost decolorised on boiling. Liquid colourless; with excess of soda-lye—yellow. | *Conc.*:—Fibre brown; on addition of water—fibre brighter.<br>*Dil.*:—Heated—fibre brown, liquid pale yellowish. With excess of ammonia—intensely yellow. | *Conc.*:—Fibre browner; heated—liquid yellow, fibre brown; on addition of water—fibre brighter.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre pale yellow; on addition of water—deep yellow.<br>*Dil.*:—Heated—fibre brown, liquid yellow; acidified—colourless. | No action | On boiling—fibre orange, liquid intensely yellow. | No action | Warmed with ferric chloride—fibre olive. Boiled with aluminium acetate—a yellow solution with bluish-green fluorescence results. |
| 34.<br>Woad.<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid pale yellow.<br>*Dil.*:—Heated—fibre completely decolorised. | *Conc.*:—Fibre brownish-yellow.<br>*Dil.*:—Heated—liquid pale yellow. | *Conc.*:—Fibre brownish-yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre unaltered, liquid pale yellow.<br>*Dil.*:—Heated—fibre decolorised, liquid pale yellow; acidified—colourless. | No action | Hardly any action | No action | Warmed with ferric chloride—fibre olive. |
| 35.<br>Flavine.<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid yellow. On addition of water—fibre bright yellow, liquid colourless.<br>*Dil.*:—Heated—fibre decolorised. | *Conc.*:—Fibre brown. On addition of water—fibre brighter.<br>*Dil.*:—Hardly any action. | *Conc.*:—Fibre olive-green, liquid intense yellow. On addition of water—fibre bright, liquid greenish-yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid yellow.<br>*Dil.*:—Warmed—liquid yellow, acidified colourless. | Fibre little altered, liquid yellow. | Fibre brownish-yellow, liquid yellow. | No action | Boiled with lead acetate—fibre orange. Boiling acetic acid extracts the colouring matter, the solution exhibiting a green fluorescence. |

Detection of Artificial and Natural Colouring Matters on the Fibre—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 36.<br>Avignon Berries. Persian Berries.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brighter; heated—liquid pale yellow. On addition of water—liquid colourless.<br>*Dil.*:—Heated—fibre greenish-yellow. | *Conc.*:—Fibre brownish; heated—fibre brighter.<br>*Dil.*:—Heated—liquid faintly yellow. With excess of ammonia—intensely yellow. | *Conc.*:—Heated—liquid yellow, fibre olive-green. On addition of water—fibre pale yellow, liquid intensely yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid pale yellow.<br>*Dil.*:—Same as concentrated. | Colouring matter slightly extracted. | On heating—fibre brown, liquid yellow. | No action | Boiled with lead acetate—fibre orange. |
| 37.<br>Turmeric.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately brown; original colour restored on adding water.<br>*Dil.*:—No action. | *Conc.*:—Fibre at first reddish-brown, then almost decolorised; heated—fibre colourless; on addition of water—fibre pale yellow.<br>*Dil.*:—Heated—fibre decolorised. | *Conc.*:—Fibre dark reddish-brown; on addition of water—fibre again yellow.<br>*Dil.*:—No action. | *Conc.*:—Fibre orange; on addition of water—liquid orange.<br>*Dil.*:—Fibre orange; heated—fibre brighter, liquid orange; acidified—colourless. | Fibre and liquid, on warming, orange; acidified—liquid colourless. | Fibre reddish-brown, liquid colourless. | Colouring matter extracted on boiling, solution having a green fluorescence. | Boiled with a solution of boric acid in alcoholic hydrochloric acid—fibre reddened. |
| 38.<br>Chrome yellow.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately decolorised, the original colour not reappearing on adding water.<br>*Dil.*:—Heated—fibre decolorised. | *Conc.*:—Same as concentrated hydrochloric acid.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre almost decolorised.<br>*Dil.*:—Heated fibre almost decolorised. | *Conc.*:—Heated—fibre almost decolorised; on addition of water—fibre completely decolorised.<br>*Dil.*:—Fibre decolorised in the cold. | No action | Immediately decolorised. | No action | .. .. |
| 39.<br>Rust yellow. Iron buff.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre citron yellow, liquid same; on addition of water—fibre and liquid decolorised.<br>*Dil.*:—Heated—fibre decolorised, liquid pale yellow. | *Conc.*:—Heated—fibre brighter.<br>*Dil.*:—Heated—fibre decolorised, liquid colourless. | *Conc.*:—Little action.<br>*Dil.*:—Same as dilute hydrochloric acid. | No action | No action | Fibre decolorised on warming. | No action | Heated with ammonium sulphide—fibre black. Warmed with concentrated hydrochloric acid and potassium ferrocyanide added—blue colour (Prussian blue) developed. |

—A. R. L.

### *Lactophenine.* H. Thoms. Pharm. Ges. Ber. 1894, **4**, 161.

This new therapeutic agent is *lactyl-p-phenetidide*—

$C_6H_4(OC_2H_5).NH.CO.CH(OH).CH_3$.

It forms colorless, odorless, bitter crystals, melting at 117·5°—118° C., and is soluble in 500 parts of water at 15° C.; in 55 parts of boiling water. Its solutions are neutral to litmus. For testing its purity the following reactions are recommended:—When 0·1 grm. is boiled for a minute with 1 cc. hydrochloric acid, the whole diluted with 10 cc. water, allowed to cool, filtered, and 3 drops of a chromic acid solution added, a ruby-red coloration is produced. Phenacetine gives a similar coloration. When 0·3 grm. of powdered lactophenine is triturated with 2 cc. of nitric acid the mixture becomes yellow. After standing for an hour the mixture is diluted with water and the nitroproduct filtered, washed, and recrystallised from benzene, when nitrolactophenine is obtained, melting at 96·5°. This, when warmed with alcoholic potash, yields red crystals of *o*-nitrophenetidine, melting at 110·5°. Under hot water, lactophenine melts without coloration. It dissolves in concentrated sulphuric acid without coloration, and should leave no ash when burned.—L. T. T.

## ORGANIC CHEMISTRY.—QUANTITATIVE.

### *The Determination of Benzene in Illuminating Gas.* W. A. Noyes and W. N. Blinks. J. Amer. Chem. Soc. 1894, **16**, 697—698.

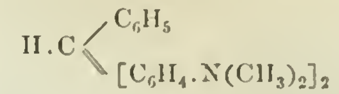
The authors apply the Bunte burette to the method of Hempel and Dennis (this Journal, 1891, 578). 100 cc. of gas are measured at atmospheric pressure by attaching a side tube or bottle to the burette below. The water is then removed from the cup of the burette above, and that within the instrument is drawn down to the stop-cock. 3 cc. of absolute alcohol are now poured into the cup, and so slowly introduced into the burette from above, 1 cc. at a time, that the inner walls are kept moistened with the spirit. The alcohol is then withdrawn, and the tube is washed by admitting 2 or 3 cc. of water above, and drawing it off below. Finally, water is introduced to bring the gas to its original pressure, and the volume is read. Five determinations with coal gas gave 1·2 (thrice), 1·3, and 0·5, the cause of error in the last case being unknown. By a modification of Bunsen's method, 16·8 cc. of liquid hydrocarbons were obtained from the same gas supply; this is equivalent to 1·31 per cent, which agrees sufficiently well with the other determinations, seeing that the hydrocarbons measured would contain other substances besides benzene.—W. G. M.

### *Estimation of Triphenylmethane Colouring Matters by Means of the Reaction with Nascent Bromine.* W. Vaubel. J. für prakt. Chem. 1894, **50**, 347—351.

It has previously been shown by the author that the presence of the amido group or mono-alkylated amido group causes nascent bromine to be taken up in the ortho- and para-positions, whilst in the presence of the dialkylated amido group substitution of bromine takes place only in the para- and one ortho-position.

The reaction of bromine upon the triphenylmethane colours, which is effected by adding potassium bromate to a hydrobromic acid solution of the base until the bromine reaction of the solution remains permanent, may also be made use of for the quantitative analysis of a number of the colouring matters in question and their corresponding leuco bases.

*Tetramethyl diamido-tri-phenylmethane*—



$$H.C\begin{cases}C_6H_5\\ [C_6H_4.N(CH_3)_2]_2\end{cases}$$

takes up 2 atoms of bromine. The bromide separates as soon as the reaction is finished. An excess of bromine leads to oxidation and the formation of a green colour.

*Malachite Green G (Sulphate) or Brilliant Green.*—The yellowish-green solution of this body in dilute sulphuric acid is by the action of bromine gradually turned yellow. A bromide insoluble in water and containing 2 atoms of bromine, separates, which, with alcohol, forms a blue solution, turning yellowish-red on the addition of caustic soda.

*Leucorosaniline* forms a penta-bromide, presenting the appearance of greyish-violet flakes. A violet colour is produced by gradual oxidation.

*Pararosaniline chloride* shows the remarkable property of combining with only 5 atoms of bromine. The bromide separates quickly and possesses a violet tint.

*Rosaniline chloride,* analogous to pararosaniline, combines with only four bromine atoms. In this case the brominating method may advantageously be used for ascertaining the amount of pararosaniline in commercial magenta, and it might also be of importance as a test in the manufacture of rosaniline blue.

*Hexamethyl-paraleucaniline,* $HC = [C_6H_4N(CH_3)_2]_3$, forms a tribromide. The end of the reaction is readily recognised.

*Crystal Violet, Hexamethyl-pararosaniline chloride.*—The action of bromine upon this body proceeds slowly after the formation of the mono-bromide, but 3 atoms of bromine are ultimately taken up. The bromide retains, though in a very reduced measure, the nature of a colouring matter.

*Methyl Green* combines smoothly with 2 atoms of bromine. The colour of the solution is changed into yellow. Zinc dust restores the green colour, which by the further reducing action of the former disappears entirely. The methyl chloride appears to deprive the di-alkylated amido group of the capacity of taking up bromine, hence only a di-bromide is formed.

*Iodine Green* has but slight affinity for bromine, a peculiarity which is shared by the phenylated rosanilines.

Regarding the influence of the hydroxyl groups this may be said to favour the introduction of three bromine atoms in the ortho- and para-positions. The alkylated hydroxyl group as proved by the bromination of anisol $C_6H_5OCH_3$ has the effect of but 1 atom of bromine being taken up, and that in the para position.

*Aurin,* in accordance with the theory, is in a glacial acetic acid solution converted into a tetra-bromide, which separates from an alcoholic solution as a non-crystalline substance.

*Phenolphthalein* also combines with 4 atoms of bromine. The characteristic property of phenolphthalein to turn red with alkalis is almost lost in the bromide.

Fluorescein was not tested, but, as may be presumed from the preparation of eosine, probably also takes up 4 atoms of bromine under the same conditions.

*Rhodamine S*, the chloride of dimethyl- or ethylene-amido-phenol succineïn takes up bromine very slowly, hence it is impracticable to apply the bromination method for the estimation of this dye.—F. M.

### *Estimation of Sulphur in Volatile Organic Compounds.* C. F. Mabery. Amer. Chem. Jour. **16**, 544—551.

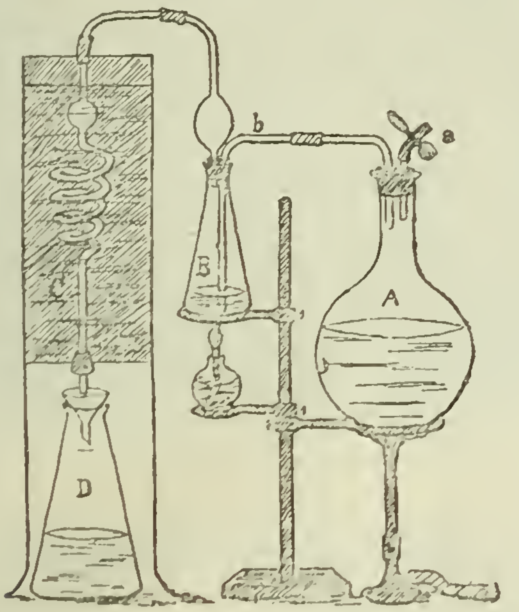
The author describes a modification of the Burton-Sauer method which is of service in estimating the sulphur present in Canada and Ohio petroleums. The substance contained in a porcelain boat is burnt in a current of air, the products of combustion passing through dilute solution of caustic soda. The combustion tube (18 mm. internal diameter) is constricted at the middle, and the air passes in through a narrow tube from the rear which reaches this constriction, The forward part of the combustion tube is connected with a U-tube (34 cm. high, 25 mm. internal diameter) which is partially filled with broken glass, and contains 50 cc. of caustic soda solution, of a strength corresponding to 1 mgrm. or 5 mgrms. of sulphur per cubic centimetre, according to the amount of sulphur in the oil under investigation. The titration of the excess of alkali is performed in the U-tube itself, methyl orange being used as indicator. No nitrogen acids are formed during the combustion, and the results agree closely with those obtained by the Carius method.

—J. W.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *The Determination of Volatile and Insoluble Fatty Acids in Butter Fat.* W. H. Beal. J. Amer. Chem. Soc. 1894, **16**, 673—676.

In order to shorten the time and to minimise the difficulties of the Moore-Waller process, the author has introduced the following modification :—2·8 to 2·9 cc. (equal to about 2·5 grms.) of the pure fat are measured into a long, narrow 200 cc. Erlenmeyer flask of known weight. 2 cc. of a solution of 50 grms. of pure potassium hydroxide (free from carbonates) in 100 cc. of water and 5 cc. of 95 per cent. alcohol are then added, and the mixture is heated on a water-bath, with a reflux condenser fitted to the flask, until saponification is complete, which is usually the case in five minutes. The last traces of alcohol are removed with the filter-pump, as described by Nilson (this Journal, 1889, 822). The soap is then dissolved in 30 cc. of warm water, and treated with 20 cc. of a 20 per cent. solution of orthophosphoric acid. The flask (B) is now connected with a glass spiral condenser C, passing through a tank of flowing water, and delivering, through a funnel containing a small filter, into an Erlenmeyer flask D, which has on its neck a scratch indicating a capacity of 500 cc. Distillation is effected by a current of steam from the flask A, passed through the solution, which is at first maintained at constant volume, and afterwards evaporated to about 15 cc. with the aid of a small spirit lamp. 500 cc. of distillate are collected and titrated with decinormal soda solution, using phenolphthalein as indicator; then, as an extra precaution, a further quantity of 50 cc. is collected and titrated separately. The spiral is now rinsed out with boiling water, the washings being run into the flask B, containing the non-volatile acids. The flask with its contents are shaken with the hot water, which is then cooled and poured off through the filter previously used in the neck of flask D; 100 cc. of hot water are now added to B, shaken, cooled, and poured through the same filter, and this treatment is repeated until the washings are quite free from phosphoric acid. The filter is now exhausted with strong hot alcohol, and the alcoholic solution is run into the flask containing the insoluble acids. Finally the alcohol is expelled on the water-bath, and the fatty acids dried at 100° C. in the air-bath, until they begin to gain in weight. The removal of the volatile acids by steam distillation is very uniform and complete, the extra 50 cc. last collected never using more than 0·2 cc. of soda solution. Results are concordant.



—W. G. M.

### *Method of Determining the Koettstorfer Number of Dark-coloured Substances.* P. C. McIlhiney. J. Amer. Chem. Soc. **16** 408—410.

A solution of neutral soap, to which ammonium chloride had been added, when submitted to distillation, liberated a quantity of ammonia equivalent to the alkali existing as soap. The following method is based on the foregoing fact.

Two grms. of the substance to be tested are weighed into an Erlenmeyer flask, excess of an alcoholic solution of caustic soda added, and the alcohol evaporated off. 250 cc. of "93 per cent. alcohol" is added, the soap is dissolved by the aid of heat, and carbon dioxide is passed through the solution for about one hour, in order to precipitate the excess of alkali as carbonate and bicarbonate. The solution is filtered, and the alcohol is nearly all distilled off. To the contents of the retort a solution of 10 grms. of ammonium chloride in 100 cc. of water is added, and the ammonia is distilled into 20 cc. of normal hydrochloric acid, the excess of which is afterwards titrated. As 100 cc. of alcohol of 93 per cent. was found to dissolve enough sodium bicarbonate to neutralise 0·34 cc. of normal acid, an appropriate correction must be made. A sample of linseed oil tested in this way gave a Koettstorfer number of 192·4, as against 193·1 by the ordinary process. A sample of dragon's blood resin gave 124·9.—L. A.

### *Gantter's Process for Determining the Iodine Value of Fats.* P. C. McIlhiney. J. Amer. Chem. Soc. **16**, 372—374.

Gantter (this Journal, 1893, 717) has published results showing that in determining the iodine number of fats and oils by Hübl's reagent, the amount of iodine absorbed depends upon the quantity of mercuric chloride present, and he proposes to use carbon tetrachloride as a solvent for both the oil and the iodine, and to dispense with the use of mercuric chloride altogether.

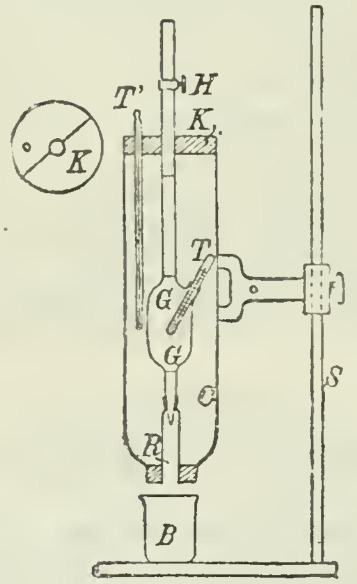
To ascertain whether fats would absorb from a solution of iodine alone as much iodine as would be necessary to convert them into saturated bodies, oleic acid was treated with measured volumes of solutions of iodine in three different solvents. The results were as follow :—

| Solvent. | Oleic Acid taken. | Excess of Iodine in cc. of N/10 Thiosulphate. | Iodine Number. |
|---|---|---|---|
| | Grms. | | |
| Alcohol ................ | 0·9947 | 43·4 | 30·4 |
| „ ................ | 1·1145 | 43·5 | 26·1 |
| Carbon disulphide ...... | 0·9791 | 58·9 | 52·7 |
| „ „ ...... | 1·0044 | 59·0 | 51·3 |
| Carbon tetrachloride... | 0·1171 | 27·9 | 27·6 |
| „ „ ... | 0·1186 | 28·2 | 24·1 |

The iodine number of the oleic acid used, by the Hübl process, was 80. Therefore iodine alone, without mercuric chloride, will not saturate fats, and Gantter's number is an arbitrary figure, which is not comparable with the results obtained by any other process.—L. A.

### *A Simple Method for the Detection of Foreign Fats in Butter.* C. Killing. Author's Pamphlet, per Chem. Zeit. Rep. 1894, **18**, 314.

The method is based on the determination of the viscosity of the butter. The apparatus employed, shown in the drawing, consists of a wide cylinder, closed at the bottom by a cork, through which passes a tube into which the point of the pipette G fits tightly. The pipette carries a thermometer, and is supported in the outer jar, along with a second thermometer, by a split bung. The determination of viscosity is effected at 40° C., and is carried out as follows:—60 cc. of the butter to be tested are melted at 50°—60° C., filtered, and cooled to 40·5° C. The pipette is then charged with the melted fat by suction, placed in position in the cylinder and the latter filled with water at 42° C. and closed. By this time both thermometers will generally indicate 40° C., and all that remains is to carefully note the time required for the fat to descend from the mark above to the mark delow the bulb of the pipette. The time required in the case of distilled water at 20° C. (both thermometers) is taken as a standard and represented by 100, the relative time for butter being termed its "viscosity number."



The viscosity of pure butter varies between very narrow limits, and the author, therefore, considers his method to be of great value, especially as a determination can be made in a few minutes. The percentage of margarin in impure butter may be deduced by the formula—

$$x = 2\cdot76(V - 278\cdot5),$$

in which V represents the viscosity number of the sample. In a table, the results of the examination of various pure and artificial butters are given, from which the method appears to be distinctly valuable.—H. T. P.

### *The Quantitative Separation of Rosin Oil from Mineral Oils.* P. C. McIlhiney. J. Amer. Chem. Soc. **16**, 385—388.

This process depends upon the known fact that nitric acid, when heated, reacts with rosin oil, converting it into a brittle red resin, while the mineral oil is not much affected. The red resin was found to be insoluble in petroleum ether in which the mineral oil easily dissolves. After some preliminary experiments, the following process was devised:—

50 cc. of nitric acid (sp. gr. 1·2) are heated to boiling in a flask of 700 cc. capacity. The flame is removed, and 5 grms. of the oil are dropped in. The flask is then heated on the water-bath, with frequent shaking, for 15—20 minutes, about 400 cc. of cold water are added, and the liquid is made quite cold. The unchanged mineral oil is then dissolved by shaking with petroleum ether, which is separated and distilled in the usual manner. The residual oil is weighed; and as mineral oils lose about 10 per cent. when treated in this way, the weight obtained divided by 0·9 gives the amount of mineral oil in the quantity taken. A mixture of 76 per cent. mineral oil and 24 per cent. rosin oil gave, by this method, 76·8 per cent. of mineral oil.

—L. A.

### *The Analysis of India-Rubber Articles.* C. A. Lobry de Bruyn. Chem. Zeit. **18**, 1894, 1566, 1618.

1. *Dry Heat Test at* 135° C.—Henriques' objection that the presence of a large proportion of free sulphur in a sample of india-rubber must vitiate the result of this test cannot be sustained in view of the fact that on heating pure sulphur to 135° C. for two hours, a loss of only 0·6 per cent. of the sulphur used could be observed. Moreover, the presence in a sample of india-rubber of a large proportion of free sulphur is alone sufficient to condemn the sample.

2. *Extract Test.*—After the extraction of india-rubber with alcoholic soda Henriques evaporates the alcohol without first separating it from the extracted india-rubber by filtration. Such sodium compounds of the india-rubber resins which are soluble in alcohol but insoluble in water are, in his process, obtained, together with the rubber, and weighed as such, whereas in reality they ought to have been weighed together with the resinous impurities of the india-rubber.

3. *The Nature of the India-Rubber Resins and of India-Rubber.*—There is still some uncertainty as to whether the resins observed in india-rubber stand in some definite relation to the latter or whether they are mere accidental impurities. A comparison of the observations of Burghardt, Weber, Terry, and Henriques, amongst themselves, as also with the author's, seems to point to the fact that not only is there a great difference in the nature of the various india-rubber resins, but also that the proportion of resin in different samples of the same brand of india-rubber is subject to very considerable variations. The fact that the india-rubber trees belong to at least three different classes of plants renders also the existence of different india-rubber hydrocarbons very probable. Such differences are also suggested by the great variations in the powers of resisting oxidation exhibited by different brands of india-rubber. Weber's vindication of the use of india-rubber substitutes could only be accepted if he could furnish an analytical method to distinguish good from bad substitutes. As regards the percentage of free sulphur allowable in india-rubber articles, Weber's observations show the importance of this question and render the establishment of a maximum standard of the percentages of total and free sulphur in india-rubber articles highly desirable.—C. O. W.

### *The Estimation of Water in Raw Sugars.* Gunning and Alberda. Sucr. Belg. 1894, **23**, 108.

Ordinary beet sugars, even if faintly alkaline, can be completely dried at 105°—108° C. in a current of air, without suffering appreciable decomposition, or loss of matters other than moisture. From faintly-acid sugars, the fatty acids are volatilised, without, however, fresh quantities of acid being formed. In the case of strongly-acid beet-sugars or colonial sugars, an accurate determination of moisture is impossible, and at 108° C. quite unreliable results are obtained. Levulose loses one-tenth of its weight at 95° C. as water, levulosan being formed; and at 108° C. the latter is still further decomposed. Besides this, a species of dry distillation of the organic non-sugars takes place, and acids are formed which invert fresh quantities of cane-sugar. The volatile products given off at 108° C. are shown to contain formic, acetic, butyric and valerianic acids, acetone, furfurol, and a crystalline body yielding, with ferric chloride, a blue coloration.—H. T. P.

### *Quantitative Estimation of Starch.* J. Krieger. Der Amer. Bierbrauer, 1894, 27, 580.

The following method is claimed to be rapid and accurate. Two portions of the sample to be examined, finely powdered, each weighing 10 grms. in the case of cereals, or 3 grms. when the material is poor in starch (bran, brewers' grains) are employed. One portion is transferred to a tared filter-paper, washed with water containing, roughly, 0·4 per cent. of sulphurous acid, to remove soluble matters, then washed with pure water, and dried, first at a low temperature, afterwards at 105° C.

The second portion is boiled in a beaker with 300 cc. of water for half an hour, cooled to 80° C., treated with 100 cc. of filtered malt extract (1 in 20), and kept at 65° C. until all soluble starch has disappeared, then gradually heated to 80° C., again boiled for half an hour, cooled to 70° C., a further quantity of 25 cc. of malt extract added, and digested at 65° C., until saccharification is complete. The liquid is then filtered through a tared paper, the insoluble matter transferred thereto, washed with boiling water, and dried at 105° C. The difference in weight between the two filters represents the weight of starch.—H. T. P.

### *Improvements in the Method of and in Means and Appliances for Testing Yeast and Barm.* A. Čečetka, Vinohrady, Bohemia. Eng. Pat. 21,440, November 7, 1894.

The intention herein is to improve upon the usual method of determining the fermenting power of yeast and barm, so as to make the test available for use by persons unacquainted with chemical or experimental knowledge.

Suitable quantities of the substance to be fermented and the yeast or barm to be tested are brought together in a convenient vessel provided with a thermometer and a delivery tube for the evolved carbon dioxide. Connected with this fermentation vessel, maintained at a uniform temperature, is a tared cylindrical receiver containing water or other liquid, neutral to carbon dioxide (*e.g.*, brine), followed by a second similar tared but empty vessel into which the gas produced in the fermentation, forces water over from the first cylinder in proportion to the vigour of the yeast and corresponding production of carbon dioxide.

The relative increase in the weight of the receiving vessels indicates the weight of carbon dioxide produced in the given time in the reaction vessel, and the weight of water forced over from the first into the second receiver will denote the volume of the evolved gas. These data supply the means for estimating the fermenting power of the yeast, &c.

### *Brullé's Method for Testing Butter.* C. A. Lobry de Bruyn. Chem. Zeit. 1894, 18, 1341—1342.

The author is carrying out a series of experiments to test the accuracy of Brullé's *oleogrammeter* method of testing butter (this Journal, 1893, 717). As Brul'é has not yet given the diameter of the rod of his oleogrammeter the author has used rods of 10 and 12 mm. diameter.

The author is so far unable to fully confirm Brullé's statements, for whilst as a rule the margarins tested gave much higher numbers than the pure butters, this was not always the case. The numbers with some margarins were lower than those given by some butters, whilst those given by butters also differed considerably. Thus, with a 12 mm. rod and at 21° C., the numbers (in kilogrammes), for pure butters varied from 0·9 to 2·0, and for margarins from 1·7 to 9·0. The size of the rod and the temperatures employed influence the results very materially and irregularly. The presence of vegetable oils in the margarin, as admitted by Brullé, renders this test fallacious, and these must, therefore, always be separately tested for. Certainly until Brullé gives a fuller description of his apparatus and process, and more complete instructions for carrying out the latter, his process cannot be considered as reliable and practicable.—L. T. T.

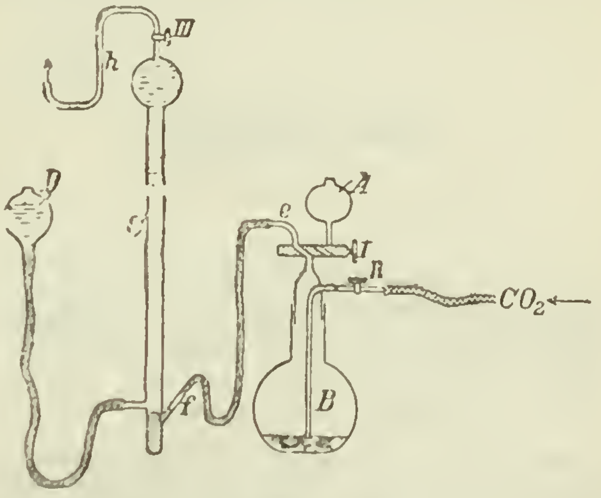
### *Estimation of Antipyrine.* M. F. Schaack. Amer. Journ. Pharm. 1894, 66, 321.

The author recommends the utilisation of the blue-green colour of dilute solutions of nitroso-antipyrine, for colorimetric estimations. A standard solution of antipyrine is made, containing 0·02 grm. of antipyrine in 25 cc. of water. To this are added 1·6 cc. of 1 per cent. sulphuric acid and 8 cc. of a 1 per cent. solution of sodium nitrite, and the whole is then made up to 100 cc. The best quantity of reagent to be used with the substance to be tested, must be determined by a preliminary trial. The strength of the antipyrine should never exceed 0·2 per cent., or the nitro-compound is likely to crystallise out. The reaction only takes place in the presence of *free* nitrous acid, so that the presence of *spirit, ætheris nitrosi*, &c., is not harmful.

—L. T. T.

### *The Estimation of Nitrogen in Nitrocellulose.* D. Stanojewitsch. Zeits. ang. Chem. 1894, 676—678.

Schloesing's and Lunge's methods of determining nitrogen are combined in this method, which aims at the removal of the difficulty experienced in preventing the oxidising effect of small quantities of air remaining in the apparatus upon the nitrogen oxide. The apparatus employed consists of the flask B, furnished with a ground-in stopper carrying the two-way stop-cock I. This serves for communication with either the bulb-funnel A, containing sulphuric acid, or the gas-conducting tube *e*. The stopper is also provided with a tube bent at a right angle, reaching to nearly the bottom of the flask and carrying the stop cock II. The tube *e* communicates by means of an india-rubber tube with the tube attachment *f* of the gas burette C, which is connected with the level adjusting arrangement D. Besides being filled with a 25 per cent. solution of caustic soda, this burette also contains a quantity of mercury sufficient to reach to *f*, and preventing the caustic soda from getting into the tube *e*. At the top the burette has a globular expansion and a stop-cock III, to which, in case of there being no graduation, a bent tube *h* is attached by means of which the gas can be collected in a measuring tube.



The *modus operandi* is as follows :—From 50 to 60 grms. of mercury, together with the weighed substance, are introduced into the previously well-dried flask B, adding, if necessary, one or two drops of liquid paraffin to prevent frothing. Carbonic acid is then passed through the flask until all the air is expelled, the stop-cock I being, during this operation, turned so as to allow the gas to escape through *e*, and to shut off communication with the bulb A, which contains from 10 to 15 cc. of sulphuric acid. In the first stage of this operation the india-rubber tube is detached from the burette and the gas is allowed to escape into the atmosphere. The greater part of the air having been expelled the flask is connected with the burette C. The small quantity of air accumulating in the latter is removed by opening the stop-cock III and raising the bulb D. All air being removed from the apparatus, the current of carbonic acid is interrupted and the sulphuric acid sucked from A into B by a corresponding turn of the stop-cock I and lowering of D. Then B and C are again set into communication. By shaking the flask B decomposition of the substance, being tested, sets in, the nitrogen oxide generated being collected in the burette by suitable lowering or raising of D. The flask is ultimately heated and all the nitrogen oxide expelled from it by means of the carbonic acid current. For ascertaining the volume of the nitrogen oxide produced it is best to transfer the gas to a measuring cylinder filled with pure water.

Gelatinised nitrocellulose requires heating on the water-bath to start the decomposition. If, however, the nitrocellulose be previously heated with the mercury alone the addition of the sulphuric acid produces a violent reaction, generally resulting in an explosion.

The apparatus described is also well adapted for the estimation of the amount of nitroglycerin in dynamite either direct or after extraction in a Soxhlet's apparatus, which may be attached to the decomposing flask B, the latter containing the solvent during the extracting process.

—F. M.

*Examination of Two Varieties of Crude Benzene from Coke Oven Gases.* G. Lunge and H. von Kéler. Zeits. angew. Chem. 1894, 637.

*See under* III., *page* 143.

*Note on the Unreliable Nature of the Sulphuric Acid Test for the Detection and Estimation of Fusel Oil in Spirit.* M. Glasenapp. Zeits. für Spiritus ind. 1894, **17**, 344.

*See under* XVII., *page* 174.

## New Books.

CELLULOSE. An Outline of the Chemistry of the Structural Elements of Plants with reference to their Natural History and Industrial Uses. By CROSS and BEVAN (C. F. Cross, E. J. Bevan, and C. Beadle). London: Longmans, Green, and Co. New York: 15th East 15th Street. 1895. Price 12*s*.

THIS work is one of 8vo. size, containing Preface, brief Table of Contents, text covering 310 pages, an Appendix chiefly devoted to the figuring and description of 14 illustrative plates, and alphabetical indexes of subjects and names.

The text is subdivided as follows:—I. THE TYPICAL CELLULOSE AND THE CELLULOSE GROUP. II. COMPOUND CELLULOSES. *a.* Pectocelluloses and Mucocelluloses. *b.* Adipocelluloses and Cutocelluloses. III. EXPERIMENTAL AND APPLIED. In the latter part of the volume certain industrial problems of considerable scientific interest are *inter alia* attacked, notably, that of the composition of "Waste Sulphite Liquors" of wood-pulp works, pages 197—203. As is well known, these liquors which, on the one hand, create considerable nuisance when run hot to waste, also contain gummy matters of great adhesive power, which, mainly owing to the nuisance arising on evaporation, cannot so far be profitably handled. The light thrown upon this sulphite liquor problem from the scientific standpoint, as giving impetus for further work will be judged of from the following summary of probable factors in the reaction of the sulphite wood-pulp digestors:—"(*a.*) The hydrolytic action of the sulphurous acid. (*b.*) The formation of aldehyde bisulphite compounds. (*c.*) The probable sulphonation of side-chains of the general formula $x.CH:CH.COH$, as in the well-known reaction of cinnamic aldehyde with sodium bisulphite. (*d.*) The saturation of acid OH groups by CaO."

The Appendix comprises 14 beautifully executed plates, from photo-micrographs by Mr. J. Christie, F.R.M.S. These plates refer to—1. Flax. 2. Ramie. 3. Jute. 4. Jute. 5. Sisal hemp. 6. Oil Palm Leaf. 7. Esparto. 8. Esparto. 9. Straw (Wheat). 10. Wood. 11. Wood. 12. Raffia (*transverse section*). 13. Ditto (*surface view*). 14. Bottle Cork.

THE CYANIDE PROCESS FOR THE EXTRACTION OF GOLD, AND ITS PRACTICAL APPLICATION ON THE WITWATERSRAND GOLD FIELDS IN SOUTH AFRICA. By M. EISSLER, Member of the Institute of Mining and Metallurgy, &c. London: Crosby, Lockwood, and Son, 7, Stationers' Hall Court, Ludgate Hill, E.C. 1895. Price 7*s*. 6*d*.

8VO. VOLUME, containing an introduction of interest as developing mainly the question, and its answer:—"How is it that within the last few years the cyanide process has come into such pre-eminence and such success, in spite of the repeated failure in America and elsewhere?" Next follow table of contents, list of illustrations, 90 pages of subject-matter, and alphabetical index. The volume is illustrated with 23 woodcuts and plans, and the mode of treatment of the subject may be derived from the sub-divisions of the work, viz.:—I. Erection of a Cyanide Plant. II. Extraction by Cyanide. III. The Siemens-Halske Process. IV. Particulars of Operations of Various Works. V. The Chemistry of the Cyanide Process. Of special interest is the description of the Siemens-Halske Process (pages 40—46). The method of treatment of this subject may be gathered its leading themes, viz.:—(*a.*) The Electric Precipitation of Gold from Cyanide Solutions. (*b.*) How the process was discovered. (*c.*) The Action of the Electric Current on the Gold Solution. (*d.*) Why Mercury cannot be used as a Cathode. (*e.*) Conditions which the Metal Cathode must fulfil. (*f.*) The Anode. (*g.*) Electric Current required for Precipitation. (*h.*) Advantages of Electrical Precipitation.

The methods described (pages 82—90) for testing the strength of solutions, determining the gold in cyanide solutions, and the Feldtmann extraction tests, conclude the work.

# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

*(From the Board of Trade Journal.)*

### CUSTOMS TARIFF OF BRITISH INDIA.

The following rates of Customs import duty leviable in British India are extracted from an extraordinary issue of the "Gazette of India" of the 27th Decemer last :—

| Articles. | Rates of Duty. | |
|---|---|---|
| | | Rup. Ann. |
| LIQUORS, OPIUM, &c. | | |
| Liquors :— | | |
| Ale, beer, and porter .......... | Imperial gallon or six quart bottles. | 0 1 |
| Cider and other fermented liquors ...................... | | |
| Liqueurs ...................... | „ | 6 0 |
| Spirit intended to be used exclusively in arts or manufactures, or in chemistry, and which has been rendered effectually and permanently unfit for human consumption | *Ad valorem* five per cent. | |
| Spirit when used in drugs, medicines, or chemicals in a proportion of less than 20 per cent. of spirit of the strength of London proof ............ | *Ad valorem* five per cent. | |
| Spirit when so used in a proportion of 20 per cent. and upwards ................... | Imperial gallons or six quart bottles of the strength of London proof. | 6 0 and the duty to be increased or reduced in proportion as the strength of the spirit exceeds or is less than London proof. |
| Spirit, perfumed, in wood or in bottles...................... | Imperial gallon or six quart bottles. | 8 0 |
| Spirit, other sorts ............ | Imperial gallon or six quart bottles of the strength of London proof. | 6 0 and the duty to be increased or reduced in proportion as the strength of the spirit exceeds or is less than London proof. |

ARMS, AMMUNITION, &c.

| | Tariff Valuation. | |
|---|---|---|
| | R. A. | |
| Gunpowder, common | Per lb. 0 5 | 10 per cent. |
| „ sporting | „ 1 0 | |
| All other sorts of arms, ammunition, and military stores ..... | *ad valorem.* | |

CUSTOMS TARIFF OF BRITISH INDIA—*cont.*

| —— | | Tariff Valuation. | Duty. |
|---|---|---|---|
| ARTICLES OF FOOD AND DRINK. | | Rup. Ann. | |
| Mineral and aërated waters and all unfermented and non-alcoholic beverages. | | *ad val.* | 5 per cent. |
| Vinegar, European, in wood..... | Per imp. gal. | 1 0 | „ |
| CHEMICALS, DRUGS, MEDICINES, AND NARCOTICS, AND DYEING AND TANNING MATERIALS. | | | |
| Chemical products and preparations: | | | |
| Acid, sulphuric ............ | Per lb. | 0 2 | „ |
| Alkali, country (sajji-khár) . | Per cwt. | 1 8 | „ |
| Alum ...................... | „ | 5 0 | „ |
| Arsenic .................... | „ | 21 8 | „ |
| „ China mansil ........ | „ | 17 0 | „ |
| Bicarbonate of soda......... | „ | 7 0 | „ |
| Copperas, green ............ | „ | 3 0 | „ |
| Explosives, namely, blasting gelatin, dynamite, roburite, tonite, and all other descriptions. | | *ad val.* | „ |
| Sal-ammoniac.............. | Per cwt. | 37 0 | „ |
| Sulphate of copper ......... | „ | 15 8 | „ |
| Sulphur (brimstone), flour .. | „ | 6 0 | „ |
| „ „ roll... | „ | 5 12 | „ |
| „ „ rough | „ | 4 8 | „ |
| All other sorts of chemical products and preparations, including saltpetre and borax. | | *ad val.* | „ |
| Drugs, medicines, and narcotics: | | | |
| Aloes, black................ | Per cwt. | 14 0 | „ |
| „ Socotra ............. | „ | 30 0 | „ |
| Aloe-wood ................. | Per lb. | 6 0 | „ |
| Asafœtida (hing) .......... | Per cwt. | 65 0 | „ |
| Asafœtida, coarse (hingrá).. | Per Cwt. | 21 0 | „ |
| Atáry, Persian............. | „ | 15 0 | „ |
| Bánslochan (bamboo camphor). | Per lb. | 0 4 | „ |
| Brimstone (amalsára) ...... | Per cwt. | 50 0 | „ |
| Calumba or Colombo root ... | „ | 7 0 | „ |
| Camphor, Bhimsaini (barás) | Per lb. | 70 0 | „ |
| „ refined, cake ..... | „ | 1 4 | „ |
| „ crude, in powder . | „ | 0 12 | „ |
| Cassia lignea ............... | Per cwt. | 22 0 | „ |
| China root (chobchini), rough. | „ | 8 0 | „ |
| China root (chobchini), scraped. | „ | 17 8 | „ |
| Cubebs ..................... | „ | 25 8 | „ |
| Galangal, China............. | „ | 7 0 | „ |
| Pellitory (akalkára) ........ | „ | 40 0 | „ |
| Peppermint crystals, from China and Japan. | Per lb. | 11 8 | „ |
| Quinine and other alkaloids of chinchona. | | .. | Free. |
| Salep...................... | Per cwt. | 80 0 | 5 per cent. |
| Senna leaves................ | „ | 4 0 | „ |
| Storax, liquid (rose melloes) ......... | | 54 0 | „ |
| Tobacco, unmanufactured ........... | | .. | Free. |
| „ manufactured.............. | | *ad val.* | 5 per cent. |
| All other sorts of drugs, medicines, and narcotics, except opium. | | „ | „ |

CUSTOMS TARIFF OF BRITISH INDIA—*cont.*

| —— | Tariff Valuation. | Duty. |
|---|---|---|
| CHEMICALS, DRUGS, &c.—*cont.* | Rup. Ann. | |
| Dyeing and tanning materials: | | |
| Alizarin dye, dry 40 per cent. Per lb. | 1 7 | 5 per cent. |
| „ „ 50 „ „ | 1 10 | „ |
| „ „ 60 „ „ | 1 15 | , |
| „ „ 70 „ „ | 2 2 | „ |
| „ „ 80 „ „ | 2 8 | „ |
| „ „ 100 „ „ | 2 12 | „ |
| „ liquid 10 „ „ | 0 5 | „ |
| „ „ 16 „ „ | 0 8 | „ |
| „ „ 20 „ „ | 0 10 | „ |
| Aniline dye, liquid, indigo blue. „ | 0 9 | „ |
| Aniline dye, dry ..................... | *ad val.* | „ |
| Avar bark.................... Per cwt. | 4 8 | „ |
| Buzgand.................... „ | 27 0 | „ |
| Cochineal.................... Per lb. | 1 2 | „ |
| Gall-nuts (myrabolams) .... Per cwt. | 4 0 | „ |
| „ Persian........... „ | 35 0 | „ |
| Madder or manjit........... „ | 7 0 | „ |
| Orchilla weed............... „ | 5 0 | „ |
| Sappan wood and root ...... „ | 5 8 | „ |
| All other sorts of dyeing and tanning materials. | *ad val.* | „ |
| METALS AND MANUFACTURES OF METALS. | | |
| Quicksilver...................... Per lb. | 1 8 | „ |
| OILS. | | |
| Oils: | | |
| Cajeputi.................... Per quart | 1 4 | „ |
| Cassia...................... Per lb. | 2 8 | „ |
| Cocoanut.................. Per cwt. | 16 0 | „ |
| Earthnut.................. „ | 16 0 | „ |
| Grass...................... Per lb. | 1 12 | „ |
| Jinjili or til................ Per cwt. | 16 0 | „ |
| Linseed, European ... Per imp. gall. | 2 0 | „ |
| Otto of sorts............. Per ounce | 15 0 | „ |
| Petroleum, including also naphtha, and the liquids commonly known by the names of rock oil, Rangoon oil, Burma oil, kerosine, paraffin oil, mineral oil, petroline, gasoline, benzol, benzoline, benzine, and any inflammable liquid which is made from petroleum, coal, schist, shale, peat, or any other bituminous substance, or from any products of petroleum ........ Per imp. gallon | .. | 1 anna |
| Petroleum which has its flashing point at or above two hundred degrees of Fahrenheit's thermometer, and is proved to the satisfaction of the Customs collector to be intended for use exclusively for the batching of jute or other fibre, or for lubricating purposes.......................... | *ad val.* | 5 per cent. |
| Sandalwood................ Per lb. | 7 0 | „ |
| Whale (except spermaceti) Per cwt. and fish. | 15 0 | „ |
| Wood...................... „ | 25 0 | „ |
| All other sorts of oil, including paraffin wax. | *ad val.* | „ |

CUSTOMS TARIFF OF BRITISH INDIA—*cont.*

| —— | Tariff Valuation. | Duty. |
|---|---|---|
| OTHER ARTICLES, UNMANUFACTURED AND MANUFACTURED. | Rup. Ann. | |
| Amber and articles made of amber, including imitation amber. | *ad val.* | 5 per cent. |
| Asbestos and articles made from it....... | „ | „ |
| Building materials, viz., asphalt, bricks and tiles, cement of all kinds, fireclay, earthenware piping, lime, &c. | „ | „ |
| Candles, paraffin ............... Per lb. | 0 6 | „ |
| „ spermaceti............ „ | 0 7 | „ |
| „ wax ................. „ | 1 0 | „ |
| „ all other sorts.................. | *ad val.* | „ |
| Celluloid, articles made of .............. | „ | „ |
| Coal, coke, and patent fuel............... | .. | Free |
| Disinfecting and deodorising fluid and powder. | *ad val.* | 5 per cent. |
| Earthenware, china, &c. ................. | „ | „ |
| Fireworks and fulminating powder ...... | „ | „ |
| Gelatine................................ | *ad val.* | „ |
| Glass, glass-ware, and false pearls: | | |
| Glass, china, all colours.. Per 133⅓ lb. | 32 0 | „ |
| „ crown, colour...... Per 100 super. feet | 15 0 | „ |
| „ „ of sizes....... „ | 6 0 | „ |
| Pearls, false, bájria ......... Per lakh | 3 0 | „ |
| „ boria........... Per 1,000 | 0 10 | „ |
| „ jauria.......... Per lakh | 6 0 | „ |
| „ lolakh.......... Per 1,000 | 0 8 | „ |
| „ nathia ......... „ | 0 3 | „ |
| „ táchia ......... „ | 0 8 | „ |
| „ wattanah...... Per lakh | 10 0 | „ |
| All other sorts of glass and manufactures of glass, including false pearls and glass beads. | *ad val.* | „ |
| Gums, gum resins, and articles made of gum or gum resin: | | |
| Copal...................... Per cwt. | 70 0 | „ |
| Cutch and gambier ......... „ | 20 0 | „ |
| Gamboge ................. Per lb. | 1 4 | „ |
| Gum ammoniac............ Per cwt. | 15 0 | „ |
| „ arabic................. „ | 18 0 | „ |
| „ bdellium (common gum) „ | 8 0 | „ |
| „ benjamin ............. „ | 40 0 | „ |
| „ bysabol (coarse myrrh) „ | 16 0 | „ |
| „ olibanum or frankincense „ | 11 0 | „ |
| „ Persian (false) ........ „ | 11 0 | „ |
| „ kino .................. „ | 10 0 | „ |
| „ myrrh................. „ | 33 0 | „ |
| „ rosin.................. „ | 6 0 | „ |
| All other sorts of gums, gum resins, and articles made of gum or gum resin, including caoutchouc and gutta-percha. „ | *ad val.* | „ |
| Hides and skins (except raw or salted hides and skins, which are free): | | |
| Hides, border ............... Each | 33 0 | „ |
| „ buffalo ............. Per score | 70 0 | „ |

CUSTOMS TARIFF OF BRITISH INDIA—*cont.*

| —— | Tariff Valuation. | Duty. |
|---|---|---|
| OTHER ARTICLES, &c.—*cont.* | Rup. Ann. | |
| Hides and skins (except raw or salted hides add skins, which are free)—*cont.* | | |
| Hides, cow.................. Each | 60 0 | 5 per cent. |
| Skins, including parchment and vellum, gold-beater's skins, and all other descriptions. | *ad val.* | ,, |
| Leather and articles made of leather, including boots and saddlery. Per tola | ,, | ,, |
| Manures of all kinds, including animal bones. ,, | .. | Free. |
| Matches, all sorts............... ,, | *ad val.* | 5 per cent. |
| Oil-cloth and floor-cloth, including lincrusta, linoleum, and tarpaulins. | ,, | ,, |
| Paints, colours, painters' materials, and compositions for applications to leather, wood, and metals: | | |
| Ochre, other than European, all colours. Per cwt. | 1 8 | ,, |
| Paints, composition......... ,, | 65 0 | ,, |
| Paints, patent driers........ ,, | 10 0 | ,, |
| Prussian blue, China........ Per lb. | 0 8 | ,, |
| ,, European.... ,, | 1 0 | ,, |
| Red lead.................... Per cwt. | 14 0 | ,, |
| Turpentine............. Per imp. gal. | 2 0 | ,, |
| Verdigris.................... Per cwt. | 70 0 | ,, |
| Vermilion, Canton.......... Per box of 90 bundles | 95 0 | ,, |
| White lead.................. Per cwt. | 16 0 | ,, |
| White zinc ................ ,, | 25 0 | ,, |
| All other sorts, including glue and putty. | *ad val.* | ,, |
| Paper, pasteboard, millboard, and cardboard of all kinds, including ruled or printed forms, and account and manuscript books, labels, advertising circulars, sheet or card almanacks and calendars, Christmas, Easter, and other cards, including cards in booklet form, including also waste paper and old newspapers for packing. | ,, | ,, |
| Articles made of paper and papier-maché. | ,, | ,, |
| Perfumery: | | |
| Gowla, husked and unhusked Per cwt. | 35 0 | 5 per cent. |
| Kapurkachi (Zedoary, China) ,, | 9 8 | ,, |
| Patch leaves (patchouli).... ,, | 9 8 | ,, |
| Rose-leaves (dried) ......... ,, | 16 0 | ,, |
| Rose-water ................. Per carboy. | 5 0 | ,, |
| Per 100 flasks. | 32 0 | ,, |
| All other sorts, except perfumed spirit. | *ad val.* | ,, |
| Pipes and other implements used in the consumption of tobacco and other narcotics. | ,, | ,, |
| Pitch, tar, and dammer: | | |
| Bitumen .......................... | ,, | ,, |
| Dammer.................... Per cwt. | 5 8 | ,, |
| Pitch, American and European. ,, | 7 0 | ,, |
| Pitch, coal.................. ,, | 2 8 | ,, |
| Tar, American and European ,, | 6 0 | ,, |
| ,, coal ...................... ,, | 3 0 | ,, |
| ,, mineral ........................ | *ad val.* | ,, |
| Plants and bulbs, living and dried for herbaria. | .. | Free. |
| OTHER ARTICLES, &c.—*cont.* | Rup. Ann. | |
| Plaster of Paris, and articles made of plaster of Paris, not otherwise described. | *ad val.* | 5 per cent. |
| Plumbago, and articles made of plumbago | ,, | ,, |
| Precious stones and pearls, unset ........ | .. | Free. |
| Pulp of wood, straw, rags, paper, and other materials. | .. | ,, |
| Rags .................................. | .. | ,, |
| Sizing for cotton, paper, or any other material. | *ad val.* | 5 per cent. |
| Soap.................................. | ,, | ,, |
| Starch.................................. | ,, | ,, |
| Vulcanite or ebonite ..................... | ,, | ,, |

## SWITZERLAND.

### *Customs Decisions.*

*Note.*—Quintal = 220·4 lbs. avoirdupois. Franc = $9\frac{6}{10}d.$

The following decisions affecting the classification of articles in the Swiss Customs tariff have recently been given by the Swiss Customs authorities :—

Scoriæ of blast furnaces, in a rough state. Category 4, exempt from duty.

Scoriæ of blast furnaces, granulated. Category 7. Duty, 20 cents per quintal.

Dermatol (extract of nicotine). Category 13. Duty, 10 francs per quintal.

Formaldehyde. Category 15. Duty, 8 francs per quintal.

Bases of benzidine. Category 46. Duty, 60 centimes per quintal.

Acetine. Category 74. Duty, 2 francs per quintal.

Scoriæ of blast furnaces, ground. Category 349. Duty, 50 cents per quintal.

## BRAZIL.

### *Tariff Changes.*

The following statement of the tariff changes introduced by the Brazilian Budget Law for 1895 was enclosed by Mr. G. Greville, Her Majesty's Chargé d'Affaires at Rio de Janeiro, in a despatch to the Foreign Office, dated the 31st December last :—

The duty on matches is trebled, and that on tobacco and unrefined salt doubled.

Forty per cent. is added to the duty on fermented beverages, liqueurs, and alcoholic liquids and beverages, as also on playing cards, harness, carriages, and other articles under Class 27.

The duty on sulphuric carbon, "sulphureto de carbono" is reduced by 50 per cent., and that on maccaroni and biscuits equalised.

Casks containing oil are to pay 15 per cent., and those containing alcoholic liquors 18 per cent. *ad valorem.* Warehouse charges are increased $1\frac{1}{2}$, $2\frac{1}{2}$, and $3\frac{1}{2}$ per cent. for first, second, and third month of warehousing respectively.

The increased duties are to be levied on goods which left their port of origin after February 1st, 1895.

## ARGENTINE REPUBLIC.

### *Customs Law for 1895.*

*See* Board of Trade Journal for February, p. 191 *seq.*

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### ENCOURAGEMENT OF NATIVE INDUSTRIES IN BULGARIA.

With reference to the Bill introduced into the Bulgarian Sobranjé for the encouragement of local industries, a full translation of which appeared on p. 82 of the Society's Journal for January, a despatch, dated the 10th January, has been received at the Foreign Office from Sir A. Nicolson, Her Majesty's Agent and Consul-General at Sofia, stating that the Bill has been accepted by the National Assembly with a few insignificant modifications, the most important being one which reduces the term for which the State may give a contract to a local factory, in accordance with Article 5, from seven to five years. Lime is also now included among the articles of which the local production is to be specially encouraged.—*Board of Trade Journal.*

### ASPHALT DEPOSITS NEAR CARDENAS.

The United States Commercial Agent at Cardenas reports as follows :—

"The asphalt deposits in this consular district (Cardenas, Cuba) are nearly all submarine and situated in the bay of Cardenas. It is not known that any scientific examination into their source has been made. This territory, being of limestone formation, has very extensive subterranean passages. On each side of the city are underground streams of fresh water of such magnitude that they are generally described here as rivers. They are the source of the supply of potable water for the city, and they provide all the water consumed in the numerous sugar-boiling establishments and other manufacturing enterprises of the place. As the mines in the bay are slowly, but continually, resupplied with asphalt, it seems very probable that the source of this product is inland, and its course to the bay is through these subterranean passages. As no thorough search has been made in the bay for the asphalt, there is a great likelihood of the discovery of deposits other than those which are now known.

"As regards inland deposits, I am informed by a gentleman residing here, whose character is perfectly trustworthy, that he has discovered one within 15 miles of a railroad station, with good facilities for the construction and operation of a road and for the delivery of the product at a shipping port. This deposit is capable of yielding from 1,000 to 5,000 tons annually at slight expense and for many years, owing to the replenishment which is continually in progress. This deposit produces also an oil which has been burned in common kerosene oil lamps with good results.

"The deposits in the bay from which asphalt has been taken are four in number and of two grades. No. 1 is in the western part of the bay, and produces a very fine grade of practically pure asphalt, used in the United States for the manufacture of varnish. I have myself seen a serviceable varnish made by the simple process of dissolving this quality of asphalt in turpentine. Asphalt has been taken from this deposit in large quantities for the last 21 years. Recently, however, the work has not made rapid progress, owing to the frequent caving in of the sides of the shaft. The mode of operation is almost primitive. A lighter is moored over the shaft, which is from 80 to 125 feet in depth —varying according to the rapidity with which the asphalt is removed and replenished. A long iron bar, with a pointed end, is raised by a winch on board the lighter, and allowed to fall so that its own weight detaches portions of the asphalt, which is about as friable as cannel coal, and has much of its appearance. The gloss, however, is more brilliant. After a sufficient quantity has been detached, a common scoop net is sent down and filled by a diver—not in a diving suit. The average quantity obtained is from a ton to a ton and a half daily. The price for this grade, delivered in New York, ranges from 80 dols. to 125 dols. per ton of 2,240 lbs.

"The other three mines are of a lower grade, the product being used chiefly for paving purposes, but occasionally for roofing materials. No. 2 is north-east of Cay Coupe. No work has been done there since the hurricane of 1888, which caused the shaft to be filled up with silt. Previous to that time several cargoes were taken from the deposit. Nos. 3 and 4 contain asphalt of the same grade as No. 2, and adapted for the same purposes. No. 3 is situated at the mouth of the River La Palma, about 20 miles from Cardenas. It is in the same condition as No. 2. No. 4 is situated near Diana Cay, 15 miles from the city of Cardenas, and is the largest of all. It is called the "Constancia Mine," and is owned by persons residing at Cardenas. It has been under operation for more than 20 years. Probably 20,000 tons have been taken from it, and it appears practically inexhaustible. Vessels of from 150 to 200 tons have been moored over the deposit, and have been loaded by the joint labour of their own crews and the crew of the lighter usually engaged in this labour. The depth of water is about 12 feet. As there are several wells of no considerable depth, the facilities for procuring the asphalt are abundant. The deposit is enclosed within a circumference of about 150 feet, and the asphalt seems to be continually renewed in every part of this space. In 1882 an American vessel took on board, in the manner I have just described, over 300 tons in the space of three weeks.

"That the deposits of asphalt in the bay can be profitably worked as at present with methods seriously lacking in economy, suggests very strongly that considerable profit can be derived from the introduction of efficient machinery; the advantage would undoubtedly be increased in the case of easily accessible mines in the interior."—*U.S. Consular Reports.*

## *GENERAL TRADE NOTES.*

### THE CANADIAN WOOD-PULP INDUSTRY.

The following information on the subject of the Canadian wood-pulp industry is taken from a recent issue of the monthly bulletin of the French Chamber of Commerce at Montreal :—

All the elements necessary for the success of the manufacture of pulp exist in Canada, which offers peculiar advantages to the industry. The immense forests of the Dominion contain a supply, practically inexhaustible, of wood well adapted for the manufacture of pulp. These woods are of superior quality and much esteemed by the manufacturers of the United States, who, in 1893, purchased them to the value of 454,253 dols. The proof that Canadian woods are excellent for the manufacture of pulp is to be found in the increased quantity that the Americans purchase each year in order to supply their works. The exportation of pulp-wood (Canadian) to the United States commenced four years ago. In 1890, the export was valued at 57,197 dols., in 1891 at 170,636 dols., in 1892 at 183,312 dols., and in 1893 at 454,253 dols. The trade returns for 1894 have not yet been published, but it is expected that the export during that year will prove to be larger than in 1893.

As regards the quantity and quality of its timber, the position of Canada is superior to that of the United States. It is also equal, if not superior, to that of Scandinavia, which has up to the present monopolised the wood-pulp industry, which industry employs 69 factories in Sweden and Norway. If we may judge from the prices obtained in England, Canadian timber makes a better pulp than that coming from Scandinavian countries, since in 1893 Canadian pulp was sold in England at an average price of 24·80 dols. per ton, as compared with 20·77 dols., which was the price for that coming from Sweden and Norway.

As regards the water power it is practically unlimited in those regions where the wood-pulp is in greatest abundance, notably in the eastern part of the province of Quebec, and several portions of the maritime provinces. The region of Lake Superior offers many resources under this head, and the newspapers announced some weeks ago that American capitalists were taking measures in order to utilise the chutes of the river Kaministiquia, with the object of establishing pulp works.

The cost of labour in several portions of the province of Quebec is no higher than in Sweden and Norway, and owing to the facilities of transport which the large rivers of that country offer, the cost of wood will be as low as, if not lower, than in Scandinavia. Canada is, therefore, as regards the raw material, the motive power, and the workmanship, in an excellent position to succeed in the pulp industry.

In order, however, to make an industry in every way successful it is necessary not only that it should be worked under favourable conditions to produce readily, but also that it should have markets available for the disposal of its products.

The American market is practically closed by the American tariff, but it has free access to the important markets of England, France, and Belgium. In 1893 Great Britain imported 215,920 tons of wood pulp or paste, and France 106,049 tons, which forms a total of 321,969 tons for these two countries alone. Belgium, Spain, Italy, and the other European countries imported wood pulp to the extent of 200,000 tons, whilst the total imports exceed 500,000 tons per annum. This import trade shows a constant increase. Thus the imports into England were 121,534 tons in 1888, 156,609 tons in 1890, 190,946 tons in 1892, and 215,920 tons in 1893. This makes an increase of 77 per cent. in 1888. For the 11 months ending the 30th November 1894 the imports into England amounted in quantity to 255,466 tons as compared with 190,931 tons in 1893 and 168,598 tons in 1892.

This increase might continue for a long time before encumbering the English market. Thus, in 1893, in addition to the 215,920 tons of wood pulp mentioned above, England imported, in order to complete the supply of its paper-works, 20,750 tons of cloth and cotton rags, 185,450 tons of esparto, and 30,358 tons of pulp made from rags and other materials, or a total of 236,558 tons. However, this is not sufficient for the manufacture of the paper which is consumed in England, since the statistics show that, during this same year 1893, 116,644 tons of paper and cardboard were imported into the country. The production of the necessary pulp in order to make this paper and cardboard will give work to 18 factories requiring a motive power of from 2,500 to 3,000 horse-power each, and in order to produce the pulp capable of replacing the 236,558 tons of other raw materials, imported in order to complete the supply of the paper-works of Great Britain, there will be wanted 30 factories of similar capacity. At the present time there are only two establishments within Canada which produce for export to England: one in the province of Quebec, worked by the Americans, and one in Nova Scotia. There is a sufficiently large market in England for the production of 40 factories, and then there will always remain the markets of the other European countries, which can absorb annually more than 200,000 tons. These considerations, based on actual facts, may give some idea of the progress and extent of the field of operations opened to the Canadian pulp industry.—*Board of Trade Journal.*

### THE COKE INDUSTRY OF GERMANY.

The coke industry of Dortmund, which has made large and rapid progress of late years, has, during 1894, been still further developed by the erection and starting of a number of new plants, in all of which provision is made for the utilisation of the by-products of the coal distillation. This industry may be said to have commenced in the year 1850, when the total quantity of coke produced was only 78,800 tons. So recently as 1870 the total make of coke in the Dortmund region was not more than 341,000 tons; and in 1880 it had advanced to 1,291,000 tons. Between that date and 1893, however, the progress of the industry was extremely rapid, and in the last-named year the total number of coke ovens constructed had grown to 6,796, having considerably more than doubled since 1880, while the output of coke had advanced to 4,352,000 tons.

It is probable that many regard the utilisation of the by-products obtained in the process of manufacturing coke—which is so largely practised in Germany and so little practised in England—as likely to deteriorate the yield and the quality of the product. This, however, does not appear from the most recent statistics, which show that in 1880, when comparatively little was done in the direction of utilising the by-products, the yield of coke was only 71 per cent. of the coal consumed, whereas in 1893, when every coke-works made provision for the utilisation of the by-products, the percentage of the coal used recovered as coke was 72 per cent. Similarly, it appears that whereas the ovens in existence averaged 416 tons per oven per annum in 1860, the average of 1893 rose to 640 tons per oven; and that of 1894 is likely, with the improvements recently introduced, to be something more. It need hardly be added, that the German iron-masters and managers of blast furnaces are not, like their English confreres, disposed to reject a coke that has been made in an Otto or Lurmann oven, as inferior in quality.

During the last 10 years or so there has been a considerable variation of prices in the principal German coalfields, which culminated in the higher prices on record since 1873–74, when coke stood at over 22*s.* per ton in 1890. The following are official figures showing the average yearly prices of different descriptions of coal and coke in the Dortmund district—which produces 56 per cent. of the total coal output of Prussia—in the year 1887, and in the four years ending 1893, in marks per ton and decimals thereof:—

| —— | 1877. | 1890. | 1891. | 1892. | 1893. |
|---|---|---|---|---|---|
| Gas-flame coal .... | 5·72 | 12·36 | 11·02 | 9·75 | 8·08 |
| Fat coal .......... | 5·63 | 10·72 | 9·86 | 8·50 | 7·29 |
| Lean coal ......... | 4·88 | 11·00 | 9·73 | 7·75 | 7·50 |
| Gas coal .......... | 7·10 | 13·47 | 12·91 | 11·75 | 9·79 |
| Foundry coke..... | 8·67 | 22·00 | 17·00 | 14·63 | 14·00 |
| Blast-furnace coke | 7·83 | 19·78 | 13·50 | 12·00 | 11·00 |
| Nut coke ......... | 8·32 | 22·61 | 18·00 | .. | .. |
| Briquettes........ | 7·30 | 14·64 | 14·25 | 11·38 | 9·75 |

This table shows that there was an extraordinary rise of prices as between 1887 and 1890, most descriptions having risen by at least 100 per cent., and foundry and furnace coke having advanced to a much larger extent even than that. The advance was out of all ordinary proportion to the increase of wages in the same years, the rise in hewers' wages having only been a fraction over a 1*s.* a ton, as between 1887 and 1890, while the advance in surface labour was less than 6*d.* per ton. It may therefore be inferred that coalowners in Westphalia had a good thing in hand during the last four years, and especially in 1890–91, when the prices of coke, and of coal generally, were much higher than the average prices realised in Great Britain in the same years. It is, however, proper to add that for a number of years prior to 1889 the coal industry of Westphalia had been in a very unsatisfactory state, and that some of the principal collieries had been losing money on their operations, while very few of them were able to pay more than 2 to 3 per cent.—*Ibid.*

### THE WORLD'S SUPPLY OF TIN.

According to data collected by M. Murtelet since 1888, the Malay Peninsula has supplied nearly 30,000 tons of tin; that is to say, more than half of the total production of the world. The difference is distributed in the following manner:—England, 9,000 tons; Australia, 6,500 tons; America, Tasmania, and the rest of Europe, 13,090 tons.

In 1891 the figures of production show that the annual yield has varied but little in England, while it is smaller in Australia and has increased at Banca and Blitong. The greatest progress has been made in the peninsula of Malacca, which delivered for export 28,500 tons—about doubling the figure of its production during the last decennial period.

This result is due less to the processes of working, which are of the simplest, than to the wealth of the deposits worked. The stanniferous deposit stretches for a length of from 1,900 to 2,000 kilometres; it consists of ores which are found at a few centimetres distance from the surface. The ore is almost pure metal. According to Mr. Wildman, United States Consul at Singapore, the mines increased this production during 1893 to the quantity of 32,700 tons of tin. The working of the mines for these valuable ores is of the simplest kind.—*Ibid.*

### THE WORLD'S PRODUCTION AND CONSUMPTION OF COPPER, LEAD, AND ZINC.

The "Bulletin du Musée Commercial," states that the Metal Society of Frankfort has recently published its annual statistics concerning the production and consumption of copper, lead, and zinc, in the principal countries of the world.

The following figures, showing a comparison between the years 1893 and 1892, are extracted from the returns in question:—

| —— | 1892. | 1893. |
|---|---|---|
| | Tons. | Tons. |
| COPPER. | | |
| Production | 315,000 | 312,000 |
| Consumption | 327,000 | 319,000 |
| Excess of consumption | 12,000 | 7,000 |
| LEAD. | | |
| Production | 631,000 | 630,000 |
| Consumption | 638,000 | 630,000 |
| Excess of consumption | 7,000 | .. |
| Value of production | 166,250,000 frs. | 152,500,000 frs. |
| ZINC. | | |
| Production | 373,000 | 378,000 |
| Consumption | 376,000 | 381,000 |
| Excess of consumption | 3,000 | 3,000 |

It would appear from the above figures that, notwithstanding the depreciation in silver and the financial crisis in America, the relation of consumption to manufacture, during the year 1893, remained extraordinarily firm for copper, whilst the consumption of lead and zinc progressed *pro rata* with production.

The production of lead in the latter country in 1893 showed a diminution of 15,000 tons compared with the year 1892, a diminution which has been compensated by the increase in Mexican production. Compared with the second half of 1893, American production during the first half of 1894, fell off by 11,000 tons.

On the other hand, the diminution of 8,000 tons noted in the consumption of lead in the United States in 1893 has been compensated by a corresponding increase of European consumption.

The consumption of copper in the United States in 1893 diminished by about 47,000 tons, whilst the total consumption of this metal was only reduced by 7,000 tons, Europe having absorbed the American exports, which reached 80,000 tons in 1893 as against 40,000 tons in 1892.

During the year 1894, the export of copper to the United States fell off considerably, and only reached 38,000 tons during the first six months, and 20,600 tons during the third quarter of the year.—*Ibid.*

### RESIN AND TURPENTINE PRODUCTION IN BRITISH INDIA.

The production of resin and turpentine from Indian pines is the subjebt of one of the Indian series of the Handbooks of Commercial Products. The question of securing a market in Europe for these two rather important staples of commerce was taken up by the Government of India in 1888, and a letter on the subject was addressed to the North-Western Provinces Government. The Conservator of Forests in the school circle was accordingly requested to set on foot experiments in certain directions indicated.

Calcutta "Capital" in its issue of the 12th December states that of the *Pinus longifolia*, the well known *chir* of the North-Western Provinces, there are extensive areas in Kumaon and Garhwal, and investigations were undertaken to ascertain how far it would be possible, by devising cheap, rapid, and exhaustive methods of tapping and distillation, and of the preparation of the by-products of distillation, and also by studying the conditions under which the trees give their maximum yield, to ensure the desired result.

Most people are doubtless aware of the extensive industry carried on in France and America in resin (or colophany) and turpentine, owing to the peculiar facilities that exist in these countries for their production. Further, that the resin as produced by the tree is subjected first to liquefaction and filtration, by which means the oil of turpentine is separated; the latter is then distilled and yields essence of spirits of turpentine and resin. Also that the spirits of turpentine are largely used in the mixing of oil paints, the manufacture of varnishes, caoutchouc, and as well as extensively dispensed in the pharmaceutical chemist's shop; and that the resin is still in considerable demand for soap-making (American being most highly valued for this purpose, chiefly owing to its finer odour), printers' ink, the coarser description of varnish and sealing wax, for lining barrels, bending lead pipes, &c.

India at present depends chiefly on America for her supplies of turpentine, which are shipped from England. What is sold in the Calcutta market as American turpentine is, however, said to be impure, being largely adulterated in England with kerosine, naphtha, benzoine, &c., and it is almost unnecessary to add that in common with almost every other commodity capable of being so dealt with, it is subjected to further sophistication in India. Probably the same state of things exists in Bombay by use and custom; therefore, the traits of the pure article have become practically unknown in India, consequently there is little demand for it, purchasers in fact looking more to quantity than quality. It is further stated that the little genuine turpentine to be found in the hands of local merchants is imported direct from America, not through the United Kingdom. In illustration of the fact that unadulterated turpentine is, to all intents and purposes, unknown in Calcutta, a case is quoted in which a sailor brought some to the port and offered it for sale, but found the greatest difficulty in disposing of it on account of its odour being different from the made-up stuff usually sold in the bazaars.

Mr. Thurston, in a concluding note on the subject, points out that the Dehra turpentine is of very superior quality, but that it cannot be sold at the highest price obtained for the best imported article.—*Ibid.*

### THE AMBER TRADE OF DANTZIG.

The French Consul at Dantzig, in a recent report, refers to the amber trade and manufacturing industry at Dantzig. He states that while they were very flourishing some years ago, they have only shown a decrease within the last 20 years.

The mines of Palmnicken, situated in the province of Eastern Prussia, near Kœnigsberg, which still contain abundant deposits of amber, only yielded, in 1893, 165 tons of this substance, against 195 tons extracted in 1892, whilst the demand for local industry has been small. The yield of amber on the shores of the Baltic, the waves of which throw numerous fragments on the shore, generally of small size, has also shown a falling off, and, prices having further fallen during the course of the year, the coast residents have almost entirely given up the fishing of this substance, so very unprofitable had this industry been.

The Dantzig factories give employment to 500 workmen, and the quantity of amber which was worked in 1893 may be estimated at about 43 tons; the preceding year was a little better, and 60 tons of this substance were imported from Palmnicken.

Within the last few years there have been manufactured at Dantzig new articles of amber waste, machine-pressed, which almost exactly imitate natural amber in a single piece, although of a duller colour, and which are designated in trade under the name of ambroid. The low price of this new product is extraordinary and makes it sought after by foreigners. In 1893 a very large quantity was exported to the United States, to South America, to Austria-Hungary, to Roumania, to Bulgaria, and to Servia, where it is sold as true amber.

In the eastern markets, articles of ambroid have not, on the contrary, met with any success. The large consignments of this new composition which have been sent to Constantinople, Smyrna, and Bagdad, have been returned to the consignors and have not found any market in those countries.—*Ibid.*

### The German Chemical Industry.

The Hamburg "Bœrsen Halle" publishes a short exposé of the state of the chemical products industry of Germany during the year 1893.

Notwithstanding the low price of most of the products, this large branch of German industry made considerable progress in the course of last year. The loss resulting from the low price has in fact been compensated by the discovery of new products and a greater extension of the market.

The chemical products industry in Germany is shown as holding itself always in direct contact with scientific progress, and the confidence which it inspires in all the importing countries facilitates the exportation of the products. Thus the financial result of the 1893 season was superior to that of the preceding year. The 91 companies which published a balance sheet show an average dividend of 13·18 per cent. as compared with 11·92 per cent. in 1892. These 91 companies represent in fact a total capital of 220,666,200 marks, and they have been able to distribute a total dividend amounting to 29,096,170 marks.

The "Bœrsen Halle" remarks, however, that the 91 companies in question only form a relatively small portion of the existing enterprises. They work with capital larger than that of private concerns, and consequently have a larger profit.

The comparison of the first nine months of 1894 and 1893 gives the following results for drugs, pharmaceutical and colouring products :—

1893, from January to the end of September 4,285,896 metric quintals, valued at 197,601,000 marks. 1894, 4,415,434 metric quintals, valued at 200,144,000 marks.

There was therefore in 1894 a further increase in value as well as in quantity exported.

This industry furnishes also a favourable exception to the general results of the first nine months of the present year, since the statistics show to the end of September 1894 a decrease of 139,732,000 marks in the total exports, compared with the corresponding figures of 1893.—*Ibid.*

### The German Glass Industry.

According to the report recently submitted to their shareholders by the managers of the Stolberg Glass Works, 1894 has not been a favourable year for the glass industry in Germany. The small works were compelled to accept any prices they could get in order to find an outlet for their goods. This led to such a drop in prices, especially in stoppered bottles, that most transactions resulted in a loss rather than a profit to the makers. The manufacture of table glasses has also almost ceased to be profitable. Fortunately the exportation of common glassware to the United States and Russia, which was temporarily rendered impossible by the increase of Customs duties, has again been resumed.—*Chemist and Druggist.*

### Another New German Pharmaceutical Factory.

According to the *Pharmaceutische Zeitung*, the excellent financial results which have attended the preparation of the pharmaceutical articles by aniline-dye works, have led the directors of the well-known Actien Gesellschaft für Anilin-fabrikation in Berlin, one of the largest concerns of this class, to commence the manufacture of medicinal preparations. When the decision of the directors became known, the shares of the company advanced immediately.—*Ibid.*

### The Mineral Production of Austria.

The "Oesterreichische Zeitschrift für Berg und Hüttenwesen" gives a statement of the mineral production of Austria for the year 1893, the figures being taken from the returns made to the Ministry of the Interior. The returns for the more important minerals are as follows: Lignite, 16,815,955 tons; coal, 9,732,651 tons; iron ore, 1,109,112 tons; quicksilver ore, 76,215 tons; zinc ore, 30,531 tons; graphite, 23,807 tons; silver ore, 18,018 tons; and alum and vitriol shale, 13,370 tons. The output for the more important metals was as follows: Pig iron (foundry), 555,062 tons; pig iron (forge), 108,283 tons; lead, 7,212 tons; zinc, 5,870 tons; sulphuric acid, 10,248 tons; and silver, 37,344 kilograms. It is stated that the output for most of the metals is of a steady nature. The increase in iron production is, however, considerable, and indicates a steady growth. The gold and silver output was almost entirely from Bohemia, as in former years. The quicksilver was chiefly from the famous mines of Idria, which supplied 87 per cent. of the total, the rest coming from St. Anna and Littai. The copper was from Bohemia, Salzburg, and the Tyrol. Nickel, cobalt, arsenic, and chrome ore have disappeared from the list of the products reported in former years, none of these minerals having been produced last year.

### Decreased Output of Russian Quicksilver.

The output of quicksilver from the mines owned by Messrs. Auerbach and Co., in the consular district of Taganrog, Russia, during 1893, was 60,713 tons of ore, producing 3,944 cwt. of quicksilver, being a decease of 4,651 tons (7·1 per cent.) of ore, and 2,781 cwt. (41·4 per cent.) of quicksilver. The large falling-off in the quicksilver produced is not so much on account of the smaller quantity of ore mined as because the ore now obtained is of inferior quality, and contains a much smaller percentage of mercury. In order to extend their operations, the company have purchased a tract of land, of about 1,350 acres, from the peasants of the village of Nikitovka.—*Chemist and Druggist.*

### American and Scotch Oil Companies.

Recently the representatives of the Scotch oil companies met in conference at Glasgow with Mr. Bedford, of the Standard Oil Company of America, to consider the renewal of the arrangement made between the two rival interests two and a half years ago. It was agreed that the Standard Oil Company should stop sending American burning oil to Scotland, and as, consequently, the chief competition with the Scotch companies will be removed, the shares of these concerns have risen considerably. The price of Scotch solid paraffin is also to be advanced a farthing per lb., which will increase the revenue of the Scotch oil companies by 50,000*l.* annually.—*Ironmonger.*

### South African Nitrates.

Dr. Marloth's report on nitrate prospects at Prieska, which have raised some interest in nitrate circles, refers merely to his researches at one particular farm—Doornbergfontein. The three localities where nitrates have been discovered are situated in the mountains, at an altitude of 3,000 to 4,000 feet. Here the nitrate occurs under overhanging rocks, or in caves, filling fissures or incrustating the rocks. In most instances the layers are not more than $\frac{1}{8}$ inch thick, in some places reaching $\frac{1}{2}$ inch. The material consists mostly of nitre-bearing lime, but is found occasionally almost pure, containing as much as 95·5 per cent. of finely crystallised saltpetre. Samples of soil from the neighbouring plains were also found to all contain some nitrate. Dr. Marloth attributes the occurrence of the nitrates to the accumulated refuse of rock-rabbits.—*Chemist and Druggist.*

### ALIZARIN v. INDIGO.

It is reported that the Prussian military authorities have decided to use alizarin in future instead of indigo for dyeing the soldiers' uniforms, and have given the contract for the new dye to the Badische Anilin Fabrik in Ludwigshafen. The average value of the indigo hitherto employed for this purpose was 50,000*l.* a year.—*Ibid.*

### USE OF ALUMINIUM IN REFINING METALS.

A communication to the Liege Section of the Association des Ingenieurs de Liege, by M. J. Faucan, engineer at the Ateliers de la Meuse, on the refining of metals by aluminium, terminates as follows:—The use of aluminium as a refining agent does not dispense with the usual precautions, it being still necessary to allow the metal to cool properly and give off its gas before casting; and, while pouring, the stream should be kept continuous and central, care being taken to avoid its falling too quickly so as to make large runners. If the metal be subject to considerable contraction, the ingot-molds must be protected from too rapid cooling; and, if depressions be produced by suction, hot metal must be immediately poured in to fill them. If these precautions be observed, the following results may reasonably be expected, viz.: Suppression of the use of silico-carbonated iron and a diminution in that of ferro-manganese, aluminium playing the same part as the former under better conditions and restricting that of the latter to the elimination of sulphur; in making nickel steel, great homogeneity of the product, aluminium acting violently in the steel and nickel bath, and greatly facilitating a union which is not otherwise easy; in making iron and steel castings generally, leaving out of the question red shear iron (fer metis), in which aluminium plays an important part; the obtention of castings very clean, very compact, and standing as well hot as cold; dense brass castings, easy to work with the hammer and having an electric conductibility more than double that of ordinary castings; and lastly, in working nickel, all the advantages of refining with magnesium, but obtained more economically.—*Engineering and Mining Journal.*

### BRICK-DUST MORTAR.

*Chemical Trade Journal.*

The use of brick-dust mortar as a substitute for hydraulic cement, where the latter cannot be obtained, is now recommended, the *Southern Architect* says, on the best engineering authority, experiments made with mixtures of brick-dust and quicklime showing that blocks of one-half inch in thickness, after immersion in water for four months, bore without crushing, crumbling, or splitting, a pressure of 1,500 lbs. per square inch. It is considered, too, that the addition of even as small a proportion as one-tenth as much brick-dust as sand to ordinary mortars is preventive of the disintegration so often characterising mortars used in the masonry of public works. The use of brick-dust mixed with lime and sand is said to be generally and successfully practised in the Spanish dominions, and is stated to be in all respects superior to the best Rosendale hydraulic cement in the construction of culverts, drains, tanks, or cisterns, and even roofs, whether for setting flat tiles or for making the usual tropical flat roof. The proportions used there in the manufacture are, approximately, one of brick-dust, one of lime, and two of sand, mixed together dry and tempered with water in the usual way (see also this Journal, 1892, 282).—*Chemical Trade Journal.*

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Month ending 31st January | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,726,970 | 1,604,199 |
| Chemicals and dyestuffs | 763,042 | 600,583 |
| Oils | 665,342 | 676,876 |
| Raw materials for non-textile industries. | 2,752,124 | 2,699,557 |
| Total value of all imports | 38,458,613 | 36,753,068 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 31st January | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,077,815 | 2,033,598 |
| Chemicals and medicines | 720,019 | 662,667 |
| Miscellaneous articles | 2,068,539 | 2,220,621 |
| Total value of all exports | 18,151,880 | 18,224,236 |

### IMPORTS OF METALS FOR MONTH ENDING 31ST JANUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper:— | | | | |
| Ore Tons | 6,474 | 7,588 | 29,175 | 78,382 |
| Regulus „ | 6,457 | 7,581 | 160,512 | 165,486 |
| Unwrought „ | 5,763 | 5,305 | 251,933 | 222,823 |
| Iron:— | | | | |
| Ore „ | 343,112 | 289,029 | 240,777 | 189,521 |
| Bolt, bar, &c. „ | 2,683 | 3,160 | 21,096 | 26,420 |
| Steel, unwrought „ | 1,615 | 704 | 17,311 | 8,673 |
| Lead, pig and sheet „ | 15,927 | 13,321 | 152,272 | 126,678 |
| Pyrites „ | 61,526 | 49,736 | 104,313 | 83,782 |
| Quicksilver Lb. | 13,800 | 45,000 | 1,092 | 3,850 |
| Silver ore Value £ | .. | .. | 275,203 | 231,361 |
| Tin Cwt. | 78,063 | 76,878 | 293,009 | 243,622 |
| Zinc Tons | 3,308 | 4,701 | 54,109 | 69,172 |
| Other articles Value £ | .. | .. | 126,168 | 154,429 |
| Total value of metals | .. | .. | 1,726,970 | 1,604,199 |

### IMPORTS OF OILS FOR MONTH ENDING 31ST JANUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut........ Cwt. | 17,626 | 65,934 | 21,622 | 73,805 |
| Olive ............. Tuns | 1,942 | 1,096 | 69,239 | 38,832 |
| Palm ............. Cwt. | 94,451 | 85,189 | 111,712 | 89,876 |
| Petroleum ........ Gall. | 14,130,526 | 17,349,778 | 269,151 | 269,657 |
| Seed ............. Tons | 3,234 | 3,484 | 70,679 | 75,346 |
| Train, &c. ........ Tuns | 1,343 | 1,027 | 22,946 | 15,690 |
| Turpentine ....... Cwt. | 13,274 | 28,911 | 14,370 | 29,414 |
| Other articles .. Value £ | .. | .. | 85,623 | 84,256 |
| Total value of oils ... | .. | .. | 665,342 | 676,876 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST JANUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 3,631 | 5,529 | 7,406 | 10,045 |
| Bristles.......... Lb. | 189,875 | 293,190 | 24,220 | 40,804 |
| Caoutchouc...... Cwt. | 31,368 | 32,766 | 342,034 | 405,234 |
| Gum :— | | | | |
| Arabic......... „ | 4,209 | 7,743 | 9,068 | 13,290 |
| Lac, &c. ....... „ | 7,083 | 9,836 | 37,475 | 52,589 |
| Gutta-percha .... „ | 6,765 | 8,461 | 75,764 | 70,029 |
| Hides, raw :— | | | | |
| Dry............ „ | 30,962 | 31,578 | 74,848 | 78,090 |
| Wet ........... „ | 56,805 | 40,828 | 108,364 | 82,195 |
| Ivory............ „ | 663 | 908 | 23,298 | 39,146 |
| Manure :— | | | | |
| Guano......... Tons | 3,797 | 3,479 | 18,234 | 19,943 |
| Bones.......... „ | 6,280 | 5,123 | 30,662 | 24,010 |
| Nitrate of soda... „ | 89,917 | 1,882 | 91,005 | 15,380 |
| Phosphate of lime „ | 28,499 | 35,379 | 51,200 | 63,487 |
| Paraffin.......... Cwt. | 89,917 | 73,274 | 91,363 | 74,130 |
| Linen rags....... Tons | 1,330 | 1,730 | 12,168 | 17,366 |
| Esparto.......... „ | 13,750 | 16,861 | 66,035 | 72,657 |
| Pulp of wood .... „ | 24,715 | 23,595 | 105,084 | 120,623 |
| Rosin............ Cwt. | 108,864 | 70,944 | 21,135 | 15,253 |
| Tallow and stearin „ | 160,997 | 128,312 | 220,499 | 157,538 |
| Tar .............Barrels | 1,755 | 1,918 | 1,057 | 1,018 |
| Wood :— | | | | |
| Hewn ......... Loads | 123,752 | 139,592 | 191,289 | 242,188 |
| Sawn .......... „ | 101,619 | 84,050 | 234,824 | 195,848 |
| Staves ......... „ | 8,002 | 6,577 | 49,151 | 38,017 |
| Mahogany ..... Tons | 5,416 | 5,486 | 44,646 | 40,174 |
| Other articles....Value £ | .. | .. | 821,295 | 810,593 |
| Total value ....... | .. | .. | 2,752,124 | 2,699,557 |

Besides the above, drugs to the value of 62,433*l.* were imported, as against 75,522*l.* in January 1894.

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST JANUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 6,898 | 15,532 | 5,682 | 10,435 |
| Bark (tanners', &c.) „ | 19,324 | 15,434 | 6,500 | 5,183 |
| Brimstone........ „ | 55,815 | 29,990 | 11,854 | 5,860 |
| Chemicals...... Value £ | .. | .. | 137,047 | 85,797 |
| Cochineal ........ Cwt. | 804 | 279 | 4,729 | 1,808 |
| Cutch and gambier Tons | 2,322 | 2,978 | 48,216 | 62,663 |
| Dyes :— | | | | |
| Aniline....... Value £ | .. | .. | 20,522 | 34,348 |
| Alizarin ...... „ | .. | .. | 27,872 | 21,972 |
| Indigo ........... Cwt. | 13,936 | 13,190 | 296,140 | 22,152 |
| Nitrate of potash . „ | 16,281 | 25,590 | 15,458 | 23,825 |
| Valonia ........... Tons | 1,836 | 3,201 | 24,822 | 37,693 |
| Other articles... Value £ | .. | .. | 164,200 | 88,847 |
| Total value of chemicals | .. | .. | 763,042 | 600,583 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST JANUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 8,354 | 71,905 | 31,831 | 30,587 |
| Copper :— | | | | |
| Unwrought..... „ | 22,117 | 40,027 | 49,503 | 85,094 |
| Wrought........ „ | 27,416 | 30,405 | 75,547 | 79,857 |
| Mixed metal.... „ | 33,566 | 25,688 | 74,262 | 53,044 |
| Hardware ..... Value £ | .. | .. | 149,436 | 149,617 |
| Implements....... „ | .. | .. | 101,701 | 97,593 |
| Iron and steel..... Tons | 161,804 | 166,711 | 1,406,963 | 1,351,086 |
| Lead ............. „ | 3,441 | 2,527 | 41,456 | 31,194 |
| Plated wares... Value £ | .. | .. | 19,338 | 19,372 |
| Telegraph wires „ | .. | .. | 18,738 | 35,193 |
| Tin ............... Cwt. | 8,803 | 10,678 | 35,212 | 35,673 |
| Zinc ............. „ | 19,489 | 14,207 | 13,536 | 9,295 |
| Other articles .. Value £ | .. | . | 60,292 | 56,013 |
| Total value ......... | .. | .. | 2,077,815 | 2,035,598 |

### Exports of Miscellaneous Articles for Month ending 31st January.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 606,700 | 360,400 | 12,825 | 9,214 |
| Military stores.. Value £ | .. | .. | 60,059 | 104,733 |
| Candles.......... Lb. | 1,620,200 | 1,913,800 | 29,024 | 31,669 |
| Caoutchouc..... Value £ | .. | .. | 91,745 | 96,727 |
| Cement.......... Tons | 27,030 | 24,593 | 44,110 | 39,630 |
| Products of coal Value £ | .. | .. | 106,107 | 144,903 |
| Earthenware ... „ | .. | .. | 109,322 | 133,557 |
| Stoneware...... „ | .. | .. | 10,623 | 12,866 |
| Glass:— | | | | |
| Plate........... Sq. Ft. | 95,393 | 89,463 | 4,917 | 4,824 |
| Flint........... Cwt. | 6,962 | 7,208 | 15,229 | 17,090 |
| Bottles......... „ | 47,910 | 50,627 | 22,815 | 23,845 |
| Other kinds.... „ | 8,948 | 18,004 | 7,799 | 12,669 |
| Leather:— | | | | |
| Unwrought.... „ | 10,474 | 11,320 | 95,224 | 103,024 |
| Wrought..... Value £ | .. | .. | 21,239 | 23,130 |
| Seed oil.......... Tons | 5,616 | 3,663 | 118,403 | 74,818 |
| Floorcloth ..... Sq. Yds. | 1,629,300 | 2,091 800 | 58,911 | 74,402 |
| Painters' materials Val. £ | .. | .. | 106,794 | 105,715 |
| Paper ........... Cwt. | 69,477 | 68,238 | 114,800 | 108,695 |
| Rags............. Tons | 3,702 | 4,272 | 21,588 | 25,321 |
| Soap............. Cwt. | 53,024 | 44,925 | 53,734 | 48,562 |
| Total value.......... | .. | .. | 2,068,539 | 2,220,621 |

### Exports of Drugs and Chemicals for Month ending 31st January.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 483,812 | 500,505 | 145,863 | 120,368 |
| Bleaching materials „ | 94,307 | 93,253 | 37,736 | 34,274 |
| Chemical manures. Tons | 28,074 | 27,728 | 208,390 | 203,069 |
| Medicines....... Value £ | .. | .. | 80,112 | 91,957 |
| Other articles ... „ | .. | .. | 247,918 | 212,999 |
| Total value.......... | .. | .. | 720,019 | 662,667 |

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### Applications.

918. A. T. Clarkson and J. B. Spurge. Improvements in apparatus for regulating the flow of compressed gases. January 15.

1415. C. Pratten. Improvements in presses suitable for moulding plastic materials and subsequently dividing the same into blocks. Complete Specification. January 21.

1423. F. M. Robertson, W. S. Miller, and H. S. Fearon. Improvements in the process of and apparatus for evaporating or drying. January 22.

1619. W. L. Wise.—From K. Schlatter and L. Hermsdorf, Germany. Improvements in or relating to vacuum drying apparatus. January 23.

1807. E. Gearing. Improvements in furnaces for producing carbide of calcium and the like. January 25.

1889. S. Taylor. Improvements in appliances for use with crucibles or melting pots during the melting of metals and metallic alloys in the said crucibles or pots. Complete Specification. January 26.

1956. D. P. F. Cardozo. Improvements in evaporating apparatus. Complete Specification. Filed January 28. Date applied for 26th September 1894, being date of application in United States.

2287. W. T. Griffin, J. Lewis, and G. H. Llewellyn. *See* Class VIII.

2424. A A. Robin. Differential low-pressure still for the distillation of volatile and inflammable compounds. February 4.

2437. D. B. Morison. Improvements in apparatus for generating gas, such as acetylene. February 4.

2452. J. Klein. Improvements in or relating to graduating or cooling apparatus and processes. February 4.

2485. J. Patterson. Improved apparatus for utilising the waste heat of furnace gases. February 5.

2540. E. J. O'Brien. Improvements in apparatus for separating fluids from solids. Complete Specification. February 5.

2717. F. E. Gätcke. An improved method of an apparatus for counteracting, deflecting, and distributing gases and flames in chemical works, furnaces, or the like. February 7.

2722. F. H. Eydman. Improved filtering process and apparatus. February 7.

2723. F. H. Eydman. Improvements in apparatus for heating, evaporating, distilling, and condensing. February 7.

2824. S. M. Lillie. Improvements in methods and apparatus for the continuous concentration of liquids. February 8.

2929. G. Lake. Improvement in overflow vessels for the circulation, concentration, and distillation of liquids. February 11.

2946. E. L. Pease and Ashmore, Benson, Pease, and Co., Lim. An improved retort for chemical processes. February 11.

3118. J. Foster. Improvements in or relating to evaporating apparatus. February 13.

### Complete Specifications Accepted.*

### 1894.

2085. J. J. Meldrum and T. F. Meldrum. Condensers. January 30.

2915. D. Wickham. Apparatus for measuring still or gaseous liquids. February 13.

4622. R. Andrew. *See* Class XII.

5119. D. Drummond. Method and apparatus for expressing sap or juice from fibrous canes, &c. January 23.

6176. J. E. Tolson and G. Tolson. Automatical hydro-extractor. February 6.

6462. K. C. Edmunds. Compound for freezing or chilling. January 23.

7388. E. G. Scott. Evaporating apparatus. February 20.

15,885. J. C. S. McLay. Non-heat-conducting materials. February 6.

### 1895.

10. W. Brothers. The softening of hard water. February 13.

## II.—FUEL, GAS, AND LIGHT.

### Applications.

940. B. H. Thwaite. Improved process for generating oil-enriched and luminous water-gas, and in apparatus therefor. January 15.

950. H. Weymersch. The manufacture and production of a new material for use in obtaining oxygen from atmospheric air. January 15.

988. J. M. Rusby. Improvements in water-gas apparatus. Complete Specification. January 15.

1067. T. Rowan. Improvements in apparatus appertaining to gas lighting. January 16.

1281. W. J. C. Nicholson. Easy method of ensuring to hydrocarbons, especially earth and rock petroleum oils, a flashing point exceeding 212 degrees Fahrenheit. January 19.

1334. J. A. Macmeiken. Improvements in apparatus for the manufacture of artificial fuel. January 19.

1420. H. T. Stevenson. Improvements in the manufacture and production of fire-lighters. January 21.

1487. A. G. Glasgow. Improvements in apparatus for the manufacture of water-gas. Complete Specification. January 22.

1604. F. Heusler. Process for the purification and desulphurisation of tar oils and petroleum for the production of pure burning and lubricating oils therefrom. January 23.

1616. P. C. Tennant and J. E. Hall. Improvements relating to the carburetting and enriching of coal and other gas and to apparatus therefor. January 23.

1847. A. E. Yeadon and J. Richardson. Improvements in the manufacture of briquettes or blocks of compressed fuel. January 26.

1953. L. M. Bullier. Improvements in carburetting air and gases. January 28.

1961. A. J. Boult.—From G. Cabrié, France. Improvements in carburrettors. Complete Specification. January 28.

2017. C. W. Pinkney. Improvements in apparatus for furnaces for producing gas from carbonaceous matter. January 29.

2092. F. S. Cripps. Improvements in valves for use in connection with purifiers employed in gasworks. January 30.

2180. W. Ewing and J. Meikle. Improvements in apparatus for carburetting illuminating gas. January 31.

2213. J. C. Richardson. Improvements in the production of oxygen or hydrogen gas. January 31.

2224. J. Moeller. An improvement in illuminant appliances for incandescence gas lights. January 31.

2437. D. B. Morison. *See* Class I.

2732. O. Kroll. Improvements in or relating to the manufacture of refractory bodies for use in gas and other burners. February 7.

2838. A. Friedeberg. An improved method and apparatus for the production of illuminating gas. February 8.

2897. S. Butler. Improvements in the manufacture of patent fuel. February 9.

3056. C. Jousset and F. O'C. Prince. A new gas. February 12.

3089. A. C. Humphreys and A. G. Glasgow. An improved method or process of carburetting water-gas and apparatus therefor. Complete Specification. February 12.

3333. F. O'C. Prince. Improvements in apparatus for producing and regulating the outflow of gas produced from a mixture of ingredients. February 15.

3354. P. Brentini. New or improved process and apparatus for the manufacture of gas for lighting and heating purposes. February 15.

3393. W. Knowles. Improvements in the composition and manufacture of artificial fuel. February 16.

3424. D. Hancock, J. B. Craig, and A. H. Hancock. Improvements in incandescent carburetted air or gas lighting and apparatus therefor or connected therewith. February 16.

3425. D. Hancock, J. B. Craig, and A. H. Hancock. Improvements in carburetting apparatus. February 16.

### Complete Specifications Accepted.

### 1894.

1190. F. McNamee. Method and apparatus for drying peat for fuel, litter, &c. January 30.

3018. A. Farinetti. Automatic apparatus for producing gas. February 13.

3078. J. Jameson. Appliance for increasing and regulating the pressure of gas in houses, &c. January 30.

4053. J. Laing. Manufacture of gas from mineral and other oils and tars, and apparatus therefor. February 13.

4506. R. Dunlop. Treating and utilising certain gases from the carbonisation of coal. January 30.

5510. G. Wilton. Method and apparatus for carbonisation of coal. February 20.

7772. G. S. Cory and C. Cory. Manufacture of artificial fuel. February 13.

8098. L. Dardel and H. Bécoulet. Solid combustible, and manufacture of same. February 20.

21,658. J. J. Adkins. *See* Class XVII.

24,620. C. W. Claybourne. Method and apparatus for burning coal-dust or other granulated or powdered fuel. January 23.

21,624. J. L. Hastings and C. D. Hank. Method and apparatus for manufacturing gas. January 30.

25,001. E. Stauber. Production of peat briquettes. January 30.

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* *See* Note (*) on previous page.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Application.

2188. R. V. Horsfall. Improvement in plant for distilling, cracking, or gasifying oils, tars, or any liquid hydrocarbons. January 31.

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## IV.—COLOURING MATTERS and DYES.

### Applications.

1002. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. Improvements in the manufacture of azo dyes, and in the production of black shades on cotton or other vegetable fibre, or on silk and the like. January 15.

1352. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik, Germany. The manufacture and production of new basic colouring matters. January 19.

1388. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in and relating to the manufacture of colouring matters. January 21.

1392. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning, Germany. Manufacture of alpha-amido-alizarine sulphonic acid. January 21.

1414. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co., Germany. Improvements in the manufacture of colouring matters. January 21.

1525. F. O. Dagnall. Improvements in the manufacture of ink. January 22.

1941. O. Imray.—From The Society of Chemical Industry in Basle, Switzerland. Manufacture of indigo-blue colouring matters. January 28.

1963. G. W. Johnson.—From Kalle and Co., Germany. Improvements in the manufacture and production of para-amido-benzyl-alcohol and homologues, and analogues thereof and derivatives therefrom. January 28.

2041. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters. January 29.

2387. A. M. Clark.—From P. Becker, Russia. Improvements in the manufacture of diazo-dyestuffs. February 2.

2504. Read, Holliday, and Sons, and R. Holliday. Improvements in the production of new blue colouring matters for dyeing and printing. February 5.

2900. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. February 9.

3414. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Manufacture of the colouring matters termed thio-catechines. February 16.

3415. J. Imray.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of azo dyes. February 16.

3416. J. Imray.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of azo-dyes. February 16.

### Complete Specifications Accepted.

1894.

3842. C. D. Abel.—From the Actien Gesellschaft für Anilin Fabrikation. Manufacture of new bases and their sulpho-acids. January 30.

4460. O. Imray.—From The Society of Chemical Industry, Basle. Manufacture of poly-azo colouring matters. January 23.

5414. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of dry alizarine. January 23.

5636. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of poly-azo dyestuffs. January 23.

5709. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of new colouring matters. January 23.

5711. H. E. Newton.—From The Farbenfabriken vormals Bayer and Co. Manufacture of colouring matters and materials therefor. January 23.

5853. Brooke, Simpson, and Spiller, Lim., and A. G. Green. A new direct-dyeing yellow colour for cotton, and process for its manufacture. January 30.

7044. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters of the induline series. February 6.

8381. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of a new naphthylene-diamine mono-sulpho acid, and of colouring matters derived therefrom. February 20.

8564. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Production of new azo-colouring matters. February 6.

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## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

941. K. H. E. Balatsch and A. Rayer. Improved process for removing pitch, tar, and other coloured impurities from finished or partially finished fabrics. Complete Specification. January 15.

1362. F. Barraclough. An improvement in the milling or fulling of woollen cloth. January 21.

1380. F. W. Oliver. Improvement in waterproofing thread. January 21.

1518. F. Girard. Improvements in waterproofing paper and other fabrics and apparatus therefor. January 22.

1618. W. L. Wise.—From K. Schlatter and L. Hermsdorf, Germany. Improvements in the treatment of cotton yarn whilst in the form of cops, bobbins, and the like. January 23.

2711. R. Aitken. Treatment of animal fibres and mixed animal and vegetable fibres. February 7.

2778. J. H. Dawson. The conditioning of warps in process of manufacture. February 8.

3041. K. T. Sutherland and G. Esdaile. An improved method of degumming or separating the filaments of stalk fibres. Febraary 12.

### Complete Specifications Accepted.

1894.

1218. H. H. Boyle. Machinery for decorticating fibrous grasses, &c. January 30.

4697. A. Zimmermann. — From J. Holfert. Treating tissues, fibres, paper, &c. January 23.

7093. J. Hargreaves. Manufacture of ornamental woven fabrics. February 13.

22,595. W. P. Thompson.—From J. F. Kerr. Method for softening vegetable fibres. February 13.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

### APPLICATIONS.

1691. G. Markus, and M. Baender, and F. Sicker. Improvements in or relating to processes and apparatus for printing yarns in skeins. January 24.

2614. W. J. S. Grawitz. Improvements in dyeing or printing fibres black or shades approaching thereto with aniline, its homologues or derivatives. February 6. Date applied for July 9, 1894.

2676. T. Pickles. Improvements in the printing of cotton or linen warps or warp yarns, in connection with sizing or other treatment thereof, for weaving purposes. February 7.

2716. J. Ribbert. Process for the production of coloured designs on an anilin black ground. February 7.

2764. T. Pickles. Improvements in the dyeing of cotton or linen warps or warp yarns, in connection with sizing or like treatment thereof for weaving purposes. February 8.

2860. C. E. Middleton, F. P. Middleton, and A. T. Middleton. Improvements in dyeing apparatus. February 9.

3123. L. Cresswell. Improvements in dyeing or colouring asbestos cloth or fabrics. February 13.

3184. W. Mather. Apparatus for subjecting fabrics or yarns to the action of air, or other gas, steam, water, or other liquids for effecting washing, bleaching, dyeing, or other like operations. February 13.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

5186. G. Keighley. Method for dyeing warp on the beam. February 13.

6054. H. Lange and R. Homberg. Methods and apparatus for bleaching, mordanting, dyeing, steaming, &c. February 6.

6521. B. Cawthorn and J. P. Cornett. Apparatus for breaking and bleaching fibrous materials. February 13.

7133. W. McNaught. Machinery for scouring and washing wool, &c. February 13.

7135. A. Blanchon and A. Allegret. Printing indigo on fabric and yarn. February 13.

25,128. L. Weldon. Dyeing-machines. February 6.

1895.

119. L. Frotscher. Apparatus for treating fibrous materials with dyeing, bleaching, and other liquids. February 13.

## VII.—ACIDS, ALKALIS, AND SALTS.

### APPLICATIONS.

882. J. J. Hood. Improvements in the manufacture of gold solvents. January 14.

993. A. Goldberg and W. Siepermann. An improved process for the preparation of sulpho-cyanides. January 15.

994. E. G. Scott. Improved process for the manufacture of acetic acid. January 15.

1168. F. F. Benker. Improvements in the manufacture of sulphuric acid. January 17.

1341. D. B. Morison. Improvements in the manufacture of carbide of calcium and apparatus for the purpose. January 19.

1348. H. Brewer. Improvements relating to the utilisation of liquors from chlorination-roasted ores or tailings. January 19.

1360. J. Enright. Improvements in the manufacture of sulphurous anhydride and its derivatives. January 21.

1419. J. L. Kessler. Improvements in the manufacture, treatment, or purification and production of salts or compounds of alumina. January 21.

1575. T. G. Webb. Improvements in the method of and apparatus for concentrating sulphuric acid and other liquids. January 23.

1967. C. H. Huntley. Improvements in recovering salts or salines from solutions. Complete Specification. January 28.

2191. P. Duggan. An improved saturator for the manufacture of sulphate of ammonia from gas ammoniacal liquor. January 31.

2361. E. Fidler. Improvements in the manufacture of bleaching powder. February 2.

2466. W. Garroway. Improvements in the manufacture of sulphuric, nitric, and nitrous acid, and of sulphate of soda and oxide of iron. February 5.

2625. T. Twynam and F. E. Matthews. Improvements in the recovery of ammonia from sewage effluent and other weak ammoniacal liquors. February 6.

2660. A. E. Morgans. Improvements in the production of cyanogen compounds. February 6.

2670. T. Twynam. Improvements in the utilisation of felspar and other insoluble silicates containing potash, and in the manufacture of fertilisers. February 7.

2696. W. Donald. Improved process of treating chlorides for the production of chlorine and alkalis and the recovery of by-products. February 7.

2820. L. M. Bullier. Process for the manufacture of carbides or acetylides of the earth metals and alkali earth metals and of the oxides or salts of these metals. February 8.

2840. F. L. Teed. Improvements in the manufacture of cyanides. February 8.

2884. O. Jacck. Process for the production of cyanide and ferrocyanide compounds of the alkalis and alkaline earths. February 9.

2894. R. W. Hill. Improvements in the production of zinc chloride and in the generation of electricity. February 9.

2943. M. N. d'Andria. Improvements in and relating to the manufacture of magnesium sulphate. February 11.

3227. C. P. Shrewsbury, F. L. Marshall, and J. Cooper. *See* Class X.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

1442. G. S. Johnson. A new compound of sodium sulphite. January 23.

2060. H. H. Lake.—From J. B. Tibbits. Manufacture of lead salts. February 6.

3372. S. Z. de Ferranti and J. H. Noad. Manufacture of oxides of lead and apparatus therefor. February 20.

5830. A. E. Hetherington and E. K. Muspratt. Manufacture of ferrocyanide of potassium or of sodium from sulphocyanide. January 30.

5832. A. E. Hetherington, F. Hurter, and E. K. Muspratt. Manufacture of cyanide of sodium or of potassium from their ferrocyanides. January 30.

7636. A. Shearer and R. R. Clapp. Manufacture of phosphorus and compounds thereof. February 20.

14,520. W. B. Maxfield.—From W. Dieterle and L. Rohrmann. Process and apparatus for distilling and condensing nitric acid, tar, and other liquids. January 30.

19,684. V. I. Feeny.—From The U.S. Smokeless Powder Co. Preparation of ammonium chromates and of explosive compounds. February 13.

25,073. R. O. Lorenz. Production of hydrochloric acid from chlorine and of hydrobromic acid from bromine. January 30.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

842. J. Sherwin. An improved construction of oven for the firing of pottery, tiles, or the like. January 14.

1221. W. Smith. An improvement in or pertaining to the "salt-glazing" of earthenware, stoneware, and other fictile articles. January 18.

1645. J. A. Fleming and E. Woollam. A rectangular oven or kiln for firing clay goods in any stage of manufacture, or other materials. January 24.

2175. A. Sherwin and C. W. Cobden. A novel or improved compound for use in the process of decorating or ornamenting ceramic ware. January 31.

2176. W. Wade. A new process for the floral decoration of pottery. January 31.

2201. J. W. S. Holt, S. Hargreaves, and J. Davies. Improvements in or relating to the manufacture of crucibles, fireclay, refractory and non-conducting bricks and blocks, furnace linings, or the like. January 31.

2287. W. T. Griffin, J. Lewis, and G. H. Llewellyn. Improvements in kilns or ovens for firing or baking porcelain, earthenware, and other descriptions of pottery and clay goods, and for calcining purposes. February 1.

2559. M. E. Norris. Artificial stained or painted glass in imitation of leaded, stained, or inlaid marbled glass for all domestic purposes. February 5.

2811. A. Leroy. Application of spun glass in the manufacture of woven fabrics. February 8. Date applied for October 1, 1894.

2936. C. Billington, jun. Method of preparing prints or transfers for use in decorating ceramic ware. February 11.

### Complete Specifications Accepted.

1894.

22,834. La Soc. Anon. des Matières Manuf. des Glaces et Produits Chim. de St. Gobain. Manufacture of a new vitrified material. January 30.

25,067. C. E. Blue, jun. Moulds for the manufacture of glassware. January 30.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

1089. A. Hesme. Improved method of and apparatus for impregnating wood with liquids for the preservation, hardening, and dyeing thereof. January 16.

1092. C. Major. Improvements in and connected with fire-proof and ventilating floors. January 16.

1167. C. M. Brix. Improvements relating to the manufacture of artificial stone. January 17.

1256. R. W. Hitchins. Improved machinery for the production of slabs of plaster, cement, or composition. January 18.

1958. F. Turner. Improvements in the manufacture of cement. January 28.

1960. C. Major. Improvements in and connected with fire-proof and ventilating floors. January 28.

2710. R. Aitken. Treatment of wood with a view to preserving and colouring the same. February 7.

### Complete Specifications Accepted.

1894.

4632. A. Kulmewein. Manufacture of asbestos cement, and of coverings, &c. therefrom. January 30.

6662. W. F. F. Bevis. Building blocks. February 13.

19647. W. Owen. Manufacture of artificial stone. February 20.

25,177. C. L. Lüders and G. C. M. Lüders. Cement tiles. February 6.

## X.—METALLURGY, MINING, Etc.

### Applications.

882. J. J. Hood. *See* Class VII.

952. B. P. Stockman. Improvements in the process of producing malleable iron and steel from phosphoric and other pig-iron or ores. January 15.

967. J. G. Lorrain.—From E. C. Broadwell, United States. A new or improved method of and composition for soldering aluminium. January 15.

1148. H. R. Angel and J. Armstrong. Method of abstracting gold, silver, and antimony from their ores and apparatus therefor. January 17.

1155. C. D. Abel.—From M. M. Rotten, Germany. Manufacture of alloys of iron with other metals. January 17.

1333. A. Zimmermann.—From A. Schmidt, Germany. Improvements in solvents for gold and silver and in the extraction of those metals. January 19.

1514. J. Y. Johnson.—From L. Pelatan, France, and F. Clerici, Italy. Process of and apparatus for treating and desulphurising ores. January 22.

1523. E. Peipers. Improvements in the production of chilled metal castings. January 22.

1592. A. de Courcy Scott. An improved method of washing crushed ore and of applying thereto solvent liquids for the extraction therefrom of gold or silver. January 23.

1823. E. H. Saniter. Improvements in or relating to the purification of iron or steel. January 26.

1828. J. Miles. Improved method of extracting metals and metallic products from ironstone or argillaceous ironstone, from coal and its products, burnt or unburnt. January 26.

1889. S. Taylor. *See* Class I.

2083. J. B. Torres. Improvements in the manufacture of alloys. January 30.

2114. A. de Courcy Scott. An improvement in the process of extracting gold from crushed ore by means of solutions of cyanide of potassium. January 30.

2278. W. Kaufmann. Process for the production of metals and metallic alloys containing carbon and silicon. February 1.

2313. W. Mills. Manufacturing the monoxide of aluminium. February 2.

2493. J. Y. Johnson.—From L. Pelatan and F. Clerici. Improvements in treating ores or other substances or liquors containing gold or silver or both, and apparatus therefor. February 5.

2538. G. Robson and S. Crowder. Improvements in the treatment of finely-divided substances, such as crushed ores, slime, tailings, and the like, for the separation and recovery of metals and metallic compounds therefrom. February 5.

2729. H. L. Sulman. Improvements in or relating to apparatus employed in the recovery of precious metals from their solutions. February 7.

2730. H. L. Sulman. Improvements in or relating to the precipitation of precious metals from their solutions. February 7.

2804. O. Imray.—From L. Diehl. Metallic mixtures and alloys for effecting electro-chemical decompositions. February 8.

2812. A. E. Morgans. Improvements in the treatment of ores containing precious metals. February 8.

2844. Carron Company and C. A. Fuge. Improvements in enamelling iron and steel. February 9.

2846. J. B. Torres. Improvements in extracting gold and silver from ores and the like. February 9.

2935. T. J. Smith and A. Markham. Aluminium lining. February 11.

3073. H. Moissan. Manufacture or production of titanium and alloys thereof. February 12.

3168. J. S. MacArthur. Improvements in obtaining gold and silver from ores or like compounds. February 13.

3227. C. P. Shrewsbury, F. L. Marshall, and J. Cooper. Improvements in the method of and apparatus for obtaining sulphate of lead and galena. February 14.

3294. R. Wilson and J. C. Long. An improved steel-melting or steel-converting furnace, more particularly adapted for light weights. February 15.

3371. W. Hutchinson and T. Twynam. Improvements in the manufacture of fertilisers and in the manufacture of steel. February 16.

### Complete Specifications Accepted.

1894.

3228. J. W. Swan. Method and apparatus for desilverising lead. February 13.

5379. W. D. Allen. Furnace for treating ingots, blooms, or billets of iron or steel. January 30.

5831. A. E. Hetherington, F. Hurter, and E. K. Muspratt. Method and apparatus for production of alloys of sodium or potassium with lead. January 23.

5934. W. Perkins. Means for extracting metals from their ores. February 20.

7380. S. Taylor. Solder for aluminium and its alloys. February 13.

8405. H. L. Sulman. Treatment of ores. February 20.

22,415. P. Inch. Improved composition of metals. January 23.

24,535. M. M. Marcus, G. Buffier, E. Marcellot, and G. Durdespiune. Manufacture of ferro-zinc alloys with or without other metals. January 23.

24,569. W. Fairweather.—From the Thomson Electric Welding Co. Producing locally annealed steel and other metal plates, and apparatus therefor. February 6.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

883. R. W. Hill. Production of liquid ammonia by electricity. January 14.

1117. R. McL. McDonald and A. McDonald. Improvements in electric batteries. January 17.

1180. H. Levetus, E. M. Levetus, W. Rowbotham, and C. Levetus. Improvements in solutions for use in primary batteries. January 18.

1181. H. Levetus, E. M. Levetus, W. Rowbotham, and C. Levetus. Improvements in solutions for use in primary batteries. January 18.

1385. H. Tipping. Improvements in galvanic batteries. January 21.

1446. C. B. Schoenmehl and C. M. Platt. Improvements in galvanic batteries. Complete Specification. January 22.

1676. T. B. Marchant and J. Woolley. Improvements in electrical storage batteries. January 21.

1731. C. A. Faure and F. King. Improvements in secondary batteries. January 24.

2133. J. Pogneaux. Improvements in or relating to electric batteries. January 30.

2288. D. G. Fitz-Gerald. Improvements in voltaic batteries. February 1.

2394. H. Levetus, E. M. Levetus, and W. Rowbotham. Improvements in primary batteries. February 4.

2816. F. King. Improvements in secondary batteries. February 8.

2827. C. L. Charlopin, V. M. Cornely, and L. C. H. Dautelf. Improvements in primary batteries. February 8.

2883. A. Lesquoy. A new or improved process to render the liquid of primary or secondary batteries motionless. February 9.

2965. A. F. B. Gomess. An improved process for the electro-deposition of aluminium and aluminium alloys. February 11.

2998. The Cowper-Coles Galvanising Syndicate, Lim., and S. O. Cowper-Coles. Improvements in and apparatus for the manufacture of copper, zinc, and other metal sheets, strips, or wires electrically. February 11.

2999. The Cowper-Coles Galvanising Syndicate, Lim., and S. O. Cowper-Coles. Improvements in and means to be employed for the obtainment of zinc from its ores, and the electro-deposition of zinc upon iron or other metals or alloys. February 11.

3009. C. A. Faure. Improvements in secondary batteries. February 11.

3066. E. Henriquez. Improvements in means for preventing the liquid of primary and secondary batteries being spilt, and for rendering it motionless, more especially during transport. February 12.

3067. E. Henriquez. Improvements in electrical storage batteries. February 12.

3183. L. Wacker. Process for the production of concentrated sulphuric acid by means of electrolysis. Complete Specification. February 13.

### Complete Specifications Accepted.

1894.

1903. M. Wuillot. Electrodes. February 6.

5721. C. Smith.—From G. Jorgensen. Process and apparatus for electrolysis of common salt. January 23.

7165. E. J. Clubbe and A. W. Southey. Secondary voltaic batteries. February 20.

7853. W. A. Thoms and W. H. Burgum. Electro-deposition of the heavy metals with a base metal alloy. February 13.

22,613. J. C. Richardson. Electro-chemical decomposition of solutions of salts. January 23.

24,630. H. S. Blackmore. Process and apparatus for dissociating soluble salts by electrolysis. January 23.

24,639. J. T. Harris. Method and apparatus for purifying liquids magnetically; also electrolysis and aëration. February 13.

25,080. T. T. Oliver. Separation of metals by electric action. January 30.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

1292. W. Ambler. An improved method of and apparatus for removing fatty matter from the effluent waters of wool-washing machines and like effluent waters. January 19.

2471. A. Warwick, J. Smith, and P. W. Nicolle. Improvements in the manufacture of washing powders. February 5.

2491. J. R. Lopez. An improved process for obtaining valuable products from the residue resulting from the extraction of oil from olives. February 5.

2765. J. M. C. Grierson. Antiseptic floor and furniture cleaning and polishing soaps. February 8.

### Complete Specifications Accepted.

1894.

3025. C. Weygang. Manufacture of saponaceous products from petroleum. January 23.

4622. R. Andrew. Method and apparatus for purifying liquids and fats. February 13.

7126. F. Walton. Process and apparatus for oxidising drying oils. February 13.

13,853. A. Gross, S. Sietenbürgen, and S. Leitersdorfer. Cleansing or washing agents. February 20.

15,086. B. J. B. Mills.—From J. H. Campbell and C. H. Campbell. Refining and improving butter, lard, oils, &c. February 13.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

1372. D. Marcus. An improved material for lacquering surfaces. Complete Specification. January 21.

1457. J. C. Sellars. Improved, or improvements connected with, protective covering for surfaces. Complete Specification. January 22.

1811. D. Everett and T. B. Cullen. Improvements in the manufacture of pigments. January 25.

2636. R. Alberti. An improved paint, specially applicable as a substitute for white lead, zinc white, and the like, and process of manufacturing the same. Complete Specification. February 6.

2901. C. Biot and A. Cluysenaar. Improved fixing material or varnish for art drawings and paintings. February 9.

3356. G. J. Atkins. Improvements in the manufacture of mineral and enamel colours for use in the production of ceramic and other photographs. February 15.

### Complete Specifications Accepted.

1894.

6002. J. E. Williams. An anti-salt paint. February 20.

7129. R. Matthews. Manufacture of white lead. February 20.

22,966. W. P. Thompson.—From W. Griscom, jun. Production of compounds for use as paints, for electric insulating and waterproofing, and as substitutes for rubber and gum compounds, &c. January 30.

23,849. J. Holliday and A. Cameron. Anti-fouling paint. January 30.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### Applications.

1820. C. Marter and I. Levy. New or improved process for the treatment of animal skins. January 25.

2053. S. L. Evans. An improvement in solutions used in the process of tanning. January 29.

2877. D. A. Goodman. An improved process of treating hides. February 9.

### Complete Specifications Accepted.

1893.

24,273. O. C. Hagemann. Extraction and purification of tannin. February 6.

1894.

4679. H. Walker and J. J. Wilson. Currying skins and appliances therefor. February 13.

## XV.—AGRICULTURE AND MANURES, Etc.

### Applications.

1282. J. E. Stead. Improvements in the manufacture of phosphates for manure. January 19.

2642. F. W. Saatmann. Improvements in the manufacture of superphosphates. February 6.

2670. T. Twynam. Improvements in the utilisation of felspar and other insoluble silicates containing potash, and in the manufacture of fertilisers. February 7.

3371. W. Hutchinson and T. Twynam. Improvements in the manufacture of fertilisers and in the manufacture of steel. February 16.

### Complete Specification Accepted.

1894.

21,658. J. J. Adkins. Treating spent hops for production of manure and fuel. January 23.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Application.

3049. W. P. Thompson.—From H. A. J. Manoury, France. Improvements in the manufacture of sugar. February 12.

### Complete Specifications Accepted.

1894.

2732. E. Shaw. Apparatus for boiling sugar or glucose. February 6.

5119. D. Drummond. *See* Class I.

25,242. J. Hilton. Starch or linen gloss for laundry purposes. February 20.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

2264. E. Larsen.—From The Berliner Actiengesellschaft für Eissengiesserei and Maschinenfabrik vorm. J. C. Freund and Co., Germany. Improvements relating to the malting of grain and to apparatus therefor. February 1.

2158. C. W. Ramsay. Improvements in the preparation of distilled beverages. February 5.

2662. J. H. Hassall. Malt diastase powder, the preparation and uses thereof. February 7.

### Complete Specifications Accepted.

1894.

4894. P. Puvrez. Apparatus for pasteurising or sterilising and cooling beers, and for aërating or charging beers with gas before casking or bottling. February 13.

10,667. R. W. Preston and J. M. Hogarth. Treatment of brewers' and distillers' mash and the saccharine liquid or wort therefrom. January 23.

20,988. J. T. Poplawsky. Apparatus for cooling beer. February 6.

21,658. J. J. Adkins. Treating spent hops for production of manure, firelighters, and fuel, and a powder for dry-earth closets. January 23.

25,078. A. M. Hofmann. Filling and bunging casks, &c., and carbonating beer or other liquids contained therein. February 13.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

3166. W. Gaedke. Process for the extraction or rendering soluble of cocoa. February 13.

3235. W. Kottgen.—From E. Jahr and B. Munsberg, Germany. Process for the manufacture of easily assimilable fatty foods. February 14.

3324. W. F. Maclaren. Improvements in and relating to condensed milk products. February 15.

#### *B.—Sanitary Chemistry.*

1391. E. Theisen. Method of and apparatus for purifying air and other gases from dust, soot, and other solid impurities. January 21.

1858. J. Warwick. Improvements in treating fume in lead works, applicable also to other metallic fumes and to coal smoke. Complete Specification. January 26.

2205. H. T. Wright. Improvements in or connected with apparatus for heating and softening and purifying water for feeding steam boilers, or for other purposes. January 31.

2140. P. Schottlander. An improved process for drying waste vegetable substances. February 4.

2625. T. Twynam and F. E. Matthews. Improvements in the recovery of ammonia from sewage effluent and other weak ammoniacal liquors. February 6.

3272. M. F. Purcell. An improved process and means for the treatment and utilisation of sewage. Complete Specification. February 14.

3291. J. Bromilow. Utilising sewage, wet or dry, and purifying effluent without chemical or any other precipitant or mixture. February 15.

3360. H. T. Wright. Improvements in apparatus for softening and purifying water. February 15.

#### *C.—Disinfectants.*

2724. M. R. Latham. Improvements relating to the employment of disinfectants. February 7.

### Complete Specifications Accepted.

#### *B.—Sanitary Chemistry.*

1894.

6019. J. B. Alliott. Apparatus for treating offensive and infected matters. February 6.

#### *C.—Disinfectants.*

1894.

5066. R. J. Stephens and J. Hewes. Disinfectants and deodorants. February 20.

16,414. M. S. Sharp. Means for disinfecting or deodorising. February 20.

1895.

629. J. F. Davies. Distributor for insecticide, disinfectant, and other powders. February 20.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

1078. A. Cohn. Process for the manufacturing of machine paper with coloured longitudinal stripes. January 16.

2330. H. G. Forbes and E. M. Sommerville. An apparatus for water-marking paper. February 2.

2709. R. Aitken. Treatment of paper. February 7.

### Complete Specifications Accepted.

1894.

4697. A. Zimmermann.—From J. Holfert. *See* Class V.

5054. A. E. Healey and J. Williams. Treating paper and fabrics, preparation of solutions therefor, and recovery of by-product. February 13.

5557. P. W. Wilkinson. Manufacture of paper for bank-notes. January 23.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

### Applications.

1251. J. Y. Johnson.—From F. von Heyden, Nachfolger, Germany. The manufacture and production of mono- and di-phenetidin-citric acids. Complete Specification. January 18.

1621. J. Y. Johnson.—From F. von Heyden, Nachfolger, Germany. Improvements in the manufacture of vanilline. January 23.

1959. M. Otto and A. Verley. Improvements in the manufacture of perfumes. January 28.

2127. O. Imray.—From The Farb. vorm. Meister, Lucius, und Brüning. Manufacture of ethers of paralactyl-amidophenol. February 1.

2656. A. Knoll. New or improved manufacture or production of crystallised compounds of antipyrine. Complete Specification. February 6.

### Complete Specifications Accepted.

1894.

3553. R. Haddan.—From C. Strehler and Co. Herbal extract, and production of same. January 30.

6033. A. Zimmermann.—From the Chem. Fab. auf Actien vorm. E. Schering. Manufacture of certain remedial bodies. February 13.

6800. L. Lederer. Producing oxybenzylic alcohols and their homologues. January 23.

1895.

154. G. Tobias. Manufacture of salts of pyrocatechindisulpho acid and of pyrocatechin therefrom. February 13.

417. W. Mallmann. Manufacture of musk-like substances. February 13.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### Application.

2986. C. F. Oakley. Improvements in the manufacture of photographic plates and films. February 11.

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1894.

3121. M. Russo and G. B. Zanardo. Production of objects in relief or intaglio. February 13.

4627. T. H. Blair and The European Blair Camera Co. Appliances for manufacture of photographic films. January 23.

5561. A. Zimmermann.—From The Chem. Fab. auf Actien vorm. E. Schering. Photography. January 23.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

1705. F. Render. Improvements in explosive substances. January 24.

1835. H. V. Keeson. Improvements in electric exploders. January 26.

1877. A. Luck and A. H. Durnford. Improvements in the manufacture of nitro-celluloses for smokeless powders and other purposes. January 26.

2258. H. N. Baxter. Fog signal. February 1.

3276. J. C. Thompson. Improvements in fuses for explosive projectiles or shells. February 14.

### Complete Specification Accepted.

1894.

19,684. V. I. Feeny.—From The U.S. Smokeless Powder Co. Preparation of ammonium chromates and of explosive compounds. February 13.

## XXIII.—ANALYTICAL CHEMISTRY.

### Applications.

1040 F. G. Waller. Improvements in and relating to the collecting and analysing of gases. January 16.

2308. J. A. Ewing. Improvements in apparatus for testing magnetic quality in iron. February 2.

## XXIV.—PATENT UNCLASSIFIABLE.

### Application.

975. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of chemical compounds. January 15.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

# THE JOURNAL
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## NOTICES.

The Annual General Meeting will be held in Leeds in the month of July next. Full particulars will appear in a subsequent issue.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

The Senate of the University of Glasgow has been pleased to confer the degree of LL.D. *honoris causâ* on Prof. T. E. Thorpe, F.R.S., President of the Society of Chemical Industry.

### Bankers' Orders.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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### Erratum.

In the List of Ordinary Members of Council printed on the first page of the List of Members, January issue 1895, the name of Mr. C. A. Fawsitt, Atlas Chemical Works, East Nelson Street, Glasgow, was accidentally omitted.

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SESSION 1894–95.

April 1st.—Dr. Carl Pieper, of Berlin. "The German Patent Laws and their Relation to Home and Foreign Inventions."

N.B.—The Election of Officers and Five Members to the Local Committee will take place at the Meeting on April 1st.

*Meeting held Monday, March 4th, 1895.*

MR. WM. THORP IN THE CHAIR.

## THE DURABILITY OF PIGMENTS DERIVED FROM COAL-TAR PRODUCTS.

BY A. P. LAURIE, M.A.

THE question of the durability of the pigments prepared by precipitating coal-tar colours on suitable bases is becoming of increasing practical importance. At the same time it is not a subject which lends itself to exact measurement, and we have to content ourselves with results which are rather of a qualitative than of a quantitative character. Nevertheless these results may be safely used as indicating with sufficient accuracy for practical purposes the relation as to durability of these different pigments. One practical difficulty in the way of useful results is that it is impossible to get information as to how a particular pigment has been prepared, and it is often no easy matter to identify the coal-tar colour which has been used in its preparation. I have, in these experiments, collected at random such coal-tar pigments as I could obtain, and added to them a few of my own making. The method has been to grind a little of the pigment into a stiff paste with water, and then to dilute with more water and a few drops of a strong solution of pure gum arabic. This dilution was practically the same in each case, and was so adjusted that, on stirring up the diluted pigment, which was kept in a corked bottle, and then laying on a wash with a soft camel-hair brush, I should get a tint of the depth required. These washes of colour were laid upon Watman paper in five coats, each coat covering less of the surface than the one laid on before, so that at the end, on the top of my strip of paper, I had a layer of colour five coats thick, and a series of coats lying in steps down the paper, till at the bottom I had only one coat of colour. These washes were so regulated in strength that they were not so weak as to make one and two indistinct, and not so strong as to make five and four indistinct. In practice, I get in this way coats closely corresponding for different pigments in the strength of colouring effect that they represent, and while this is, of course, far from a perfect method, it yields results which are sufficiently good for practical purposes. This is partly due to the fact that the rate of fading is not directly proportional to the strength of the washes laid on, as can be seen by the following experiment:—

Two papers of crimson lake were prepared, marked respectively 9*a* and 9*b*, the washes in the case of 9*b* being prepared from the same quantity of pigment as was used in the case of 9*a*, diluted with twice the quantity of water. In nine days 9*a* had faded to 4·5 on the scale, while 9*b* had faded to 4 on its own scale. A further difficulty to be overcome is, that at different times of the year the amount of light to which the pigments are exposed will differ considerably; but this source of error can be eliminated by comparing in each case the rate of fading with a standard wash of a standard colour. It is of importance that this standard colour should itself be fugitive and should be well known. I have therefore selected crimson lake prepared from cochineal, and prepared five washes on a large piece of paper, so as to give me a sufficient stock to take cuttings from, to expose alongside any pigment I am testing. The following figures placed side by side will show the result of observations on two portions of this standard wash of colour exposed on October 2nd and October 4th respectively.

Throughout these experiments this standard wash is referred to as No. 9.

*Exposure of No.* 9.

| Exposed on October 2nd. | | Exposed on October 4th. | |
|---|---|---|---|
| Days. | Fading. | Days. | Fading. |
| 15 | 4·0 | 13 | 4·5 |
| 27 | 3·0 | 25 | 3·5 |
| 56 | 2·5 | 54 | 3·0 |
| 61 | 2·5 | 59 | 2·5 |
| 90 | 2·5 | 88 | 2·5 |

It will be noticed here, in the first place, how nearly the observations agree for these two portions of the same sample of crimson lake, and also that after fading to a certain point, the crimson lake becomes remarkably durable. This is also true of certain other colours, and has been noticed by Prof. Hummel as true of certain dyes. The crimson lake changes rapidly in tint, becoming brownish-red in four days after exposure. It is of interest to compare with this the rate of fading of another portion of this same sample of crimson lake, exposed on December 12th, and which had only faded to 4·5 in 39 days, showing the effect of the absence of sunlight. In practice I cut a little portion from the top of my washes of the pigments, and attached it with a piece of gum-paper to a sheet of glass which was fixed to a window with a north exposure. From time to time these little portions were compared with the original washes, which were kept shut up in the dark. The next point of interest was how far the method of preparing one of these pigments would affect its durability on exposure, and for this purpose I selected some lakes prepared from brilliant green, and thrown down with tannic acid on (1) silica white, (2) barium sulphate, (3) barium chromate. There were two prepared on the barium chromate base, one containing twice as much green as the other. The result of the exposure was to show that these green, faded at practically the same rate; on the other hand, a further experiment showed that a very important influence on the durability of the colour is the way in which the colour is distributed over the base. In order to test this point, I precipitated 2 grms. of brilliant green on 50 grms. of barium sulphate, and then diluted with 50 grms. more of barium sulphate, and marked this green 42. I then precipitated 2 grms. of brilliant green on 100 grms. of barium sulphate and marked this 43, and painted out washes of these two pigments, diluted as nearly as possible to the same extent. In both cases the green quickly turned of a bluish tint, but the rate of fading was very different, as shown in the following table:—

| 12. | | 13. | |
|---|---|---|---|
| Days. | Fading. | Days. | Fading. |
| 5 | Unchanged | 5 | 4·0 |
| 16 | Unchanged | 16 | 3·5 |
| 20 | 4·5 | 20 | 3·0 |
| 29 | 3·0 | 29 | 1·5 |

These results show clearly the importance of the way in which the colour is distributed over the base.

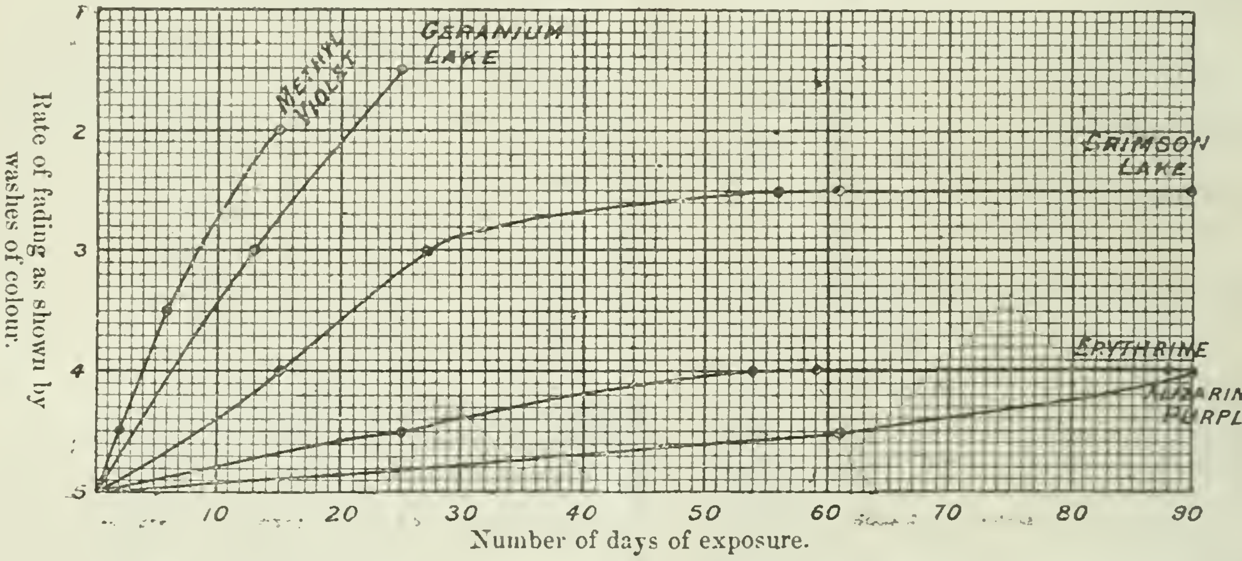
At the end of the paper will be found the results of the various exposures; but I may summarise the more important conclusions here. In the first place, the alizarin derivatives stand out above all the others, the crimson alizarins prepared with alumina, and the brown and purple alizarin prepared with copper and iron respectively, proving remarkably permanent, while the nitro alizarin orange and the dinitro-alizarin blues and greens follow close behind in durability.

"Alizarin yellow," however—of which I do not know the composition, but believe to be merely given this name because it is struck as a lake in a similar way to the alizarins—does not form a permanent pigment.

I exposed two yellows prepared from galloflavine, the one of a yellow and the other of an orange shade. The yellow shade quickly turned orange and then changed no further, while the orange shade proved quite as permanent as the alizarine lakes, and has now been exposed five months without change.

A methylene-blue quickly alters, and the methyl-violets are very fugitive; but, on the other hand, the eosines show curiously contradictory results. One geranium-lake of one maker proved very fugitive, and the geranium-lake of another maker proved very permanent, so that these eosines evidently require further investigation. It will also be noticed that naphthalene-scarlet and a lake derived from erythrene both stand exposure very fairly well, and might be placed in the second order of durable colours.

With reference to greens, brilliant green proves very fugitive, while acid green stands very fairly well, and a coal-tar green prepared in Germany occupies an intermediate position. To summarise, I can say that alizarin and its derivatives and galloflavine form remarkably durable lakes; that some eosine lakes, naphthalene, scarlet, and erythrene come next; that after these comes crimson lake; that next to crimson lake comes acid green, while among the very fugitive colours we must place methylene blues, methyl violets, brilliant green, and some eosine lakes.



## *Notes on the Tables.*

It will be noticed that in some cases a higher number is given for a colour after a longer exposure. This is probably due to errors in judging the amount of fading. In each case the colour was examined without referring to the former entries, so that each statement represents an independent judgment.

In some cases colours quickly change in tint, but do not necessarily fade rapidly. This is probably the worst fault a colour can possibly have.

The curves are merely some typical examples of colour fading plotted out. They illustrate very clearly the different rates of fading, and also the tendency of many colours to fade more and more slowly after the first loss of brightness.

### Tables of Results of Exposure of Pigments to Light.

*Compared with Crimson Lake.*

| — | Number of Days. | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 6 | 15 | 27 | 56 | 61 | 90 | |
| | Amount of Fading as measured by Washes of Colour. | | | | | | | | | |
| Crimson lake (cochineal) | 5 | 5 | *5 | 5 | 4 | 3 | 2·5 | 2·5 | 2·5 | * Little redder and duller. |
| Galloflavin lake, No. 1 (yellow shade) | 5 | 5 | *5 | 5 | 5 | 5 | 5 | 5 | 5 | * Turning brownish-orange. |
| Alizarin yellow | *.. | .. | .. | .. | .. | .. | .. | .. | .. | * Mottled: lighter portions faded to 3; darker portions brownish. No further change. |
| „ blue, No. 1 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | |
| „ blue, No. 2 | 5 | 5 | 5 | 5 | 5 | 5 | 4·5 | 4 | 4 | |
| „ brown, No. 1 (alumina and copper base) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| „ brown, No. 2 (alumina and copper base) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |

TABLES OF RESULTS OF EXPOSURE OF PIGMENTS TO LIGHT—*cont.*

| —— | Number of Days. | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 6 | 15 | 27 | 56 | 61 | 90 | |
| | Amount of Fading as measured by Washes of Colour. | | | | | | | | | |
| Bright light-blue (methyl ?) | *.. | .. | .. | .. | †.. | .. | .. | .. | .. | * Turned bluer. † Faded in spots to 2 greyish-blue. |
| Alizarin blue, No. 3 | 5 | 5 | 5 | *5 | †4 | 4 | 4 | 4 | 4 | * Portions faded to 4. † Duller and greyer. |
| Mauve lake, No. 1 (methyl violet) | 4·5 | 4·5 | *4·5 | 3·5 | 2 | †.. | ‡.. | .. | .. | * Turned a red tint. † Faded below 1. ‡ Nearly white. |
| Sky blue (methylene ?) | 5 | 5 | 5 | 5 | *4 | 3 | 3 | 4 | 3 | * Grey. Turned bluish. |
| Ultramarine | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| Alizarin blue, No. 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| Mauve lake, No. 2 (methyl violet) | *5 | †4 | ‡4 | 3·5 | 2 | 1 | §.. | .. | .. | * Changed in tint. † Redder. ‡ Redder. § Nearly white. |
| Crimson madder | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| Madder scarlet | 5 | 5 | 5 | 5 | 5 | 5 | 5 | *5 | 4 | * Little redder. |
| Galloflavin lake, No. 2 (orange shade) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| Rose madder | 5 | 5 | 5 | 5 | 5 | 3·5 | 3·5 | 4 | 3 | |
| Alizarin green | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | |
| „ purple (alumina and iron base) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4·5 | 4 | |
| Mauve lake, No. 3 (methyl violet) | *5 | †5 | ‡5 | §5 | 3·5 | 4 | ‖1 | ¶1 | 1 | * Little duller. † Redder. ‡ Redder. § Redder. ‖ Brownish-purple. ¶ Brown. |

TABLE OF RESULTS OF EXPOSURE OF PIGMENT TO LIGHT.
*Compared with Crimson Lake.*

| —— | Number of Days. | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 4 | 13 | 25 | 54 | 59 | 88 | |
| | Amount of Fadings as measured by Washes of Colour. | | | | | | | | |
| Crimson lake (cochineal) | 5 | 5 | *5 | 4·5 | 3·5 | 3 | 2·5 | 2·5 | * Little redder. |
| Nitro-alizarin orange lake | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | |
| Scarlet lake (eosin) | 5 | 5 | *5 | †5 | 4 | ‡3·5 | §4 | ‖.. | * Little duller. † Little duller. ‡ Spotty. § Brownish, spotty. ‖ Spotty; faded in spots to 2. |
| Geranium lake (eosin) | 5 | 5 | 5 | 3 | 1·5 | *.. | .. | .. | * Nearly white. |
| Extra geranium lake (eosin) | 5 | 5 | *5 | 5 | 5 | 5 | 5 | 5 | * Duller. |
| Magenta lake | 5 | 5 | 5 | 3 | 4 | *.. | .. | .. | * Faded below 1, brownish-purple. |
| Naphthalene scarlet | 5 | *5 | 5 | 5 | 5 | 5 | 5 | 5 | * Little duller. |
| Crimson lake (erythrene) | 5 | 5 | *5 | 5 | 4·5 | 4 | 4 | 4 | * Little duller. |

| | Number of Days. | | | | | |
|---|---|---|---|---|---|---|
| | 15 | 30 | 35 | 39 | 56 | |
| | Amount of Fading as measured by Washes of Colour. | | | | | |
| Crimson lake (cochineal) | 4·5 | *4·5 | 4·5 | 4 | 3·5 | * Browner. |
| German imitation emerald green | 4 | *3·5 | 4 | 3 | †2 | * Yellower. † Patchy. |
| Crimson alizarin | 5 | 5 | 5 | 5 | 5 | |

| | Number of Days. | | | | |
|---|---|---|---|---|---|
| | 3 | 15 | 19 | 39 | |
| | Amount of Fading as measured by Washes of Colour. | | | | |
| Crimson lake (cochineal) | *5 | 5 | 4·5 | 4·5 | * Little duller. |
| Acid green and zinc chrome | *.. | †.. | ‡.. | §.. | * Little yellower. † Little yellower. ‡ Little yellower. § Quite yellow in patches; other portions faded to 4. |

### Discussion.

The Chairman having invited discussion:

Mr. T. Royle objected to Mr. Laurie's process, and would prefer the method formerly in use, viz., the exposure of washes of the same strength of colour for gradually increasing periods of time; they could then be compared. This he thought a more practical way than the exposure of different washes of varying strength. He would like to ask whether Mr. Laurie was acquainted with the bases of the lakes that had been used, as it was well known that the same colouring matter had different degrees of permanency according to the bases employed. Was the author of the paper certain of his own knowledge that the nitro-alizarine lake employed in his experiments was an alizarine colour. As regarded the question of winter and summer exposure, it was well known that unless the colours were exposed to the same amount of light the experiments were of no value, either quantitative or qualitative.

Mr. R. J. Friswell congratulated the author of the paper on having the courage to tackle so difficult a subject as the one under discussion. He thought, however, that Mr. Laurie must at once put aside all hope of approaching anything like a definite result for a long time, and was of opinion that it would be much better to select a small series of colours from representatives of different organic groups and to treat them exhaustively on different kinds of bases. Mr. Laurie had been dealing with colours similar in shade but drawn from most diverse sources. It was impossible to draw an inference from the behaviour of a particular dye when used in one way as to how it would behave when used in another. For instance, eosine, when dyed upon wool or cotton, was one of the most fugitive of the aniline colours, yet if it were precipitated on baryta or lead bases in the proper manner, it was one of the most permanent. As a manufacturer of dyes, he was interested in their permanence when applied to fabrics or yarns. He had come to the conclusion that no law could be laid down that a particular colour was fugitive or non fugitive *sui generis.* All experiments showed this to be absolutely impossible. The permanence of a colour was a function of the colour itself plus the substance with which it was combined. That was shown by the behaviour of colours of the methyl violet, brilliant green, and malachite green series when dyed upon starch. The speaker instanced some tubes of starch dyed with 1 per cent. of methyl-violet and brilliant green. These tubes were prepared about ten years ago, and after being shown for months in an exhibitio nin East London, had been exposed to sun and light for years, but were still absolutely unchanged. Had wool or cotton been used, the colour would have disappeared in a few months. To obtain reliable results, Mr. Laurie should obtain colours the genuineness of which could be certified, and should himself prepare the lakes to be experimented with. He would caution the author against being misled upon one point. If he dyed two parts of colour upon 50 grms. of barium sulphate and then mixed it with another 50 grms. of barium sulphate undyed, and compared this with another 100 grms. dyed with 2 per cent., the two might, owing to the imperfection of human vision, appear to have the same tint. But as a matter of fact he would have double the amount of colour undergoing the action of light in the one case, just as a double depth of solution gave double absorption in the spectrum of the colours. The slowness of some colours to fade might be accounted for by their producing dark-coloured decomposition products on the surface, which had a protective action on the colour beneath.

Mr. A. P. Laurie, in reply to the first speaker, thought that his method of procedure had been misunderstood by him. He prepared a series of washes, not for exposure, but to form a standard by which the rate of fading of particular washes could be determined. He cut off a small piece covered with five washes and exposed it to the light, keeping the rest in the dark, and from time to time compared the exposed piece with his standard, noting how far it had faded, whether to the fourth, third, second, or first washes of the standard. He thought that by this method he could get a better average result, as he made comparisons at intervals of a few days. As regarded the nitro-alizarine employed, he had obtained it from a well-known firm as nitro-alizarine, and the lake he prepared himself. As he had explained, he considered he was merely breaking ground with a view to drawing other men into the work, and in his opinion the best plan was to begin with widely different pigments, such as alizarine, nitro- and dinitro-alizarine, and the methyl colours. As to the double dyeing of the brilliant green, of course the 50 grms. of barytes contained twice as much dye per grm. as the 100 grms. of barytes, but when the 50 grms. was let down by another 50 of white, a green very much approaching the shade of the other preparation was obtained, at all events near enough for a practical colour maker, who would wish to use as much baryta and as little green as he could; and he thus obtained a colour which would bear exposure to light better while the effect to the eye was very nearly the same. Of course, the question of bases was very important and necessitated a separate enquiry. He found one eosine lake to be remarkably permanent, another exceedingly fugitive. The results he had obtained were merely an introduction to a large subject, but he hoped it was sufficient to show that he had broken the ground, and if he could get others interested in the question there was no doubt that very valuable results could be obtained.

## THE "HERMITE" PROCESS OF SEWAGE TREATMENT.

BY SIR HENRY E. ROSCOE, F.R.S., D.C.L., LL.D., AND JOSEPH LUNT, B.SC., F.C.S.

[*Communicated from the Chemical Laboratory of the British Institute of Preventive Medicine.*]

The following is a record of chemical and bacteriological experiments made in an investigation of the above process undertaken by the British Institute of Preventive Medicine during an experimental demonstration carried out on a considerable scale at Worthing, under the sanction of the corporation of that town. The plant was erected and worked by Messrs. Paterson and Cooper, electrical engineers, M. Hermite's representatives in England.

The Hermite process proposes to effect a complete disinfection and sterilisation of the entire sewage of towns by a method of "electrical sanitation" depending upon the electrolysis of natural or artificial sea-water, and the consequent formation of a disinfecting liquid which is used for flushing purposes, both in the water-closets and drains of a town's sewage system.

This process differs essentially from the electrical process of Mr. Webster, inasmuch as the latter deals directly with the sewage itself at an outfall, subjecting it to a process of electrolysis in which iron electrodes are used, and during which iron compounds are formed, which act as precipitants and deodorants.

Thus, in M. Hermite's system, the sewage itself never undergoes electrolysis, whilst in Mr. Webster's process on the other hand, the sewage is the liquid which is electrolysed.

The subject under consideration may be conveniently dealt with as follows:—

I. Description of the plant employed at Worthing, methods of analysis, &c.
II. Relation between the amount of current used, and the yield of effective disinfectant, including some account of the chemical character of the disinfecting material, with especial reference to its instability.
III. Bacteriological experiments on the action of the disinfectant on pure cultures of bacteria.
IV. Action of the disinfectant on fæcal matter on a small scale in the laboratory, and on a large scale at Worthing.
V. Summary and conclusions.

The experiments were carried out partly in the chemical laboratory of the British Institute of Preventive Medicine, and partly in the works erected for the demonstration at Worthing.

### I. *Description of the Plant employed at Worthing, Methods of Analysis, &c.*

The motive power was obtained from a road traction-engine of 7 horse-power, belonging to the Corporation. It was soon found that this engine was not well suited to a scientific experimental investigation, as its speed, and therefore the constancy of the current produced by the dynamo which it drove was not under satisfactory control and could not be regulated with precision.

This is shown by the slight want of uniformity in the results of the experiments on the electrolysis of sea-water. The inequalities are, however, too slight to affect the practical results.

Fig. 1.

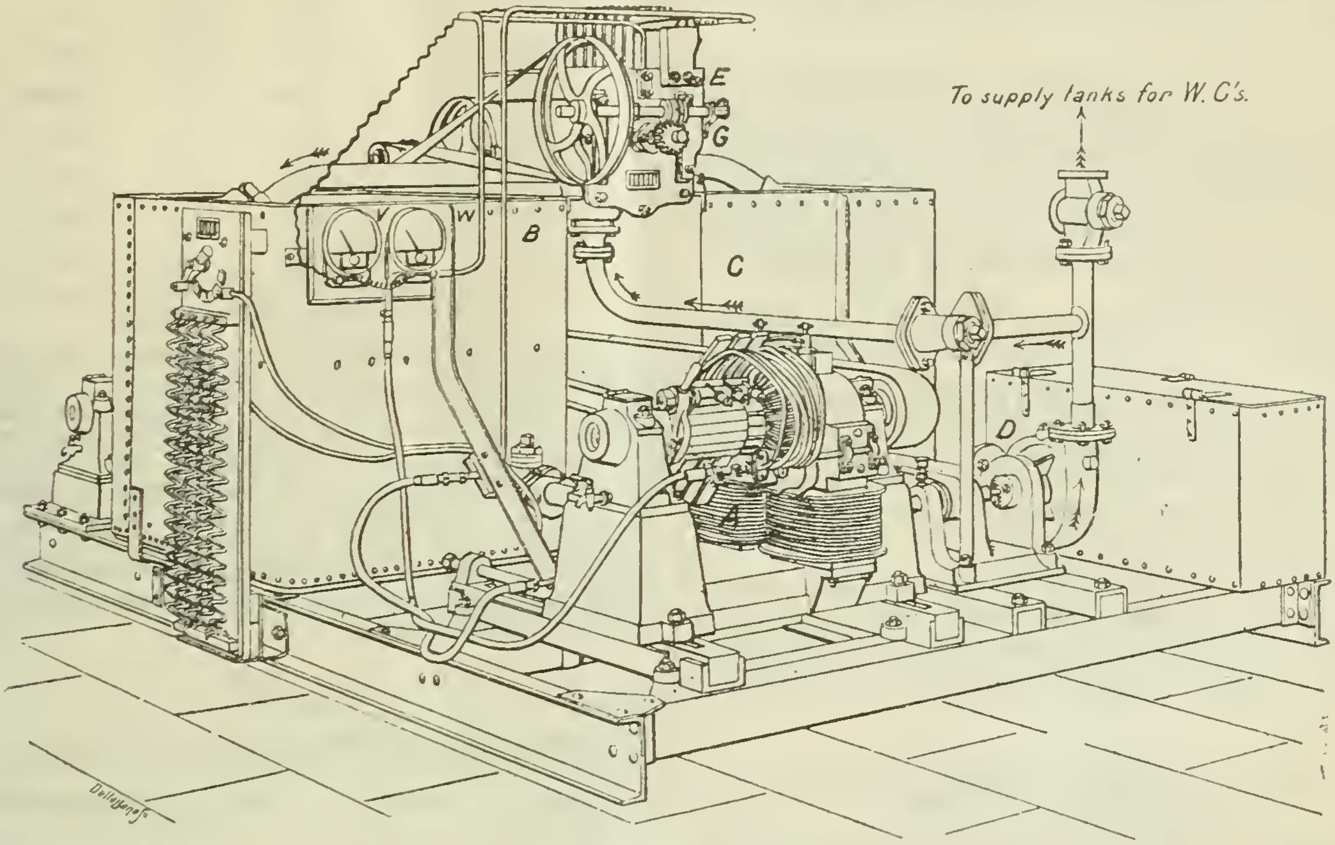


Fig. 1 shows the nature and disposition of the plant employed at Worthing. The engine is used not only for driving the dynamo A which produces the current used in the electrolysis of sea-water, but also for pumping the sea-water from the Corporation water-carts, by means of the rotary pump D into the tanks B and C, and also for pumping the finished liquid from the tanks B and C into other storage tanks placed at an elevation.

From these latter, the electrolysed sea-water flows by gravitation into the 2-gallon flushing tanks of the water-closets of 14 cottages close by, and into those of two public water-closets used by a gang of navvies employed in the vicinity on the new drainage works.

The tanks B and C each hold about 1,000 litres, or 220 gallons, being about a cubic metre in capacity.

Only one tank is used at a time, the other being generally full of sea-water for the purpose of steadying the plant.

The current produced by the dynamo is used at a pressure of about 6 volts and a strength of 250 ampères.

These values were measured on a volt-meter [V] and an ammeter [W] attached to tank B, and these instruments were verified at the end of the experiments by comparison with the standard instruments of an independent authority. The errors of readings about the two points named were found to be quite insignificant.

The dynamo A is of the "shunt" type, and its main cables lead through the ammeter to the electrolyser E, which is about 50 litres in capacity.

#### *Description of the Electrolyser.*

The negative electrodes consist of a dozen circular zinc discs, about 9 or 10 inches in diameter, which are constantly rotated on an axis passing centrally through them by means of the worm-gearing G, and as they revolve, their surfaces are kept clean and free from the deposit of magnesia which would otherwise gradually accumulate on them, by being scraped against zinc knives placed in contact with them along their diameter.

The positive electrodes consist of 44 cylinders of fine platinum wire gauze, wrapped once round each of 44 glass rods, which act as supports for them. These are metallically connected with the positive terminal of the dynamo.

Four of these platinum gauze electrodes are placed between each pair of zinc discs, two on each side of their axis of revolution, and they are immersed in the sea-water during the electrolysis for a depth of about 9 or 10 inches.

During the electrolysis the sea-water is constantly being pumped by the rotary pump in the direction of the arrows from the tank B, through the electrolyser E, back again into the tank, and the liquid is thus kept circulating for a length of time depending upon the strength in "available chlorine" which it is desired to attain in the finished product.

It was stated by M. Hermite's agents that the strength used was half a gramme of "available chlorine" per litre of electrolysed sea-water as estimated by the arsenious acid test.

#### *Current Conditions Determined by M. Hermite.*

All experiments on the production of the disinfecting compounds from sea-water were made at Worthing with natural sea-water and M. Hermite's plant, and the conditions as to voltage, strength of current, and current density, as well as the exact mode of conducting the electrolysis were those which had been previously ascertained by M. Hermite to be the most suitable, and these pre-determined conditions were never departed from in the following experiments:—

#### *Nature of the Disinfectant.*

The electrolysed sea-water is a clear, colourless liquid, possessing a faint chlorous odour, resembling bleaching-powder, and, notwithstanding statements which have been made to the contrary, has a very distinctly alkaline reaction with litmus paper, the bleaching of which is by no means immediate.

On the addition of acids free chlorine is evolved, which would likewise be the case with sodium hypochlorite or bleaching powder.

After a considerable volume of sea-water has been electrolysed the sides of the electrolyser become coated with a white deposit of magnesia, whilst a larger quantity of it collects on the floor of tank B.

It is not our object in this paper to enter into any discussion of the intricate chemical actions which take place in the electrolyser.

The possible chemical changes are numerous, for not only may we have the decomposition of water and of its dissolved chlorides, more especially the chloride of magnesium, from which magnesia is precipitated during the electrolysis, but also we may have further oxidations and reductions effected by the nascent oxygen and hydrogen which are evolved from the electrodes during the electrolysis, as well as further interactions of the primary products of the electrolysis to form new compounds.

M. Hermite himself is content to state, very vaguely, that "the disinfecting principle is an oxygenated compound of chlorine."

Messrs. Cross and Bevan and Dr. Hurter have published papers in the Journal of this Society which have for their object the elucidation of this subject (this Journal, Vol. VI., 1887, pp. 170 and 246, 337; Vol. VII., 1888, pp. 292, 726), but our aim has been rather to ascertain the practical value of the process than to discuss the nature of the chemical changes which the solution undergoes.

Suffice it here to say that the principal product of the electrolysis is a soluble hypochlorite which remains in solution, and that the method used in these experiments, to estimate its amount, is one which is used for the estimation of hypochlorites in bleaching-powder.

### *Method of Estimating "Available Chlorine" in Electrolysed Sea-Water.*

The method consists in titrating 50 cc. or 100 cc. of the electrolysed sea-water with a decinormal solution of alkaline potassium arsenite until a drop of the liquid no longer gives a blue coloration when dropped on a filter-paper impregnated with a solution of potassium iodide and starch. The volume of arsenite thus required is then calculated into "available chlorine" just as though the solution were sodium hypochlorite or bleaching-powder.

This method was found to be in practical, and often very exact, agreement with the different method of estimation employed by the electrical engineer in charge of the plant at Worthing. This latter method consisted in titrating a definite volume (3 cc. or 5 cc.) of arsenious acid, or its equivalent, with the electrolysed sea-water to be examined, using a few drops of indigo sulphate solution as an indicator, an excess of electrolysed sea-water causing its bleaching.

### *Relation between "Current" and "Yield."*

The following experiments were made with the object of ascertaining the relation between the amount of current used and the yield of available chlorine, in order that reliable data might be obtained as to the cost of production.

In all cases the tank (A or B) used for the experiment, as well as the electrolyser, was thoroughly cleaned out and fresh sea-water pumped into it before each electrolysis.

In the first series of experiments the volume of sea-water taken was 750 litres. The current used was, however, somewhat erratic, owing to defective driving of the traction engine. It started at 275 ampères and 6·3 volts, but was allowed to run at 300 ampères or more and 6·6 volts after the first half hour. The liquid was tested every 15 minutes for the amount of "available chlorine" and Table I. shows the results.

Table I.

First Series of Experiments at the Electrolyser.

*Volume of Sea-Water, 750 litres. Current erratic. Date, February 15, 1894.*

| Duration of Electrolysis. | C.c.'s of $\frac{N}{10}$ Arsenite required for 100 cc. E.S.W.* | Strength in Grms. of available Chlorine per Litre. |
|---|---|---|
| Minutes.<br>15 | 2·5 | 0·88 |
| 30 | 4·95 | 0·175 |
| 45 | 7·45 | 0·263 |
| 60 | 10·5 | 0·371 |
| 75 | 12·8 | 0·453 |
| 90 | 15·0 | 0·531 |
| 95 | 15·3 | 0·541 |

* E.S.W. = Electrolysed sea-water.

Samples of the finished product, containing 0·541 grms. of available chlorine per litre, were brought away in stoppered Winchester quart bottles, for further examination. The next day the strength was again determined, and it was then found to have undergone a very remarkable diminution. This result was the more noteworthy inasmuch as a sample of electrolysed sea water taken from the elevated tank supplying the w.c.'s, but prepared and sent up for use before the above experiments were made, was not found to diminish in strength in this manner, as the following results show:—

Table II.

First Series of Experiments on Stability.

| Sample from Tank B. Initial strength, 0·541 grms. | | | *Sample from Elevated Tank. Initial strength, (?). | | |
|---|---|---|---|---|---|
| When Examined. | C.c.'s of Arsenite for 100 cc. E.S.W. | Strength. | When Examined. | Cc.'s of Arsenite for 100 cc. E.S.W. | Strength. |
| Immediately | 15·30 | Grms.<br>0·541 | | | |
| After 20 hours | 2·35 | 0·083 | After 1 day | 6·60 | Grms.<br>0·233 |
| „ 2 days | 0·50 | 0·017 | „ 3 days | 6·20 | 0·219 |
| „ 4 „ | 0·30 | 0·010 | „ 6 „ | 6·20 | 0·219 |
| „ 6 „ | 0·20 | 0·007 | „ 8 „ | 6·10 | 0·216 |
| „ 12 „ | 0·15 | 0·005 | „ 12 „ | 5·95 | 0·210 |
| „ 23 „ | 0·10 | 0·003 | „ 23 „ | 5·70 | 0·201 |

* The age of this sample when taken is unknown, probably it was made the day before it was taken from the tank (see subsequent experiments).

It will afterwards be seen how these observations can be reconciled. The results show that the sample from the elevated tank was of a stable character, whilst the one from tank B was exceedingly unstable. This latter sample, 24 hours after making, was found to be incapable of sterilising fœcal matter and urine when used in the proportion of 2 galls. to one stool, the ratio it is proposed to use on a large scale.

On March 7 these experiments were repeated, as the previous results seemed at that time so unaccountable. On this occasion also, the tanks were cleaned out and filled with sea-water, which gave no coloration with starch and potassium iodide solution. The driving of the engine on this occasion was more perfect, and the current was kept as constant as possible at 250 ampères and 6·1 volts. The solution was examined every 15 minutes for the amount of "available chlorine," with the following results:—

### TABLE III.

SECOND SERIES OF EXPERIMENTS AT THE ELECTROLYSER.

*Volume of Sea-Water, 750 litres. Current fairly constant at 250 ampères and 6·1 volts. Date, March 7th, 1894.*

| Duration of Electrolysis. | C.c.'s of $\frac{N}{10}$ Arsenite required for 100 cc. E.S.W. | Difference for 15 Minutes. | Strength in Grms. of available Chlorine per Litre. | Difference for 15 Minutes. |
|---|---|---|---|---|
| Minutes.<br>5 | 0·70 | | 0·024 | |
| 15 | 2·40 | 2·4 | 0·085 | 0·085 |
| 30 | 4·75 | 2·35 | 0·168 | 0·083 |
| 45 | 6·95 | 2·20 | 0·246 | 0·078 |
| 60 | .. | 2·18 | .. | 0·077 |
| 75 | 11·3 | 2·17 | 0·400 | 0·076 |
| 90 | 13·3 | 2·00 | 0·470 | 0·070 |
| 105 | 15·1 | 1·80 | 0·534 | 0·064 |

It will be noticed that the increment in strength of the solution for each additional equal amount of current gradually diminishes. This we shall find to be still better exemplified when the production of higher strengths are considered, for they are not so economically produced as are the lower strengths.

The behaviour of samples of the finished product which were brought away in stoppered Winchester quart bottles, and of which the initial strength was 0·534 grms. of available chlorine per litre, entirely confirmed the previous experiment, for in 24 hours the strength had fallen over 90 per cent. (from 0·534 grms. to 0·049 grms.), whilst again a sample from the elevated tank used for supplying the water-closets, showed only a slight diminution in strength in 24 hours, being in fact a very stable solution, as the following results show:—

### TABLE IV.

SECOND SERIES OF EXPERIMENTS ON STABILITY.

| Sample from Tank B. Initial Strength 0·534 Grms. | | | * Sample from Elevated Tank. Initial Strength (?). | | |
|---|---|---|---|---|---|
| When Examined. | C.c.'s of $\frac{N}{10}$ Arsenite required for 100 cc. E.S.W. | Strength. | When Examined. | C.c.'s of $\frac{N}{10}$ Asenite required for 100 cc. E.S.W. | Strength. |
| | Cc. | Grms. | | Cc. | Grms. |
| Immediately | 15·10 | 0·534 | When taken | 15·60 | 0·552 |
| After 1 day.. | 1·40 | 0·049 | After 1 day | 12·80 | 0·453 |
| 2 days. | 0·50 | 0·017 | „ 2 days | 12·65 | 0·447 |
| 3 „ . | 0·30 | 0·010 | „ 3 „ | 12·60 | 0·446 |
| .. | .. | .. | „ 61 „ | 8·80 | 0·311 |

* The age of this sample when taken is unknown, probably it was made the day before it was taken from the tank (see subsequent experiments).

The samples of the final product made on March 7th (Table III.), and which had a strength of 0·534 grms. when first made, were found next day to be incapable of sterilising broth cultures of bacillus pyocyaneus and staphylococcus albus, when 1 volume of culture to 5 volumes of electrolysed sea-water were allowed to remain in contact for 18 hours, as characteristic pure cultures were afterwards plentifully obtained from the fluid. It was similarly ineffective when tried on the spores of moulds.

These experiments so conclusively proved the great instability of a solution of half a grm. strength (tested immediately after making) and also its uselessness as a disinfectant when 24 hours old, that on the next visit to Worthing, the experiments were repeated, but instead of stopping the engine when a strength of half a grm. was reached, the dynamo was allowed to run on until a strength of 0·683 grms. in one series and 1·136 grms. in another series was obtained, (see Tables V. and VII.).

In these experiments a volume of 1,000 litres was employed, and the current kept as nearly as possible to 250 ampères and 6·1 volts.

### TABLE V.

THIRD SERIES OF EXPERIMENTS AT THE ELECTROLYSER.

*Volume of Sea-Water, 1,000 litres. Current fairly constant at 250 ampères, and 6·1 volts. Date, March 21st, 1894.*

| | First Electrolysis. | | Second Electrolysis. | |
|---|---|---|---|---|
| Duration of Electrolysis. | C.c.'s of $\frac{N}{10}$ Arsenite for 100 cc. E.S.W. | Strength in Grms. of available Chlorine per Litre. | C.c.'s of $\frac{N}{10}$ Arsenite for 100 cc. E.S.W. | Strength in Grms. of available Chlorine per Litre. |
| 15 minutes | 1·75 | 0·062 | .. | .. |
| 30 „ | 3·60 | 0·127 | 3·90 | 0·138 |
| 45 „ | 5·35 | 0·189 | .. | .. |
| 60 „ | 7·10* | 0·251* | 7·20* | 0·255* |
| 75 „ | 8·85 | 0·313 | .. | .. |
| 90 „ | 10·35 | 3·366 | .. | .. |
| 105 „ | 11·55 | 0·409 | .. | .. |
| 120 „ | 13·15* | 0·465* | 13·15 | 0·465 |
| 135 „ | 14·00* | 0·495* | .. | .. |
| 150 „ | .. | .. | 14·7* | 0·520* |
| 180 „ | .. | .. | 16·4 | 0·580 |
| 210 „ | .. | .. | 17·4 | 0·616 |
| 240 „ | .. | .. | 19·3* | 0·683* |

* Samples were taken at these points in Winchester quart stoppered bottles for the experiments on stability given in Table VI.

With a view to watching the progress of the decomposition of the electrolysed sea-water during the first 24 hours, in which time solutions of half a grm. per litre lose over 90 per cent. of their strength; the samples marked * in Table V. were examined at definite intervals of time after being made. The results are shown in Table VI.

This table and the accompanying curves in Figure II. show very clearly that within 14 hours (and with lower strengths within 11 hours) all the solutions up to a strength of 0·52 grms. of available chlorine have sunk below 0·1 grm. It is evident, therefore, that solutions up to half a grm. strength, whatever they may be capable of when freshly prepared, are of so low a strength as to be valueless *within 12 hours.* On the other hand, a solution of 0·68 grm. shows a far greater stability; for even after 47 days it still contains over a quarter of a grm. of available chlorine per litre (0·272 grm.), see curve III., Fig. III.

The next experiments were made with the object of studying still further the behaviour of solutions of higher strengths than had previously been obtained, and at the same time to obtain data as to the relation between the amount of current and "yield" when these higher strengths had to be made.

In the following series the dynamo was allowed to run for seven hours without stopping, except a few minutes for oiling the machinery.

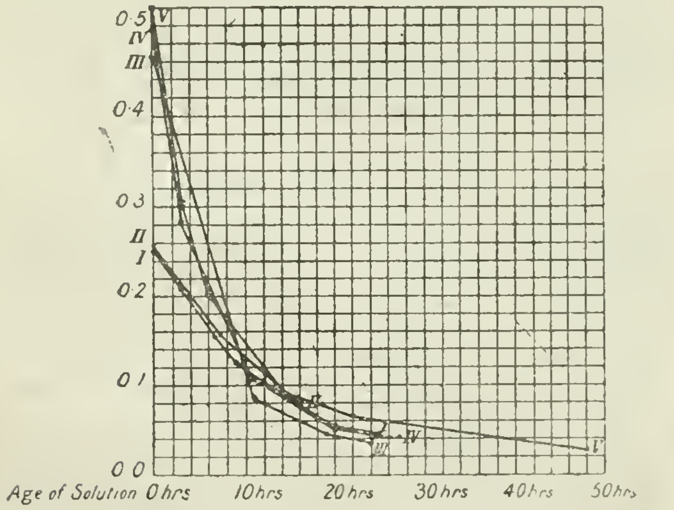
### Table VI.

### Third Series of Experiments on Stability.

| Examined. | Strengths in Grms. of available Chlorine per Litre after definite Times. | | | | | |
|---|---|---|---|---|---|---|
| | Sample I. | Sample II. | Sample III. | Sample IV. | Sample V. | Sample VI. |
| Immediately | 0·251 | 0·255 | 0·465 | 0·495 | 0·520 | 0·683 |
| After 0 hours 15 minutes | .. | .. | .. | 0·463 | .. | .. |
| ,, 3 ,, 0 ,, | 0·209 | .. | .. | 0·283 | 0·304 | .. |
| ,, 4 ,, 0 ,, | .. | .. | .. | .. | .. | 0·418 |
| ,, 5 ,, 30 ,, | .. | .. | .. | .. | .. | 0·417 |
| ,, 6 ,, 0 ,, | .. | .. | .. | .. | 0·201 | .. |
| ,, 6 ,, 40 ,, | 0·156 | .. | .. | .. | .. | .. |
| ,, 7 ,, 15 ,, | .. | 0·156 | .. | .. | .. | .. |
| ,, 9 ,, 0 ,, | 0·124 | .. | .. | .. | .. | .. |
| ,, 11 ,, 0 ,, | .. | .. | 0·085 | 0·109 | .. | .. |
| ,, 12 ,, 0 ,, | 0·103 | .. | .. | .. | .. | .. |
| ,, 13 ,, 0 ,, | .. | .. | .. | .. | .. | 0·364 |
| ,, 14 ,, 0 ,, | .. | .. | .. | .. | 0·095 | .. |
| ,, 16 ,, 0 ,, | .. | 0·079 | .. | .. | .. | .. |
| ,, 19 ,, 0 ,, | .. | .. | 0·046 | 0·053 | .. | .. |
| ,, 20 ,, 0 ,, | 0·056 | .. | .. | .. | .. | .. |
| ,, 22 ,, 0 ,, | .. | .. | .. | .. | 0·067 | .. |
| ,, 24 ,, 0 ,, | .. | .. | 0·035 | 0·046 | .. | .. |
| ,, 25 ,, 0 ,, | 0·046 | .. | .. | .. | .. | .. |
| ,, 27 ,, 15 ,, | .. | .. | .. | 0·042 | .. | .. |
| ,, 48 ,, 0 ,, | .. | .. | .. | .. | 0·028 | 0·340 |
| ,, 3 days | .. | .. | .. | .. | 0·021 | .. |
| ,, 6 ,, | .. | .. | .. | .. | 0·009 | .. |
| ,, 9 ,, | .. | .. | .. | .. | 0·005 | 0·336 |
| ,, 23 ,, | .. | .. | .. | .. | 0·003 | 0·308 |
| ,, 47 ,, | .. | .. | .. | .. | 0·002 | 0·272 |

Fig. 2.

Grms. of Available Chlorine. Strengths up to 0·52 grms.



Curves showing Instability of Electrolysed Sea-Water.

(Table VI.)

The following table shows the results:—

### Table VII.

### Fourth Series of Experiments at the Electrolyser.

*Volume of Sea-Water* 1,000 *litres. Current* 250 *ampères and* 6·1 *volts. Date, March* 22*nd*, 1894.

| Duration of Electrolysis. | | Cc.'s of $\frac{N}{10}$ Arsenite required for 100 cc. E.S.W. | Strength Grms. per Litre. |
|---|---|---|---|
| Hrs. | Min. | | |
| 1 | 0 | 7·15 | 0·253 |
| 2 | 0 | 12·60 | 0·446 |
| 2 | 30 | 14·70 | 0·520 |
| 3 | 30 | 18·00 | 0·637 |
| 4 | 30 | 21·30 | 0·754 |
| 5 | 30 | 25·10 | 0·888 |
| 6 | 0 | 27·30 | 0·966 |
| 6 | 30 | 29·60 | 1·047 |
| 7 | 0 | 32·10 | 1·136 |

Samples were taken at each of these points, except the first two, and their stability examined, see Table VIII.

TABLE VIII.

FOURTH SERIES OF EXPERIMENTS ON STABILITY.

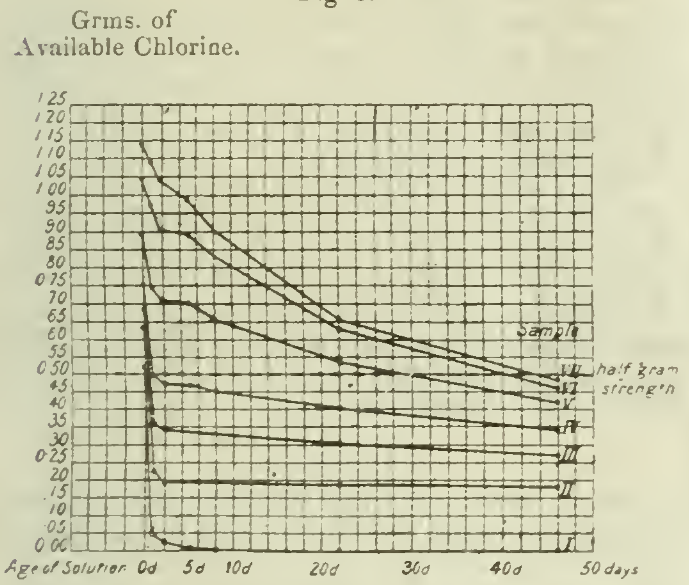
| When examined. | Strengths, in Grms. of Available Chlorine per Litre after definite Intervals of Time. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Sample I. | Sample II. | Sample III. | Sample IV. | Sample V. | Sample VI. | Sample VII. |
| Immediately | 0·520 | 0·637 | 0·683* | 0·754 | 0·888 | 1·047 | 1·136 |
| After 1 day | 0·049 | 0·226 | 0·364† | 0·495 | 0·739 | 0·975 | 1·086 |
| „ 2 days | 0·026 | 0·198 | 0·340 | 0·474 | 0·718 | 0·906 | 1·044 |
| „ 5 „ | 0·007 | .. | .. | 0·471 | 0·700 | 0·892 | 0·984 |
| „ 8 „ | 0·005 | 0·198 | 0·336 | 0·456 | 0·658 | 0·835 | 0·902 |
| „ 22 „ | 0·003 | 0·193 | 0·308 | 0·403 | 0·534 | 0·626 | 0·658 |
| „ 46 „ | 0·002 | 0·182 | 0·272 | 0·340 | 0·421 | 0·463 | 0·481 |
| Percentage loss on the first day | 90·4 % | 64·5 % | 46·6 % | 34·2 % | 16·7 % | 6·9 % | 4·3 % |

The figures in the above table are shown as curves in Fig. III.

* From the previous series.

† After 13 hours only.

Fig. 3.



CURVES SHOWING INSTABILITY OF ELECTROLYSED SEA-WATER.

(TABLE VIII.)

These results show conclusively that although the product which is of only half a grm. strength immediately it is made is very unstable and loses over 90 per cent. of its strength during the first 24 hours, yet the higher strengths are not so unstable. Solutions of 0·6 are not so unstable as those of 0·5 strength, whilst when a strength of 0·75 is reached we have a marked gain in stability, and a solution of 1·136 grms. strength only falls below a grm. in five days. The percentage loss of strength during the first 24 hours illustrates very clearly that the stability increases with the strength. It must be pointed out, however, that the higher strengths are not so economically produced as are the lower strengths, *e.g.*, if we double the amount of current or rather double the length of time during which the sea-water undergoes electrolysis in order to obtain 0·5 grm., we do not get 1·0 grm. but only 0·75 grm. In other words, if we increase the current 100 per cent. we only get an increased yield of 50 per cent., yet it must be observed that it is just this increase which renders the solution relatively stable.

Further experiments were made on the stability of electrolysed sea-water of strengths 0·6, 0·7, 0·76, 0·78 grm., which had been prepared by electrolysing a mixture in the proportion of 2 : 1, of fresh sea-water with sea-water which had on the previous day been electrolysed to a strength of 0·8 grm.

These solutions are relatively more stable than those of similar strengths made from pure sea-water, as the following table shows :—

TABLE IX.

FIFTH SERIES OF EXPERIMENTS ON STABILITY.

| When Examined. | Strength in Grms. of Available Chlorine per Litre after definite Intervals of Time. | | | |
|---|---|---|---|---|
| Immediately | 0·607 | 0·702 | 0·761 | 0·789 |
| After 4 hours | 0·396 | .. | .. | .. |
| „ 6 „ | .. | .. | 0·584 | 0·626 |
| „ 6½ „ | .. | 0·478 | .. | .. |
| „ 8 „ | 0·332 | .. | .. | .. |
| „ 12 „ | 0·300 | 0·453 | 0·566 | 0·616 |
| „ 24 „ | 0·276 | 0·449 | 0·559 | 0·616 |
| „ 48 „ | 0·272 | 0·449 | 0·559 | 0·608 |
| „ 4 days | 0·269 | 0·442 | 0·545 | 0·594 |

From the foregoing experiments, it is evident that in judging of the stability or instability of electrolysed sea-water of various strengths, it is of the utmost importance to know how long the solution has been prepared. It is evident that, given two solutions of exactly the same strength, one newly prepared and unstable, the other old and stable, the latter will have been much more costly in production. Previous experimenters do not seem to have paid much attention to this point, and it is evident that by ignoring the age of solution, great discrepancies between results can easily arise. For example: in Table II. (right-hand columns) we see that a solution of 0·233 grm. strength is very *stable*, whereas Table VI. shows that solutions of 0·251 or of 0·255 grm. strength are very *unstable*.

Again, in Table II., we find a solution of 0·541 strength, and in Table IV. (left-hand column) a solution of 0·534 strength, both of which are very unstable, whilst, on the other hand, Table IV. (right-hand column) shows a solution of 0·552 strength, which is very stable. In Table VIII. also many other similar examples may be seen.

Hence it is, probably, that other observers conclude that comparatively low strengths, such as 0·5 and 0·6 are stable, such stable low-strength solutions having been originally produced at higher strengths and at greater cost than appears from a mere titration of such solutions when a day or more old. Estimations of strength made on the day after preparation seem to have then been taken as *initial strength*, and erroneous conclusions, therefore, drawn as to stability. All the experiments which we have made show that in this decomposition of the solution the greatest loss occurs during the first 12 hours, during which time the loss of strength is often very rapid. This is of extreme importance, because, if the electrolysed sea-water is to be made at a central station and distributed to each house in a town in pipes, like ordinary water and gas (which the Hermite process proposes), the solution will probably be standing or flowing through these pipes for a longer time than this before it comes into actual use. Indeed, it is very advisable that the disinfecting solution should remain of an efficient strength for at least 24 hours. If this be adopted as a necessary condition, then it follows that all strengths below 0·75 grm. per litre are useless, because of their great instability. It will also be shown that they are not strong enough to act as efficient disinfectants.

A solution made at 0·75 grm. will have fallen to 0·5 during the first 24 hours, and as we shall see that this strength is not effective on subtilis spores or on fæces, it follows that still higher strengths will have to be used if the substance is to act as a true disinfectant, and not merely as an antiseptic.

Before considering this question as to the effective strength of solution, it will, perhaps, be as well to consider the bacteriological experiments which we have made on the action of various strengths of solution, used in various proportions, and acting for various lengths of time on pure cultivations of bacteria.

M. Hermite's representatives in England claim that, although the lower strengths are very unstable, they are also, in virtue of their instability, all the more effective as oxidising and disinfecting agents; and this at first sight seems reasonable, but the following bacteriological experiments will show that this is by no means the case.

Taking first a solution of a strength 0·25 grm., Chamberland flasks, containing 5 or 10 cc. (as the case may be) of broth, were infected with bacillus coli communis and bacillus subtilis, the former being used five days old and the latter seven days old in one series and 14 days old in another series of experiments, the latter organism being examined microscopically, and found to be in the mature-spore condition. The culture having been mixed with the requisite volume of electrolysed sea-water (10 cc., or 50 cc. generally), so as to give the proportions of 1:1, 1:2, 1:5, and 1:10, the mixture was allowed to stand for a length of time varying from 30 minutes to $4\frac{3}{4}$ hours, and sub-cultures were made by taking out a loopful of the fluid, to make a sub-culture either in a sterile broth tube or to streak on the surface of gelatine in a tube obliquely set, or to make a gelatine-plate cultivation in a sterile Petri's dish.

The following table shows the results: The + indicates not sterilised, the 0 sterile.

### TABLE X.

### FIRST SERIES OF BACTERIOLOGICAL EXPERIMENTS.

*Strength 0·25 grm. of available Chlorine per Litre.*

#### I. BACILLUS COLI COMMUNIS.

| Age of Solution. | Duration of Action. | Sterilised (0) or not Sterilised (+). | | | | Method of Sub-Culture.* |
|---|---|---|---|---|---|---|
| | | Ratio of Vol. of Culture to Vol. of Electrolysed Sea-Water. | | | | |
| | | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | |
| 30 min. | 30 min. | + | + | + | 0 | Oblique streaks. |
| .. | 2 hours | + | + | + | 0 | Broth tubes. |
| 6 hours | 1 hour | + | + | + | + | Oblique streaks. |
| .. | $4\frac{3}{4}$ hours | + | + | + | 0 | Broth tubes. |
| 24 hours | 2 hours | + | + | + | + | Plates.† |

Six hours and 24 hours old solutions are used *a fortiori*.

* In all cases the purity of the broth sub-cultures was verified by plate culture or other test.

† All plates very crowded with colonies.

#### II. BACILLUS SUBTILIS (MATURE SPORES).

| Age of Solution. | Duration of Action. | Sterilised (0) or not Sterilised (+). | | | | Method of Sub-Culture.* |
|---|---|---|---|---|---|---|
| | | Ratio of Vol. of Culture to Vol. of Electrolysed Sea-Water. | | | | |
| | | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | |
| 30 min. | 30 min. | + | + | + | + | Loop stabs. |
| .. | 1 h. 30 m. | + | + | + | + | Plates.† |
| .. | 2 hours | + | + | + | + | Plates.† |
| .. | 2 hours | + | + | + | + | Broth tubes. |
| .. | 2 h. 15 m. | + | + | + | + | Broth tubes. |

Six hours and 24 hours old solutions are useless *a fortiori*.

* In all cases the purity of the broth sub-cultures was verified by plate culture or other tests.

† All plates very crowded with colonies.

These results show that the solution at 0·25 grm. strength is not effective on subtilis spores, even in $2\frac{1}{4}$ hours, when used in the large proportion of 1:10, but that the non-sporing organism is killed in half an hour when this large proportion (1:10) is used, but is *not* killed even in *two hours* when the proportion of volume of culture to that of electrolysed sea-water was 1:5.

When a solution of 0·25 grm. strength is used six hours after making, it is ineffective, when acting for an hour in large volume (1 to 10), but that it is slowly acting is shown by the sterility of the tube sown after a contact of $4\frac{3}{4}$ hours with the largest dose, 1:10.

Twenty-four hours after making the solution is shown, both chemically and bacteriologically, to be entirely useless.

Passing now to a strength of half a grm. per litre, we find the following results :—

### TABLE XI.

### SECOND SERIES OF BACTERIOLOGICAL EXPERIMENTS.

*Strength 0·50 grm. of Available Chlorine per Litre.*

#### I. BACILLUS COLI COMMUNIS.

| Age of Solution. | Duration of Action. | Sterilised (0) or not Sterilised (+). | | | | Method of Sub-Culture. |
|---|---|---|---|---|---|---|
| | | Ratio of Vol. of Culture to Vol. of Electrolysed Sea-Water. | | | | |
| | | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | |
| 30 min. | 30 min. | + | 0 | 0 | 0 | Oblique streaks. |
| .. | $2\frac{3}{4}$ hours | + | 0 | 0 | 0 | Broth tubes. |
| 6 hours | 30 min. | + | + | 0 | 0 | Plates. |
| .. | 3 hours | + | + | 0 | 0 | Broth tubes. |
| 24 hours | $2\frac{1}{4}$ hours | +* | + | + | + | Plates.† |
| .. | 4 hours | +* | + | + | + | Broth tubes. |

#### II. BACILLUS SUBTILIS (MATURE SPORES).

| Age of Solution. | Duration of Action. | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | Method of Sub-Culture. |
|---|---|---|---|---|---|---|
| 30 min.‡ | 30 min. | + | + | + | + | Loop stabs. |
| .. | 30 min. | + | + | + | + | Plates. |
| .. | $2\frac{3}{4}$ hours | + | + | + | + | Broth tubes. |

* No sub-cultures made in these two cases, but results follow from those with greater volume.

† All plates crowded with colonies.

‡ No experiments with 6 hours and 24 hours old solutions as they would be useless *a fortiori*.

These results show that the half grm. strength is quite ineffective on mature subtilis spores, even when used in large volumes, but that if used within half an hour after making, it is effective on the non-sporing organism in half an hour if used in twice the volume of the culture, but an equal volume is ineffective. If not used within six hours, five times the volume of the culture is required, whilst, if not used within 24 hours, the solution as shown, both chemically and bacteriologically, is quite useless.

Passing on now to a still higher strength, we find the following results :—

### TABLE XII.

### THIRD SERIES OF BACTERIOLOGICAL EXPERIMENTS.

*Strength* 0·75 *grm. of Available Chlorine per Litre.*

I. BACILLUS COLI COMMUNIS.

| Age of Solution. | Duration of Action. | Sterilised (0) or not Sterilised (+). Ratio of Vol. of Culture to Vol. of Electrolysed Sea-Water. | | | | Method of Sub-Culture. |
|---|---|---|---|---|---|---|
| | | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | |
| 30 min. | 30 min. | 0 | 0 | 0 | 0 | Oblique streaks. |
| 6 hours | 30 min. | 0 | 0 | 0 | 0 | Broth tubes. |
| 24 hours | 30 min. | + | 0 | 0 | 0 | Plates.* |
| .. | $2\frac{1}{4}$ hours | 0 | 0 | 0 | 0 | Broth tubes. |

II. BACILLUS SUBTILIS (MATURE SPORES).

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 min. | 30 min. | + | + | + | + | Loop stabs. |

* This plate was somewhat crowded but showed great diminution as compared with the lower strengths.

These results show that the strength 0·75 is not effective in any proportion on mature subtilis spores, but that an equal volume kills the non-sporing organism in 30 min., if used within 6 hours, whilst if not used within 24 hours, sterilisation is not complete in 30 min. with an equal volume, but is so in $2\frac{1}{4}$ hours or in 30 min. if double the volume is used.

### TABLE XIII.

### FOURTH SERIES OF BACTERIOLOGICAL EXPERIMENTS.

*Strength* 1·0 *grm. of Available Chlorine per Litre.*

I. BACILLUS COLI COMMUNIS.

| Age of Solution. | Duration of Action. | Sterilised (0) or not Sterilised (+). Ratio of Vol. of Culture to Vol. of Electrolysed Sea-Water. | | | | Method of Sub-Culture. |
|---|---|---|---|---|---|---|
| | | 1 : 1. | 1 : 2. | 1 : 5. | 1 : 10. | |
| 30 min. | 30 min. | 0 | 0 | 0 | 0 | Plates. |
| .. | 30 min. | 0 | 0 | 0 | 0 | Broth tubes. |
| 24 hours | 10 min. | 0 | 0 | 0 | 0 | Oblique streaks. |
| .. | 2 hours | 0 | 0 | 0 | 0 | Broth tubes. |

II. BACILLUS SUBTILIS (MATURE SPORES).

| | | | | | | |
|---|---|---|---|---|---|---|
| 24 hours | 30 min. | + | + | + | + | Loop stabs. |
| .. | 2, hours | + | + | + | + | Broth tubes. |

These results show that the grm. strength is fatal within half an hour, when equal volumes are used on a culture of bacillus coli communis, whilst even this strength is not fatal to subtilis spores, even when used in such large volumes as 1 : 10.

Dr. Ruffer, Director of the British Institute of Preventive Medicine has made a series of experiments on the action of electrolysed sea-water on various pathogenic organisms and obtained similar results.

Dr. Klein has also made experiments on pathogenic organisms, and his results are embodied in a report to the Sanitary Committee of the Worthing Town Council by their Medical Officer of Health.*

### *Laboratory Experiments with Fæcal Matter.*

M. Hermite, in all his publications, claims that fæcal matter is instantaneously destroyed, as the following quotations show : "Fæcal matter is instantaneously destroyed when mixed with the electrolysed disinfecting liquid." "By the use of the disinfecting liquid in the closets, the fæcal matter is *immediately destroyed* with all the microbes it may contain." "La matière fécale est *détruite instantanément* lorsqu'elle est mélangée avec le liquide désinfectant électrolytique, *il ne reste qu'une eau trouble* sans odeur." "*Cette destruction est immédiate.*" Again, in M. Hermite's latest pamphlet, we read "La matière fécale fraiche, mise en contact avec une quantité suffisante de ce désinfectant, *est complètement brûlée ;* il ne reste plus qu'un liquide trouble." What this "quantité suffisante" is, we learn in the next paragraph "On a constaté par de nombreuses expériences qu'une quantité de liquide électrolytique désinfectant représentant un maximum de 0·5 grms. de chlore était suffisante pour *détruire et stériliser* complètement une selle normale d'homme adulte."

Many laboratory experiments were made on fæces and urine with strengths of electrolysed sea-water varying from 0·25 to 1·0 grm., and we find that not only has the fluid no appreciable solvent or disintegrating action on solid stools over and above that possessed by ordinary sea-water, but that there is also no complete sterilisation even with strengths up to 0·75 grm. In these experiments, about 10—15 grms. of fæcal matter were weighed out, according to the total weight of the stool, and a like proportion of the urine voided at the same time was added to it and then about a litre of electrolysed sea-water was poured over the mixture so as to dose it in the proportion of two gallons of fluid per stool, which is the proportion it is proposed to use in practice.

It was found in all cases that an immediate deodorisation took place, and with higher strengths, the formation of a froth, and the disengagement of pungent chlorine.

The liquid itself, when the solid matter is allowed to subside, seems to be quite sterile, but all the more solid lumps of fæcal matter remain undissolved, even with a strength of 1 grm., and even after a week's soaking. During this time the active chemical principle is being slowly destroyed and rendered inoperative, and at the same time there is slight surface disintegration of the fæcal matter, thus exposing and setting free the more central portions which have not been in intimate contact with the active fluid originally used, and which have not therefore been sterilised ; these find themselves in a liquid in which all the available chlorine has been used up, and so begin to grow and disseminate themselves throughout the liquid.

This we have proved, not only by making cultures of the more solid flakes of fæcal matter, floating in an apparently sterile fluid, in which case we obtained typical sewage organisms† (afterwards obtained in the pure state), but also by making cultures of treated stools after a week's soaking. In this case it was found that the mixtures in which the strengths 0·25, 0·50, and 0·75 had been used had not remained sterile, whilst the gramme strength was still sterile. A series of London sewages examined under exactly similar conditions had remained sterile with all four strengths used in volume equal to that of the sewage. In this case the dilute sewage was merely a watery liquid, and an intimate contact with the disinfectant was at once assured.

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* British Medical Journal, No. 1745, June 9th, 1894, p. 1254.

† Bacillus coli communis and Bacillus mesentericus vulgatus.

This last series, as well as the sterility of the fluid used at a gramme strength, prove that the non-sterility of the fæces dosed with 0·25, 0·50, and 0·75 was real, and due to the interior of the solid lumps being protected from the disinfectant and not due to any accidental air contamination.

This conclusion is supported by the researches of Dr. Alain Piton, who made an important investigation of this process when working at Brest.*

He finds that a solution of a grm., used in the proportion of 6 litres to a stool, only sterilises the outside portions. The central parts are not acted on by the antiseptic, for he says: "Les quantités d'eau determinés par les expériences antérieures, pour la sterilisation d'une selle dure, ne sterilisent que la surface des matières. Les parties centrales ne subissent pas l'action de l'antiseptique."† He also concludes: "Que son pouvoir dissolvant des matières fécales et du papier semble nul."§ Moreover, it was found that the deodorisation effected by a solution of only 0·25 strength was only temporary, the solution losing its antiseptic powers in the chemical act of deodorisation. Such deodorised fæces or sewages afterwards develop a putrefactive odour on keeping.

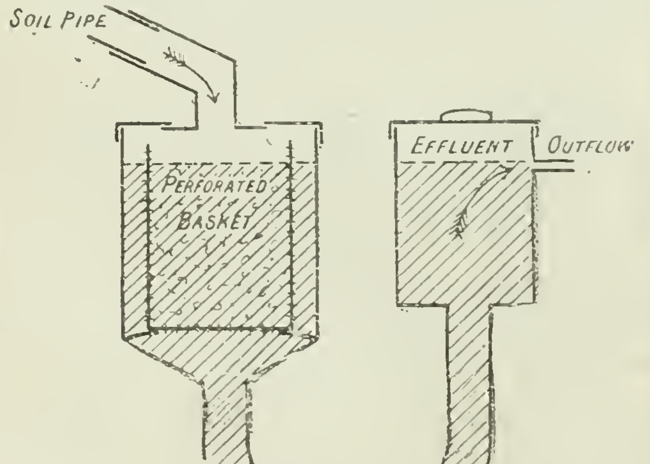
### *Experiments with Fæcal Matter on a Larger Scale at Worthing.*

Before going further, it will perhaps be as well to describe the arrangements made at Worthing for the actual application of the electrolysed sea-water for the disinfection of the water-closets and drains utilised for the demonstration. As already stated, the electrolysed sea-water was supplied to the water-closets of 14 cottages and also to two public water-closets. These latter contained the usual two-gallon flushing tanks with ordinary ball-cocks, and at every flush the liquid with its quota of fæcal matter flowed for a few yards along a channel of glazed half-pipes, cemented together, and emptied itself vertically downwards into a perforated galvanised iron "basket."

### *Description of the Syphon.*

The perforated basket was placed in the widened end of a galvanised iron U-tube (Fig. 4), the other end of which had a side opening, through which the effluent escaped into the drain. By this means the perforated basket and its contents were always immersed in the disinfecting liquid contained in the U-tube, and so the fæcal matter and paper were stated to become gradually disintegrated, and be carried forward, *viâ* the U-tube, into the drain at every flush of the water-closets.

Fig. 4.



Section of the "Syphon." §

This portion of the plant, called the "syphon," and the retaining of the fæcal matter and paper in contact with the disinfecting fluid for a certain length of time before passing into the drain, was claimed as an *essential detail* of the Hermite process.

The two public water-closets were provided with a syphon close by, in the same yard, and the effluent flowed into the common drain of the 14 cottages, the combined sewage wash-water and rain-water from which flowed into another siphon in another yard.

It is to be regretted that, owing to there being no arrangement for disinfecting the house wash-water and other refuse emptied down the sinks as distinguished from that flowing from the water-closets of the 14 cottages (which is supposed to be done in a perfect scheme), no experiments were deemed advisable with this second syphon.* Accordingly, the other syphon, receiving fæcal matter only, from the two public water-closets was alone experimented with.

The experiments with the two water-closets were carried on continuously for a week and were directly under our own control at every stage. During this time the water-closets were in constant use by workmen employed on the new drainage works close at hand.

The electrolysed sea-water was sent up to the store tanks at a uniform strength of 0·8 grm. per litre, a figure arrived at by a consideration of the foregoing experiments on cultures and fæcal matter.

Plate cultivations and broth cultures of the effluent were frequently made with several quantities graduating from a sterile platinum loop full of fluid to 1, 2, 3, 4, or 5 cc., taken from the syphon direct at the outflow by means of a sterile graduated pipette and at once introduced into sterile gelatine tubes or broth tubes, and it was always found that the effluent was perfectly sterile, with the exception of a few (less than half a dozen per cc.) spores of bacillus subtilis or bacillus mesentericus vulgatus which alone had survived.

At the end of the week's test, the previously sealed syphons were opened and it was found that deodorisation was perfect, but that a very large amount of undissolved fæcal matter and paper was present in the intercepting basket, so much so, that the mass was stirred with difficulty with a stout long stick, and the syphon would soon have become choked, if means had not been taken to get rid of the solid matter. This matter was partly broken up, after cultures of the effluent had been made, and the fæcal matter flushed down the drain with fresh electrolysed sea-water.

The resulting effluent was very foul-looking, and contained a large amount of suspended matter, and it was found not to be sterile, yet, after a week's keeping, a sample of this turbid effluent had undergone no putrefaction, and had scarcely any, and certainly no offensive odour.

It is evident, therefore, that any mere chemical analysis of the effluent flowing away into the drain during these experiments would not only be useless, but misleading, as a very large proportion of the fæcal matter was retained in the intercepting basket and this, an analysis of the effluent would leave out of account.

### *Conclusions.*

(1.) Electrolysed sea-water of half a grm. strength which M. Hermite proposes to use, is very unstable, and loses over 90 per cent. of its strength in 24 hours, and is then quite useless as a disinfectant.

(2.) A dynamo giving a current of 250 ampères at a pressure of 6 volts, must run about 2½ hours in order to make 220 gallons, or 1,000 litres, of electrolysed sea-water of a strength of half a grm., whilst it takes nearly five hours to make a solution of 0·75 strength.

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* Expériences relatives a l'eau de mer electrolysée systeme Hermite. Rapport fait au conseil municipal de Brest par Le Dr. Alain Piton, ancien élève de l'institut Pasteur. Rue Bergère 20, Paris.

† p. 32. ‡ p. 38.

§ This diagram is not drawn to scale.

* This matter is referred to in the report of the "Lancet" Special Analytical Sanitary Commission (Experiments at Worthing). The "Lancet," No. 3,691, May 26th, 1894, pp. 1326—1329.

(3.) A solution of 0·75 or 1·0 grm. strength is much more stable than a solution of 0·5 grm., for whereas a 0·5 grm. solution loses 90 per cent. in the first 24 hours, a 0·75 grm. solution loses 34 per cent., and a 1·0 grm. solution less than 10 per cent. during the first 24 hours.

(4.) The Hermite fluid even of a grm. strength seems quite incapable of sterilising a broth culture of bacillus subtilis containing mature spores. This is true when the solution is used in 10 times the volume of the culture, and allowed to act for 2½ hours.

(5.) In a large series of experiments on bacillus coli communis in artificial broth cultures, a strength of 0·25 grm. is only effective when used within half an hour after it is made (owing to its great instability) and only then if used in very large volumes (1 : 10).

(6.) A solution of 0·25 grm. strength is practically useless six hours after making owing to its instability.

(7.) A solution of 0·5 grm. strength is only effective when used within half an hour, after being prepared, if twice the bulk of the culture is used, whilst, if used six hours after making, at least five times the volume of culture must be used. Whilst if not used within 24 hours the solution becomes valueless.

(8.) A solution of 0·75 grm. strength is effective in half an hour, when an equal bulk is used on a broth culture of bacillus coli communis, whilst if not used within 24 hours, at least twice the bulk of the solution is needed to produce sterilisation in half an hour.

(9.) A solution of 1·0 grm. strength is effective in half an hour with equal volumes, even when the solution is 24 hours' old, but even this high strength in large volumes (1 : 10) will not sterilise mature spores of bacillus subtilis.

(10.) The Hermite fluid of even high strengths is incapable of destroying, or even dissolving solid fæcal matter, and will not sterilise the interior of hard stools, even after prolonged soaking.

(11.) The Hermite fluid, even of 0·25 grm. strength, acts as an excellent deodoriser.

(12.) A week's test, under own control, with the two public water-closets at Worthing, and using a solution of 0·8 grm. strength throughout, shows that the effluent is practically sterile, only spores of bacillus subtilis or bacillus mesentericus vulgatus surviving, apparently; but it must be noted that a large amount of solid fæcal matter and paper remained in the intercepting basket undissolved, and if this is mechanically broken up, and flushed down the drain, with fresh electrolysed sea-water, the resulting effluent is not only foul-looking but not sterile, and contains a large amount of organic matter.

## Discussion.

Mr. A. E. Fletcher thought that the value of a process could only be brought out by comparison with other methods of approaching the same object, and such a comparison might be drawn between the efficiency of the Hermite process and one or other of the more simple chemical methods of sewage treatment and purification. The Webster process for the electrolysis of sewage introduced a different element, in that iron plates were used as galvanic terminals. As alkaline chlorides were present in the solution treated, hypochlorites were formed; also some of the iron from the positive terminal came into solution and acted as a precipitant; the effluent was thus clarified and rendered inodorous. Evidently the electrolysis of sea-water would give hypochlorites, but it might be questioned why in the Hermite process sea-water should be added to sewage when there was already so much dissolved chloride in it. Would not the addition of some bleaching powder be a cheaper method of introducing hypochlorite?

Dr. W. S. Squire remarked that one of the most curious points was that the weaker the solution the more unstable it became. That was not the general experience in matters of a similar kind. The further the decomposition went the more alkaline must the solution become; and he suggested that the greater stability of the more highly electrolysed liquid was probably due to its becoming more alkaline, less prone to decomposition, and therefore tending more to the formation of hypochlorites than the production of chlorine. The area of the platinum gauze used was not stated; and this was important, first as affecting the cost of the plant and secondly as conveying an idea of the intensity of the current used. The intensity must have been fairly high because so great a pressure as six volts was required. A Board of Trade unit (1,000 watts) provided it consisted of 1,000 ampère hours at a pressure of one volt would be sufficient to liberate 1,320 grms. of chlorine: and if the process were carried on for one and a half hours it should liberate about 2,000 grms. of chlorine; as the current employed was only 250 ampères that would be equal to a production of 500 grms. of chlorine. But 750 litres contained only half a grm. of chlorine per litre, so that the theoretical amount was nearly 50 per cent. more than what was actually obtained, thus showing a heavy loss. The process seemed to him to be really a very cumbrous and expensive way of making chlorine, seeing that the author did not claim that the resulting liquid would do any more than a solution of bleaching powder would do; and certainly at the present price of bleach, and taking into consideration the cost of the plant, platinum, &c., the cheapest plan would be to use chlorine in that form.

Mr. E. J. Bevan said, referring to Dr. Squire's statement, that it would be as economical to add bleaching power to sewage as to make chlorine from sea-water, it was pointed out long ago that if a solution of bleaching powder were compared with a solution of electrolysed magnesium chloride of equal strength that the latter would have far more oxidising effect on colouring matters; and it was quite conceivable that in this process the electrolysed solution would be superior in its action on sewage. It did not follow that because the chlorine was present as hypochlorite it had the same action as hypochlorite made in another way. For instance, if chlorine were passed into milk of lime, calcium hypochlorite was produced, but a solution of this had by no means the same bleaching efficiency as a solution of similar strength made by dissolving bleaching powder in water. He was surprised to hear from the authors that the solution underwent change so rapidly. That was not his experience when he used the process some years ago in connection with the bleaching of paper pulp; but then magnesium chloride only was used, not sodium chloride as in this case. He would much like to hear whether the authors had made any experiments with a solution of bleaching powder of the same strength as the solution described in the paper.

Mr. Bertram Blount believed that it was shown in the evidence collected by the "Commission" appointed by the "Lancet" that a solution of magnesium hypochlorite obtained by electrolysing sea-water contained a good deal of free hypochlorous acid, and it was further shown that if carbonic acid were passed into bleaching powder, hypochlorous acid was liberated, and a solution was thus obtained which had substantially the same effect as electrolysed magnesium chloride. That would account for the greater efficiency which Mr. Bevan had found in electrolysed solutions as compared with solutions of bleaching powder. Another point on which he would be glad to be enlightened was the loss of strength of weak solutions, prepared by the Hermite process, containing, for example, 0·5 grm. per litre. It occurred to him that as ordinary sea-water contained organic matter, a good deal of current was used up in oxidising that organic matter. He wished also to know whether the authors had found any other oxidised products due to the electrolysis, such as chlorates, or whether the total chlorine was produced as hypochlorite. If, at ordinary temperatures, chlorate was formed, it would mean loss of chlorine and horse-power, since the chlorate produced would be entirely stable and valueless as an oxidising agent. That might account for the discrepancy between the available chlorine liberated and that calculated from the current used.

Mr. F. Scudder thought the author had made it perfectly clear that the Hermite process was *not* a process of purification, and in that respect it differed essentially from the Webster electrical process. He quite agreed with Mr. Fletcher that if the Hermite process had claimed to be a system of purification it would be well to compare the results of the process with those produced by bleaching-powder or other chemicals. As matters were, such comparison was not necessary, for Sir Henry Roscoe had made it quite clear that the Hermite process was of no use in dealing with sewage. Sanitary authorities had to comply with the Rivers Pollution Prevention Acts, and in order to meet the requirements of these Acts had to remove by purification the solid and liquid sewage. Not one word had been said as to the removal of organic matter. They knew the effect of adding bleaching powder to sewage. At the rate of three grains of "available chlorine" to a gallon of sewage every million gallons of sewage would cost 80*s.* for bleaching-powder alone, and the result so far as purification was concerned would be unsatisfactory. The authors, however, had experimented on solutions containing at least 0·5 grm. per litre, equal to 35·0 grains of "available chlorine" per gallon, and he could not imagine any authority attempting to deal with a town's sewage at such a cost as that would entail even if the authors' results had been more favourable.

Mr. W. F. Reid asked whether Sir Henry had traced the path of the chlorine which so mysteriously disappeared, as it seemed essential to the success of the process to find out what became of it. Also whether any experiments had been made at Worthing on the action of the effluent on plant life, and whether the arsenious acid test gave a correct indication of the action of the electrolysed products on the sewage germs.

Mr. H. de Mosenthal remarked that the results of the experiments described went to confirm the known fact that spore-bearing bacilli, and those alone, will live in sea-water.

Sir Henry Roscoe, in reply, said that he had not made any experiments with the object of comparing the Hermite process with any other process for treating sewage. He quite agreed with Mr. Fletcher as to the value and importance of such a comparison, but so far, all his experiments had been made simply with a view to understanding the Hermite process itself. He did not think that the theory put forward by Mr. Blount as to the organic matter in sea-water would hold good. With regard to the amount of voltage, he agreed with Dr. Squire that there was the very considerable loss of 50 per cent. That, however, was Mr. Hermite's affair. They had taken his method as it stood, and the apparatus was left in the charge of his own representative in order that, according to their statements, the best results of the process might be obtained. He had not said that there were no results from the system. It had proved to be effective as a *deodoriser*, but it was not applicable as a process of sewage *purification*. He had not gone into the question of the formation of chlorates, nor as to the action of the treated sewage on plant life.

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Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1894–95.

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*Meeting held Wednesday, February 6th, 1895.*

MR. EUSTACE CAREY IN THE CHAIR.

## PORTABLE RAILWAYS FOR WORKS.

BY J. WALWYN WHITE.

I have often been impressed, in going through various works all over this country and in America, with the large amount of waste of manual labour and steam power that one sees in all directions, more particularly in manual labour in this country.

One of the great forms of waste that I refer to, is in the transportation of materials, both raw and finished, from one part of the works to another, and from that portion of a works or factory where an article is finished, to where it is shipped for sending away.

In a modern engineering works or electrical factory one sees immense overhead travelling cranes throughout nearly every department, running the whole length of the shed, rapidly and cheaply conveying goods from one end to another, with an enormous saving of time and labour. This is undoubtedly a step in the right direction, but, unfortunately, the "travel" of a crane is limited by the length of the gantreys, and I have not seen one yet that would go round a curve and travel from one shop to another, and, besides, the whole deadweight of the crane has to be moved, whether the article to be conveyed weighs 1 cwt. or 10 tons—so that even here a large amount of power is lost.

I propose to draw your attention this evening to the advantages to be gained by using a system of light or portable railways throughout a works or factory, instead of using barrows or trucks running on the ordinary ground with manual labour.

Mr. J. Head, of Middlesbro', once said (Dublin meeting, Inst. Mech. E., August, 1888):—"There is no more unsatisfactory way of spending money in a works than in moving material backwards and forwards, and there are not many things that act more unfavorably on dividends."

The tractive force of horses, according to Molesworth, is as follows:—

| Rate in Miles per Hour.... | 2 | 3 | 3½ | 4 | 4½ | 5 |
|---|---|---|---|---|---|---|
| Tractive force exerted by horse, in pounds ....... | 166 | 125 | 104 | 83 | 62 | 41 |

The coefficient of traction as given by Molesworth, or resistance in lbs. per ton load exclusive of gravity.

| | | | |
|---|---|---|---|
| On railway, at 10 miles an hour | 6·9 | lbs. per ton | on level. |
| On railway, at 20 miles an hour | 9·6 | ,, | ,, |
| Stone tramway | 20 | ,, | ,, |
| Paved roads | 33 | ,, | ,, |
| Macadamised roads | 44 to 67 | ,, | ,, |
| Gravel | 150 | ,, | ,, |

Wind, curves, or imperfections of the road will very largely increase the resistance, probably by 50 per cent.

From other authorities I take the following table of resistance to traction :—

The resistance to traction of a cart or wagon on the level, in proportion to the whole weight is—

$\frac{1}{280}$ on railways.
$\frac{1}{180}$ on granite tramway.
$\frac{1}{150}$ on asphalte pavement.
$\frac{1}{110}$ on underground colliery tramroads, with 12-in. wheels on round-topped rails.
$\frac{1}{80}$ on street tramways with grooved rails.
$\frac{1}{60}$ on wood pavement.
$\frac{1}{55}$ on underground colliery tramroads with 8-in. wheels on angle-rails L.
$\frac{1}{50}$ on good macadamised roads.
$\frac{1}{25}$ on dry hard turf.
$\frac{1}{12}$ on gravel and broken stone roads in bad condition.
$\frac{1}{10}$ on fields.

Thus we see the enormous gain in tractive power by using railways.

Resistance due to gravity must be added in case of inclines, in accordance with the following formula :—

$$R = 2{,}240 \ \frac{1}{G}.$$

where R = Resistance in pounds per ton of gross load.

$\frac{1}{G}$ = rate of gradient.

To show the gain in using a portable railway over wheelbarrows and planks I give the following instance :—

With a portable railway, say of 2-ft. gauge and tipping equilibrium trucks, a man will easily take 20 cubic feet of earth, a distance of 200 yards, tip it, and return with the empty wagon inside of five minutes, whilst a man with wheelbarrow and planks would require over an hour to do the same work.

Supposing the labourer's wage to be *5d.* per hour, the cost with the railway would work out to about *½d.* per cubic yard, against nearly *6d.* with the barrow.

This would result in a week's work, if 12 tipping trucks were used, moving say 6,000 cubic yards of material, costing about 12*l.* on the portable railway and about 150*l.* on the primitive method.

The 200 yards of portable railway and 12 tipping trucks would cost about 105*l.*, whilst 125 barrows and planks would cost about 95*l.*, so that the capital cost of the two systems would only be about the same.

These figures are very instructive, and I would ask every works manager to lay them to heart, in these days of close competition, when it is only by savings like these that positive loss can, in some cases, be avoided.

A great feature in the use of narrow-gauge tramways is the very large proportion of live or paying load, to the dead load.

In an ordinary railway waggon of standard gauge the carrying power varies from 1½ to 2 times the dead weight, and the same proportion holds good with the instance I have just given of wheelbarrows, but on a 2-ft. gauge railway a well designed truck will carry about four times its own weight.

As an instance of the use of these light railways I would mention amongst others the 18-in. gauge railway at the London and North-Western Railway Works at Crewe, the same gauge at the Woolwich Arsenal, the 22-in. gauge at the great brewery of Messrs. Guinness and Co., and the 18-in. gauge railway at the Lancashire and Yorkshire Railway Works at Horwich.

The first example I have given is especially instructive, seeing that the railway company have miles of standard-gauge railway all over their works, and yet it is found advantageous to have the narrow railway in addition.

The small engines are employed not only to draw narrow gauge trucks, but also main line waggons, and even engines and tenders on the standard gauge, from one shed to another, and those of you who may have seen it, must have been reminded of the old fable of the lion and the mouse, the contrast is so great between the little engine and the huge load behind it.

Here are some details of these engines, kindly supplied by Mr. Webb :--

| | |
|---|---|
| Cylinders | 5½ ins. diam. by 6 ins. stroke. |
| Wheels | 16¼ ins. diam. |
| Wheel base | 3 feet. |
| Total length of engine | 8 ft. 8 ins. |
| Height from rail level to centre of boiler | 2 ft. 11¾ ins. |
| Length of boiler between end plates | 5 ft. 3 ins. |
| Diameter of boiler (outside) | 2 ft. 3 ins. |
| Heating surface | 57·91 sq. ft. |
| Grate area | 1·50 sq. ft. |
| Boiler pressure | 160 lbs. per sq. inch. |

There are no eccentrics or link motion for working the valves, these being driven from small cranks at the end of a countershaft, and the gearing is so arranged that the valves can be readily moved from "Forward" to "Backward" motion, by means of a handle placed at each end of the locomotive, so that the driver can always stand in front of his engine, whichever way it is working.

With regard to the Lancashire and Yorkshire Railway Company's system of 18-in. gauge railway at their new works at Horwich, there are no curves of more than 13 ft. radius. The engines have 5 ins. diam. cylinders by 6 ins. stroke; width is 2 ft. 3 ins., outside centres; wheels, 16 ins. diam.; wheel base, 2 ft. 9 ins.; boiler, 2 ft. 3 ins. diam.; heating surface, 10·42 sq. ft. in the fire-box, with 36·12 sq. ft. in the tubes.

I may add a short description of the tramway at Messrs Guinness' Brewery in Dublin. (See also S. Geoghegan, Engineering, October 12, 1888.)

### *Essentials in Designing the Line.*

Gradients not to exceed 1 in 40.

Curves as slow as possible (down to 12 ft. radius).

Rolling stock to be as large as room available. 5 ft. wide, 6 ft. high. Waggons not to exceed 8 ft. in length, and wheel base 3 ft.

To connect the old works with the new, one being 50 ft. above the other, a spiral tunnel is used of 61 ft. 3 in. diam., with 2·65 turns and gradient of 1 in 40, giving a rise of 35 ft., the remaining 15 ft. rise being effected by means of a zig-zag incline.

Instead of using turntables and points and crossings, circles and triangles are used to change the direction of the engine, so obviating shunting, &c., and saving a lot of time.

Owing to the sharpness of the curves that can be used, down to 12 ft. radius, these do not take up much room. A very ingenious arrangement, called a haulage truck, is used for the standard broad gauge, to save the necessity of a broad-gauge engine.

A truck running on the ordinary broad gauge is used, having four extra friction wheels, mounted on countershafts. The narrow-gauge engine is lifted by a crane on to the haulage truck, so that its driving wheels rest upon the four friction wheels, these latter revolving when the engine wheels are driven, and are connected by pinion wheels on the countershafts, gearing into spur wheels on the main axles, the gearing being 2 to 1, and so driving the truck.

The weight of the haulage truck is about 9 tons, that of the engine being over 7 tons, making in all over 16 tons, which gives greatly increased tractive power for the broad-gauge traffic, although, of course, the speed is correspondingly reduced.

I would especially draw the attention of the works manager to the great convenience and economy of the system of conveying loaded waggons of the standard gauge from one part of the works to another, even without the use of narrow-gauge trucks, with narrow gauge locomotives.

In many works in Widnes and elsewhere, even now, the loaded coal waggons, weighing in all some 15 tons or so, are moved from one point to another by horses, or a gang of men armed with crow-bars and levers, involving a serious loss of time and expenditure of labour, whereas a small locomotive, having say $5\frac{1}{2}$-in. cylinders and 3-ft. wheel base, as just described, would haul double the load at five times the speed and less than half the cost. The actual cost of the small locomotives at Crewe is about $\frac{1}{10}$*d.* per engine-mile.

I would even recommend the use of these narrow-gauge engines in some of the works at present using standard-gauge locomotives, where the traffic is light. As the great weight of a large locomotive involves the loss of a large proportion of power in moving the locomotive alone, with a consequently increased coal bill, to say nothing of the heavier wear and tear on the permanent way, especially round the sharp curves, necessary in a works, where the lines are very much torn up by the strain of an engine weighing some 15 or 20 tons, on four wheels (say 10 tons per axle), grinding its way round a 50 ft. curve.

An 18-in. or 20-in. gauge locomotive would move the traffic just as easily, on a coal and repairs bill less than half of the other, go round much sharper curves, and require less headway than a coal waggon, a great advantage when going through sheds, &c.

For purposes of comparison, I give particulars of four sizes of four-wheel coupled narrow-gauge locomotives suitable for works traffic.

| Diameter of Cylinder. | Length of Stroke. | Diameter of Wheels. | Wheel Base. | Water Capacity. | Fuel Space. |
|---|---|---|---|---|---|
| Ins. | Ins. | Ins. | Ft. Ins. | Galls. | Cub. Ft. |
| 4 | 8 | 16 | 2 9 | 80 | 7 |
| 5 | 10 | 20 | 3 0 | 80 | 8 |
| 6 | 12 | 27 | 4 0 | 100 | 10 |
| 7 | 14 | 27 | 4 6 | 150 | 12 |

| Haulage on Level. | Haulage on 1 in 50. | Weight in Working Order. | Suitable Weight of Rail. | Approximate Price. |
|---|---|---|---|---|
| Tons. | Tons. | Tons. | | £ |
| 38 | 8 | $4\frac{1}{2}$ | 16 lbs. to yd. | 350 |
| 60 | 16 | 5 | 18 „ | 385 |
| 90 | 22 | 7 | 20 „ | 500 |
| 120 | 32 | 9 | 25 „ | 575 |

It is rather a strange fact, but nevertheless true, that the tractive power of these little locomotives is greater in proportion to their weight, than that of a standard-gauge locomotive.

In the latter, the coefficient of adhesion, with a weight of 12 to 16 tons per driven axle, it is about one-sixth of the total weight on the driving wheels.

The late Mr. Spooner found the co-efficient of his 1 ft. $11\frac{1}{2}$ in. gauge locomotives on the Festiniog Railway, with a weight of 5 tons per driven axle to be one-fifth.

Mr. Percival Heywood, of Derby, found it to be 3·9 on his 15 in. gauge railway, with an engine of his own build having a weight of about 1 ton per driven axle, all six wheels being coupled.

His engine weighed 3 tons 2 cwts. in all, and he took a load of 4 tons up a gradient of 1 in 10 a quarter of a mile long, having a short curve of 33 ft. radius at its severest part where the gradient was about 1 in 9.

Mr. Heywood's theory for this increased tractive force is as follows, which I take verbatim from his interesting pamphlet :—"A wheel rests upon the rail on one point or possibly on a transverse line of which the length is equal to the width of the rail. With a small insistent weight the molecules of the wheel and rail interlock without injury, and adhesion, on the principle of an infinitesimal rack and pinion, is the result."

"As the weight is increased on this small bearing area the molecules of the rail and wheels become disturbed, and fail to offer so firm a fulcrum ; ultimately they become displaced and move as rollers between the two surfaces, materially reducing the adhesion."

If this theory be the correct one, the reduced adhesion for larger weights would be accounted for, and it would also account for the well known fact that a skidded wheel offers less resistance to the stopping of a train than a wheel which is braked to the bare point of skidding. In the latter case this microscopic action of rack and pinion is still going on.

I have no recent figures of coal required per ton mile on narrow gauge lines, but at a recent trial on the London and North Western main line railway of 4 ft. $8\frac{1}{2}$ ins. gauge, with ordinary engines, the consumption of coal per mile, per ton weight of train (including the weight of the engine) was 1·62 ounces on a straight run, whilst with Mr. Webb's compound engine, the consumption was only 0·969 oz. (showing an economy of 23·2 per cent for the compound engine).

These figures would of course be exceeded on a narrow-gauge locomotive, but not to such an extent as one might at first imagine, owing to the greatly reduced speed, provided of course the railway track and rolling stock were kept in good condition, and journals properly lubricated. Probably if the quantity of fuel were doubled, I should be well within the mark by saying $2\frac{1}{2}$ ounces of coal per ton mile or about $\frac{1}{120}$ part of a penny for fuel.

It is found that 4 cwts. of coal is sufficient for a full day's work of 24 hours with Mr. Geoghegan's special engines at St. James' Gate Brewery, having cylinders 7 ins. diameter by $8\frac{1}{2}$ ins. stroke.

The working pressure of steam is 180 lbs. per square inch, and the weight of the engine $7\frac{3}{4}$ tons. These engines will haul a load of 120 tons on the level at a speed of 10 miles an hour, or a load of 25 tons up a gradient of 1 in 40, including the weight of the engine itself.

Having said so much as to the many advantages of narrow gauge railways I will briefly describe the permanent way for such a road.

There are two types of track in use, one system being laid permanently, the other only temporarily, the portable railway.

The permanent line should be well laid, on a properly prepared formation, and properly boxed and ballasted after being laid. I have occasionally heard the narrow gauge railway abused and deprecated, but when I have enquired into the reason I invariably find that the line in question has been literally thrown down on the ground surface, with little or no preparation of the roadway, and very little ballasting, the rails being generally too light for the work, causing them to spring up in the centre, the ends being depressed and so making bad joints, whilst the rails have been simply spiked down directly on to wooden sleepers, too thin to bear the weight of the load, or to afford sufficient holding power for the spikes, which consequently draw, allowing the rails to work loose and the gauge to spread.

It must not be forgotten that as the width of the rolling stock is from three to four times the gauge on these narrow railways, against about $1\frac{1}{2}$ times on the standard gauge, any inequalities of the road are more exaggerated, and the importance of having the road well maintained increases as the gauge decreases.

Steel rails should be used having a tensile strength of about 38 tons per square inch, with 17 per cent. of elongation and 38 per cent. contraction at the point of fracture, and having a proportion of about 0·35 carbon.

The rails should be of ample strength to carry the loads required, and for a well-designed rail a good rule is as follows :—

"Twelve times the greatest load on one wheel in tons gives the weight of rail in pounds per lineal yard."

The sectional area of rail in inches multiplied by 10·4 gives the weight of a steel rail in pounds per lineal yard.

To keep the rails tight to the sleeper and prevent all fear of the gauge spreading, metal transverse sleepers of some kind are almost imperative, wood being generally unsuitable for several reasons, amongst which I may mention the following:—

*Firstly.*—Wood is more subject to variations of weather and temperature than metal. Heat dries it up, wet expands and softens it, causing the fastenings to draw out, and the rails to "spread gauge."

*Secondly.*—The wood under the rail seat rapidly disintegrates under the vibration of passing loads, causing the rail to rapidly sink into the timber, more or less unequally, and so causing the rails to get out of plane.

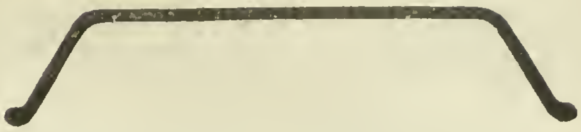
*Thirdly.*—Wood sleepers are liable, and often do, catch fire from the ashes that fall from the locomotive.

*Fourthly.*—Wood sleepers will never outlast a properly-designed steel rail, so that in the course of a few years it is found necessary, in most cases, to take out the old sleepers and put in new ones, under the half-worn rails.

Regarding the shape of the sleeper, this is a vexed question, and has not yet been settled.

The general opinion is in favour of the inverted trough. These, however, require careful packing, and are not suitable for hard ground.

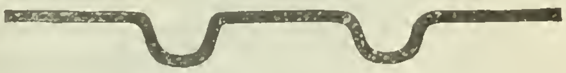
Fig. 1.



Section of Inverted Trough Sleeper.

Then there is the corrugated sleeper, as shown in the accompanying illustration.

Fig. 2.

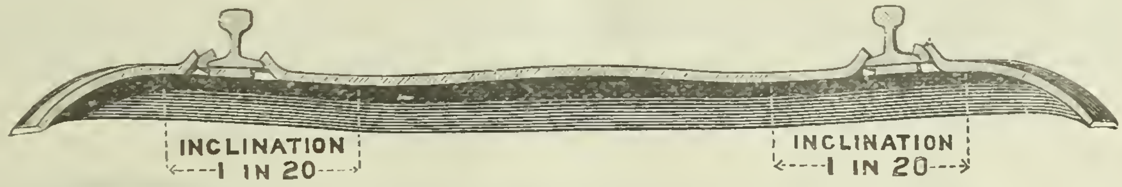


Section of Corrugated Sleeper.

This is a sleeper easily laid and packed, but it has not much "girder" strength, and is liable to buckle under heavy loads.

Then there is the bellied trough sleeper adopted by the Indian States Railway, the ends being closed in to prevent spreading of the ballast.

Fig. 3.

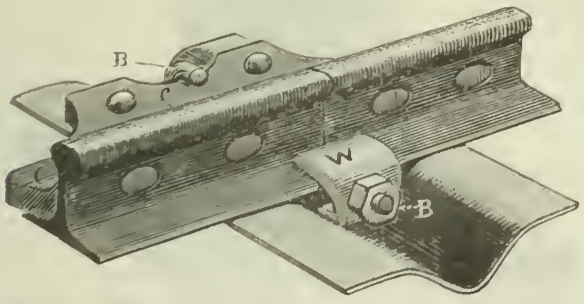


Trough Sleeper, with Closed Ends and Wedge Fastening, Indian States Railway Pattern.

The buckled shape adopted by Decauville is fairly good, but has the disadvantage of weakness of the ordinary corrugated sleeper.

The wide V-shape which I have adopted is fairly satisfactory; it is easily packed, has a great proportion of cross strength owing to its double angle shape, makes an easy running road, and the ballast does not work from underneath it. Some of these sleepers have been laid down on the North Staffordshire Railway for about eight years, and have required no attention whatever since they were laid.

Fig. 4.



Perspective View of Improved Fishjoint Sleeper, Class D 1, Wide V-shape Sleeper.

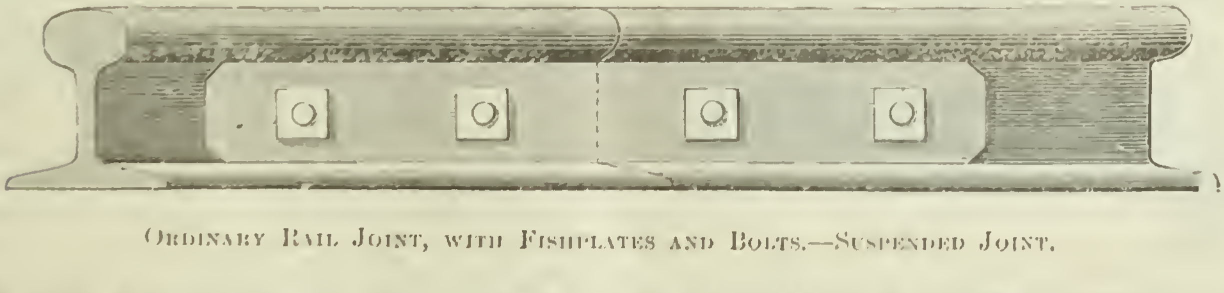
Another form of metal sleeper is the cast-iron sleeper of Mr. Heywood. It is very similar in form and fastening to the Indian States Railway pattern, being of the inverted trough shape, the ends being closed in, and the rail held by two lips cast in the sleeper, and secured by a steel key.

For joints in the rails there are two types, the "suspended" joint and the "supported" joint.

The "suspended" joint with angle fishplates and fishbolts and nuts is undoubtedly the better where the rails are heavy enough to allow of a considerable margin for the load and the speed is high, but where the rails are only just heavy enough for the load, then a "supported" joint should be used.

There are several types of supported joints in the market, each having its own special advantages.

Fig. 5.



Ordinary Rail Joint, with Fishplates and Bolts.—Suspended Joint.

For all round work I prefer the joint known as a "fished" joint, and is the only supported joint which, so far as I am aware, fastens the rails to each other, thus preventing "creeping" of the rails down an incline. It makes a good joint, and only requires one bolt and nut, against the four required on an ordinary fish joint. There is a great diversity of opinion as to the best mode of fastening the rails to the sleepers; it is difficult to assign the superiority to any one system.

The Indian States Railway have simply two lips pressed out of the metal, one on each side of the rail flange. The outer edge of the rail flange engages under one lip, whilst a wedge is driven up between the other rail flange and the other lip.

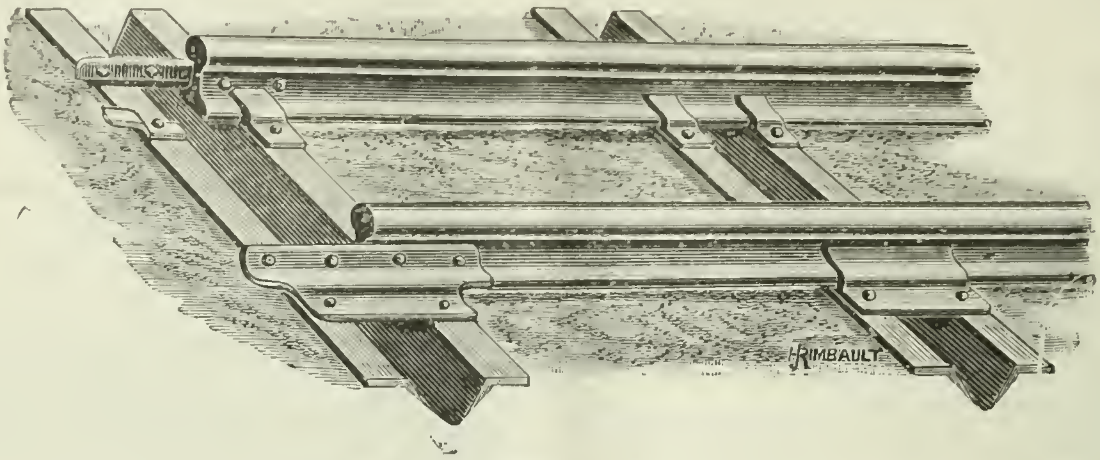
This wedge, however, is liable to work loose under the vibration of working.

Other fastenings have a lip pressed out on the outer side of the rail, whilst the inner flange is secured by a bolt and nut and wedge-shaped rail clip.

Others again use a dog or lip riveted on to the sleeper in lieu of the raised lip pressed out, with either a bolt and nut or wedge fastening on the inside.

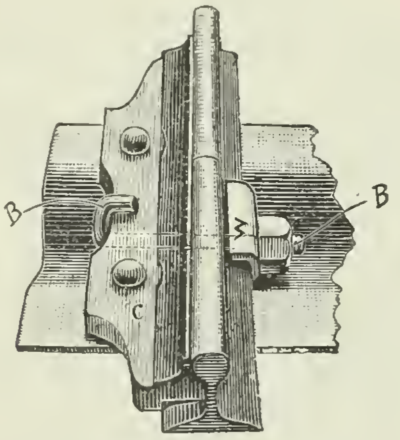
Another fastening again has the lip, or dog, riveted on the sleeper for the outer fastening, whilst a clip of steel having one corner slightly turned up is loosely riveted to the sleeper. This clip is hammered round on to the inner flange of the rail, the turned-up corner giving it a start, whilst the rest of the clip has to "spring" the thickness of the flange.

Fig. 6.



Fishjoint Sleeper, Class D, and Intermediate Sleeper, Class B, Supported Joint.

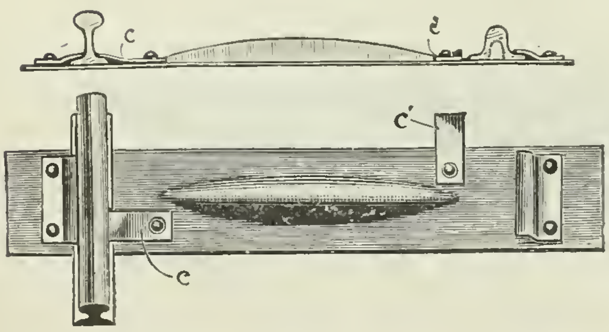
Fig. 7.



End Perspective View of Improved Fishjoint Sleeper, Class D 1.

Fig. 8.

Elevation.

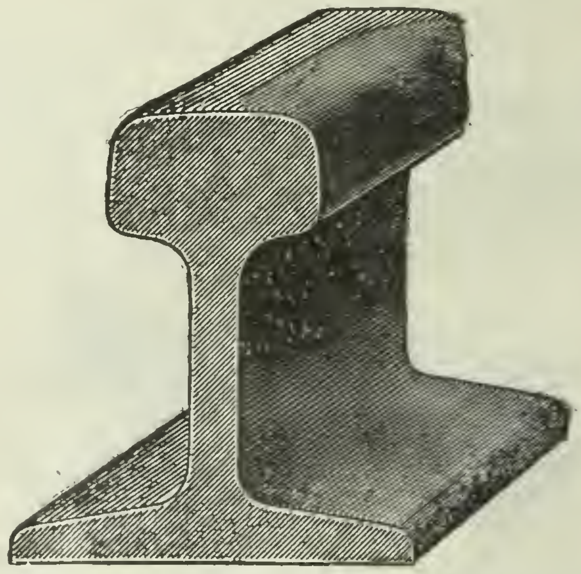


Plan of Buckled Sleeper for Hard Roads, Class B.

This forms a good "live" fastening, the "spring" of the clip taking up the wear of the rail and always holding it tight, saving the objection to the bolt or wedge fastenings, which have to be constantly tightened up.

Regarding the weight of rails to be used for our supposed works, I think for heavy traffic they should not be less than 18 lbs. per lineal yard to the section shown with a gauge of 18 inches. It is as well to have the gauge as narrow as convenient, and an 18 inch gauge will carry any ordinary traffic that is likely to be required. The narrow gauge has the advantage that the roadway takes up very little room, will go round sharp curves as low as 12 feet radius, and readily goes through doorways into sheds, &c., right alongside the boilers and furnaces, where coal can be deposited exactly where required, either on the level or, in many cases where it is desirable, along wooden gantrys at an elevation, say, of 8 or 10 feet, out of the way of any other traffic there may be.

Fig. 9.



The cost of such a railway with steel rails 18 lbs. per lineal yard, steel sleepers, and all fastenings would be about 265*l*. per mile complete. With wood sleepers the price would be less, but I do not recommend these, unless in exceptional cases, for reasons I have already named, and the charge for yearly maintenance would be much higher. To this would be added the cost of laying, ballasting, &c., say, 250*l*. per mile, rolling stock and sundries 235*l*. per mile, or a total including all contingencies of about 750*l*. per mile complete, the exact figures, of course, varying with local circumstances, the total length of the line, and the total weekly weight of material to be moved.

With regard to the portable railway, which may be looked upon as "feeders" to the permanent way, the conditions are somewhat different, but even these should be fairly well laid down and of substantial construction.

The railway is generally of lighter section of steel rails, and usually, though not always, the rails are riveted directly to the sleepers. This is the better form where shipment by sea is not incurred for delivery, as the weight of the fastenings is saved.

It is generally made in sections of 15 feet, each section being easily carried by one or two men, the sleepers being spaced every yard centres, and weighing as follows:—

| | Wt. per section.<br>Lbs. |
|---|---|
| Rails 10 lbs. to yard, 16 inches rail gauge.......... | 125 |
| „ 12 „ „ 16 „ „ .......... | 150 |
| „ 14 „ „ 18 „ „ .......... | 180 |
| „ 16 „ „ 18 „ „ .......... | 250 |
| „ 18 „ „ 20 „ „ .......... | 280 |

To illustrate the ease with which these portable railways can be laid down, where frequent renewals are necessary, four men can take up about 200 yards of railway, and relay it further on, in a quarter of an hour.

The joints for the portable railway sections are generally some form of slip joint, the best form having two short fishplates bolted or riveted to one end of the rails of a section, and having a few inches projecting beyond the rails; the web of the free rails of the next section slips between these fishplate ends thus forming a temporary joint, which can be subsequently strengthened, if desired, by passing a bolt and nut through the holes in the two free ends of the plates and the web of the rail.

It is advisable to make the switches and crossings in sections the same length as the rails, whether on the permanent line (usually 24 feets) or the portable line (in 15 feets), so that if it is desired to take off a branch from any point, all that is necessary is to take out a pair of rails and slip in the set of turnouts or switches and crossings, as they are indifferently called. Where this cannot be done, branches can be led off by means of inclined planes.

As to the question of curves, for an 18 inch gauge line, 20 feet radius is a good average for easy working, though down to 12 or 15 feet radius can be used with a wheel base of about 2 feet 3 inches or 3 feet. In these very sharp curves, however, it is advisable to use axles having one if not two loose wheels on them.

In cases where very sharp turns are to be made through doorways and the like, it might be necessary to use turntables, but I do not recommend these unless absolutely necessary, for the simple reason that only one truck can be turned at once, and this means loss of time where a train of a dozen trucks has to be got through.

Where a truck has to be moved from one set of rails to another, and there is no room for switches and crossings, say, a pair of roads at the end of a shed, a "*traverser*" is much better than a pair of turntables, and possesses the further advantage that when it is not in use it can be pushed out of the way of the travelling roads, whilst the turntables have to endure the hammering of every train that passes.

Regarding the trucks to be used the best and cheapest form is undoubtedly that known as the equilibrium tipping-type. They are very simple, have no loose parts to get out of order, and they shoot their contents clear of the line, with little trouble.

Where coal traffic is concerned I think in certain cases the following arrangement will work well, an arrangement which we have adopted on a narrow gauge tramway, near York, for carrying coal to a small gas works. The gauge of the line is 2 ft. 6 ins.

The waggons have steel frames carrying the wheels and axles, &c.; at each end of the frame or bogey is a standard high enough to carry the tipping trunnions which are mounted on the wooden boxes carrying the coal. These wooden boxes are about 4 ft. 10 ins. long, 3 ft. 8 ins. wide, and 3 ft. deep, carrying about two cubic yards each of coal, and are so made that six boxes exactly fit into an ordinary standard gauge main line waggon.

This main line waggon with its six tipping boxes goes to the colliery, where the boxes are all filled with coal in the ordinary way, then conveyed to the terminus of our narrow gauge railway.

Each box is then lifted out of the main line waggon by means of a light portable crane, and deposited on to the bogey frame standing on the narrow-gauge railway; while the six empty boxes off the bogeys are put into the main line waggon and conveyed to the colliery for a fresh load of coal.

The full boxes are then run along the narrow-gauge railway to the gas works and tipped by means of the before-mentioned trunnions, by which they are suspended in the bogey frames, direct into the gasworks' bunkers or alongside the retorts. There is thus actually no break of bulk whatever from the collieries right to the mouth of the retorts.

A similar plan could be adopted on an agricultural railway by using boxes of such a size that four would nest into an ordinary main line waggon, say 7 ft. 6 ins. long by 4 ft. 10 ins. wide by 3 ft. deep, of 3¾ cubic yards capacity. Each farmer, through or near whose land, the narrow-gauge railway passes, would have his own siding or branch line, where full or empty trucks could stand. He fills his produce, be it potatoes, corn, hay, straw, or dead meat, &c., into these loose boxes in his own farmyard, then he carts these boxes to his siding, and, with a light portable crane, loads the full boxes on to the bogey trucks in the siding.

The next train going along picks up these loaded trucks and takes them to the terminus, where the narrow-gauge line runs alongside the main line waggons. A light portable crane loads these boxes into the main line waggons as before and runs them off to the market town, where again the same boxes can be lifted on to consumer's carts, and thus carted directly to their destination. Thus there would be absolutely no break of bulk whatever from the farmer's yard to the consumer's premises, preventing damage to perishable goods.

The boxes when empty could be returned in a similar manner, loaded with manure or other goods, or, the sides being made collapsible, may be packed up and returned to the narrow-gauge railway without taking up much room.

I cannot conclude my paper without a slight allusion to electrical traction.

This method is rapidly coming into favour, and deservedly so. There are several systems, each one possessing its own good points, and all offering the advantages that, instead of requiring a separate steam engine and steam boiler, as is the case with the ordinary locomotive, the power can be derived from any existing steam engine, and it is very rarely that a works or factory has not some surplus engine power somewhere to drive the necessary dynamo.

The five great systems are:—

1. Double-wire circuit, using a separate insulated wire to complete the circuit, in addition to the wire carrying the outward current.
2. Single-wire system, using the running rails to complete the circuit.
3. The third-rail system, such as is used on the Liverpool Overhead Railway, having an insulated third rail, (generally placed between the running rails), which carries the outward current, the return being made through the running rails.
4. The conduit system, in which the current is carried by an insulated wire, laid in a conduit between the rails, the return being through the running rails.
5. Storage battery system.

Each system, as I said before, possesses its own advantages, and I will briefly describe them.

1. *Double Wire Circuit.*—This system has two separate overhead wires insulated from each other, and from the earth, and carried on poles, or on brackets fixed to existing walls and buildings. The wires can be arranged in different ways, the best being the "loop-wire system" for use in a works, as shown in enclosed sketch, and having the following advantages:—

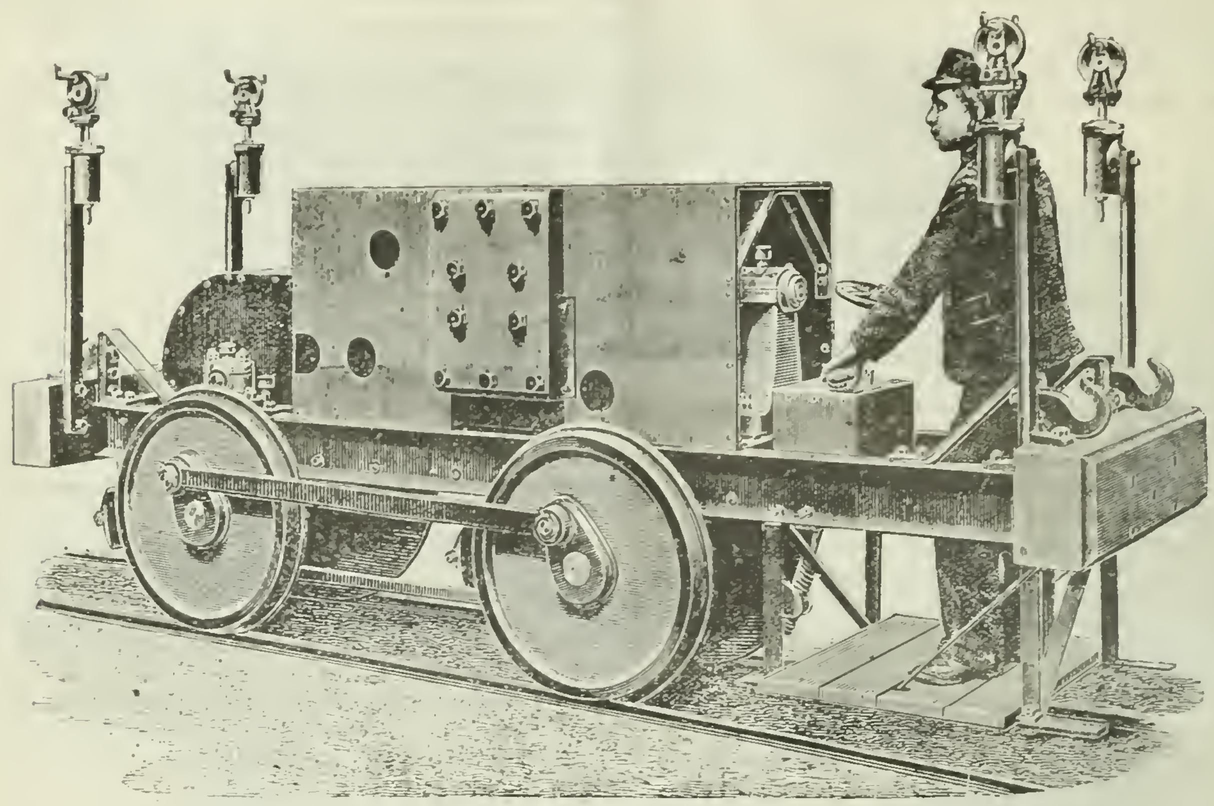
*a.* It is simple and cheap to erect.

*b.* The potential difference is constant throughout the whole circuit, thereby ensuring an uniform rate of speed of the locomotive.

c. The rails do not need bonding, so that they can be taken up and relaid when desired.

Fig. 10 shows an electric locomotive taking up the current from a pair of wires, as used at the Greenside Mining Company's Works. The gauge of the railway is 22 in., and it runs mostly underground, through a narrow roadway, in some cases only 32 in. wide. In consequence it was found impossible to place the electro-motor across the frame of the locomotive, so its shaft was arranged parallel to the rails. Three reductions of speed are employed, one necessarily being through bevel gearing. The whole framework of the machine is hinged from the driving axle, which is made exceptionally strong for the purpose, the weight on the other wheels being taken through strong spiral springs on the top of gun-metal axle-brasses. The motor is series wound for a difference of potential of 200 volts, and developes 15 brake horse-power at 1,000 revolutions per minute. The length of the road is 1,200 yards, and the current is collected from two bare copper wires, carried on insulators overhead. The electromotive force is reduced from 500 volts to 200 volts by means of a motor-transformer placed at one end of the line. The electric current is generated by a dynamo placed about 1½ miles away from the mouth of the shaft, driven by a turbine from a waterfall —the turbine being also employed to drive ore-dressing machinery. The current is generated at 500 volts pressure and carried by bare overhead wires to the transformer.

Fig 10.



Electric Locomotive taking up Current from Two Overhead Wires, on Looped Conductor System.

The installation is in every way a success, and I am informed by the manager of the mine that the locomotive has just completed its 6,000 miles with exceedingly slight repairs, having been running continuously since December 1891.

The cost of an electric haulage installation, on this system, including electric locomotive of 19 horse-power tractive force with suitable dynamo, working at 455 volts and 55 ampères together with double wires, crossing places, poles, insulators, switchboard, and indicators, for an installation 1 mile long, would be about 670*l. all complete.* Such a locomotive would be capable of drawing a nett load of 15 tons, in addition to its own weight, up gradients of 1 in 40, at a fair working speed, the exact rate depending on the condition of the road, and the rolling stock, &c.

2. *Single Wire System*.—In this case the current is led by an overhead insulated wire, whence it is usually collected by a wheel mounted at the end of a long arm, the wheel being kept in contact with the wire by means of suitable springs at the base of the arm. This is termed the "American Trolley System," and as its name implies is extensively used in America. It has been successfully adopted on the South Staffordshire Tramways at Walsall and elsewhere. I have travelled several times on these lines, and have been very much impressed by the smooth easy working of the cars.

Another method of collecting the current is by means of a pair of tranverse rubbing bars, one bar being mounted across each end of the car, so that one bar makes contact with the working wire, whilst the other may be temporarily "Off," whilst passing the point of support of the wire.

In general working, however, both bars are in contact. This is the method adopted by Dr. E. Hopkinson on the Douglas and Laxey Electric Tramway, in the Isle of Man.

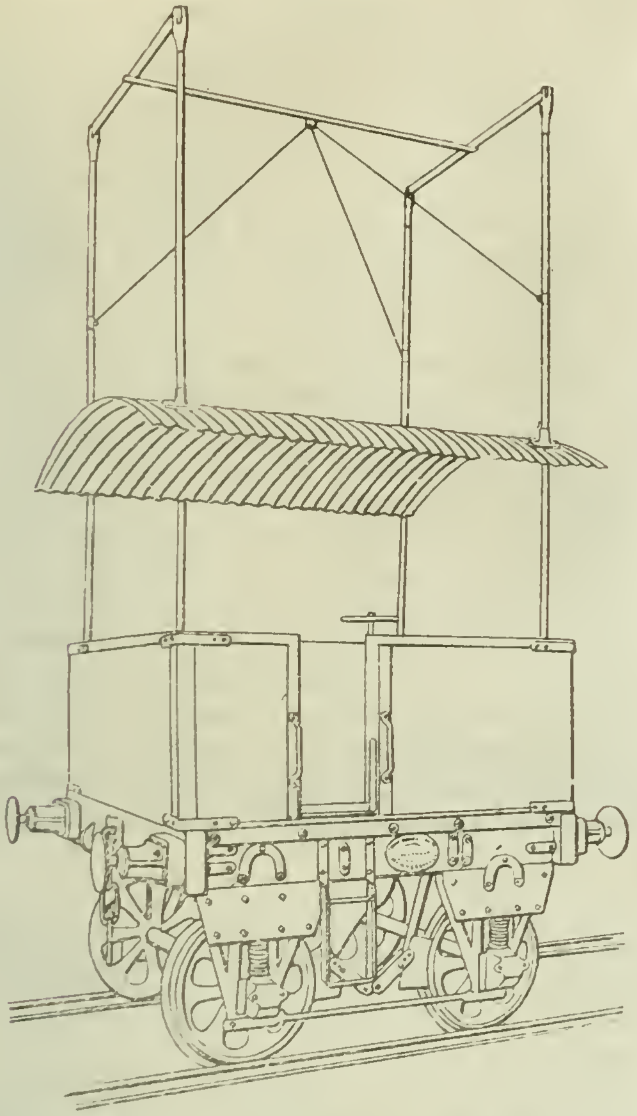
Fig. 11 shows an electric shunting locomotive recently built on this system for a machinery works at Castleton, of which I take the following description from the "Railway World":—

> "The locomotive will draw a loaded waggon weighing 20 tons at a speed of two miles an hour. It is used for shunting waggons on a siding, connecting the boiler-house and delivery stores of the works, with the main line. The electric generator, which is of the Manchester type, has an output of 54 ampères at 100 volts at 1,100 revolutions per minute, and is driven off the main shafting in the works. It is fitted with fast and loose pulleys so that it can be stopped or started as required."

The locomotive has coil spring buffers of the standard height and centres, axle-boxes, and guides, and hand screw brake, with wooden brake blocks, bearing on the car wheels, which are 28 ins. in diameter. It has a galvanised iron roof from which proceed the upright supports carrying the cross contact bars.

The driving motor is also of the Manchester type and is mounted on a cast-iron bed plate, which slides on cast-iron brackets, bolted to the framing of the car. The motor is fitted with a vulcanised fibre pinion with steel end plates of 21 teeth, which gears with a cut cast-iron wheel of 72 teeth on the gudgeon shaft on which is keyed a chain pinion of seven teeth, driving a chain wheel of 22 teeth; the latter is split into two halves and is fitted to one axle of the locomotive. A sand box is provided and the car is fitted with the usual controlling switch, resistance box for starting and regulating the speed, and a reversing switch. The weight of the locomotive is 3 tons.

Fig. 11.



Electric Locomotive taking Current from Single Overhead Wire, return Current through the Rails.

The system of cross collectors on the locomotive lends itself particularly well to the requirements of the line as there are many points, curves, and crossings on it. As the locomotive is only required for two or threee hours each day at odd times, it will be at once seen that a very great saving is effected by using an electric locomotive in place of steam, as the dynamo is only started when power is required. An ordinary labourer looks after the entire plant, including an overhead electric travelling crane, to lift 3 tons, and worked from the same dynamo.

I may add that in the case of the Douglas and Laxey Railway, the gradients are very severe, averaging 1 in 24 to 1 in 30 and in one place as much as 1 in 20, whilst the curves are very sharp, in some cases severe reverse curves being necessary. It would have been very difficult if not impossible to work this line with ordinary steam locomotives in consequence of these severe conditions.

In each of these cases, the return current after going through the electric motor, is lead back to the dynamo through the running rails, the rails being electrically connected by copper strips riveted to the ends of each rail, so as to make good metalic contact.

3. *The third rail system* is not suitable for works traffic, as the third rail would not only be in the way of ordinary traffic, but the risk of completing the circuit through any passing body, coming in contact with the third rail, and either of the two running rails, would be too great.

4. *The conduit system* is probably one of the best, but it is too expensive for ordinary commercial use except on a small scale, and the conduit would be liable to fill with water and dirt and so spoil the insulation of the current-carrying wire within it.

Recently, however, Dr. N. S. Keith has brought out at his works a very ingenious modification of this conduit system. I had the advantage of recently travelling on his electric locomotive, and was much pleased with it. The conduit consists of a semicircular cast iron casing with an open flat top, the conductor being suspended in this casing by blocks of paraffined timber.

A continuous bar of iron loosely fits on the top of the casing, completely covering it and so preventing dirt, &c., getting into it.

A small four-wheel trolley travelling underneath the electric locomotive runs along the top of the casing, and the continuous bar cover is threaded through rollers on the small trolley, so that as the trolley travels along with the locomotive, the cover of the casing is lifted up for an inch or so and falls down again as the locomotive proceeds. In this way the current is picked up as the locomotive goes along, whilst on each end of the locomotive the casing is quite covered over.

A further novelty about Dr. Keith's locomotive is that the armature which revolves horizontally, around a vertical spindle, is always running, and always in the same direction, whether the locomotive be running forwards or backwards, or stopped. The variations being effected by a pair of sleeves on the driving axle, controlled by suitable magnetic clutches either or both of which can be thrown into action as desired.

*The storage system* has many advantages to recommend it, as there are no wires in the way, or rails to be bonded, whilst the storage cells can be charged by any available engine during the night or at any other time when not required for other work.

The great objections to the storage batteries are first the loss of power in the cells, the commercial efficiency being only about 50 to 60 per cent., and secondly, the negative plate of the cell is liable to disintegration owing to the vibration of the vehicle carrying them.

The first objection is not a serious one, where plenty of surplus (or water) power is available, and Dr. E. Hopkinson informs me that they have greatly lessened the liability of disintegration in their new chloride cells, which they have recently introduced on a portion of the South Staffordshire tramways, and that they expect to work the traffic there, including all costs, maintaining the batteries, and all working expenses, for under fourpence per car mile. This, considering the heavy gradients in use, and the large co-efficient of traction on grooved tram rails (some 30 lbs. per ton of gross load on the level) would be very good work. A further advantage of these chloride cells is a very large reduction in the weight per cell. The weight of a battery of E.P.S. accumulators to drive a 15 brake horse-power locomotive would be about 8 tons empty and 10 tons charged. They would consist of about 102 cells in lead lined wooden boxes, discharging at the rate of about 75 ampères at 200 volts pressure, and would drive the locomotive continuously for 3½ hours at full load. The size of each cell would be 12½″ × 12″ × 19½″ over all, and the price about 385*l*.

To do the same work, about 96 chloride cells would be required, weighing less than half, say 3½ tons in all, and costing 375*l*.

Another form of traction is by means of gas engines. These have been used at Dresden since last August, the length of tramway being about 3 miles. The engine is of 9 horse-power and has two cylinders, the ignition being effected by electricity, and it is fixed under one of the seats. The gas used is stored in three cylinders under a pressure of 120 lbs. per square inch, the capacity of each cylinder being 33⅓ cubic feet. Once the engine is started, it is not stopped so long as the car is in service. Connection to the wheels is made through movable clutches, by controlling which the car can be stopped or reversed as required. A speed of 9 miles an hour can be attained with a car carrying 36 passengers, the cost per car-mile, being according to "Engineering" only 0·8*d*. with gas at 4*s*. per 1,000 cubic feet.

I shall look with interest on the development of this new form of traction.

Of traction generally, I may say that at present, under ordinary circumstances, steam traction is probably the cheapest method where surplus, or water, power is not available.

Electric haulage comes very close, and on occasions even cheaper, whilst the absence of steam, and smoke, makes it in most cases the preferable method.

Horse haulage is probably more than treble the cost of steam haulage, without taking into account the extra loss of time involved in the former, probably four times as much, and manual haulage is too expensive a luxury for any commercial undertaking to indulge in.

## THE INFLUENCE OF OXIDE OF IRON AND ALUMINA IN THE REVERSION OF SUPERPHOSPHATE.

BY ALFRED SMETHAM, F.I.C.

(This Journal, February 1895, p. 112.)

### DISCUSSION.

Professor **CAMPBELL-BROWN** said it was satisfactory to find that in general the use of aluminous phosphates had of late years been rated more highly than previously. There was no doubt whatever about the usefulness of phosphate as a manure if sufficiently finely ground, and no doubt Mr. Smetham was perfectly right in his conclusions, that alumina was much less objectionable than iron in the reversion of superphosphates. He was not quite sure whether Mr. Smetham indicated the method by which he determined the amount of reverted phosphate as distinguished from undissolved phosphate; he would like to ask whether Mr. Smetham felt confident that the method gave uniform results. It was extremely doubtful whether any method they knew did give uniform results; temperature, amount of water and time would make variations in the estimate of reverted phosphate. That did not detract at all from the merit of Mr. Smetham's calculations, but it might leave a difficulty in the way which should not be overlooked by the Committee which he proposes should deal with the subject. That it would be a desirable thing to have such a committee there could be no doubt whatever, and he hoped something would be done because of the practical importance of the subject to large numbers of manufacturers and agriculturists.

Mr. **RHODES** asked Mr. Smetham whether he had tried any similar experiments with high percentage superphosphates. They found generally that the high percentage supers, about 35 per cent. and upwards, did not revert or go back so much as the lower superphosphates about 26 per cent. on account of the higher superphosphates containing more free phosphoric acid. He had noticed that in high superphosphates made from Florida phosphates the solubility increased on keeping instead of reverting, and in other cases of high superphosphate not made from Florida phosphate, the solubility had increased on keeping, part of the insoluble phosphate having become soluble, so that the superphosphate was 1 per cent. to 1½ per cent. higher after keeping some weeks than what it tested when first made. In a 26 per cent. superphosphate there was no increase in the solubility of the phosphate, but on the other hand they often found there was a large reversion, two or three per cent., especially in the case of superphosphate made from Carolina phosphate. Of course these were the results obtained on a large scale and the influence of a heap had a great deal to do with the reversion. If Mr. Smetham's experiments had been tried in a large heap he might have found that the reversion was nearer the theoretical quantity; but certainly alumina did not seem to have the same effect as iron in reverting a superphosphate.

Mr. A. J. **SQUIRES** remarked that, so far as his experience went, he was at one with Mr. Smetham. He had found, practically, that oxide of iron had a greater tendency to revert superphosphates than alumina had; but still they had to consider that in working with a large amount of superphosphates, say 300 to 400 tons, the conditions would be somewhat different from the conditions in a small sample contained in a bottle, and they would find that the alumina would have a tendency to send back far more phosphate, although he would admit that even in Florida phosphates if they had 3 per cent. of oxide of iron and alumina, chiefly alumina, they would find there that the phosphate would remain soluble for a much greater length of time than if they had another phosphate containing 3 per cent. of oxide of iron and alumina, the greater proportion of which was oxide of iron. He would like to mention one or two other points; for instance, in working Peace River phosphates, they found a certain amount of organic matter. His own experience tended to prove that the organic matter reduced the oxide of iron and that when oxidation took place in the heap, there were consequently more phosphates thrown back than might be expected. Again, if they had a large excess of free acid, and, say, 3 per cent. of oxide of iron and alumina, they would get a much larger proportion of reverted phosphate, than would be expected under the circumstances. If they took a little more than the theoretical quantity of acid, they would get a superphosphate much more stable. Another interesting point was the finding of carbonate of lime in the mixed superphosphate; this was due probably to the particles getting coated with gypsum, whereby further action of the acid was prevented.

Dr. **KOHN** asked why it was that the iron and alumina were only considered as taking part in the reversion of superphosphate in the condition of oxides and not as phosphates. If considered as phosphates they would considerably modify the conditions of reversion suggested by Mr. Smetham as the result of his synthetical experiments.

Mr. **SMETHAM** said, in reply to Dr. Campbell Brown, that the process he used scarcely called for the criticism which undoubtedly might be brought against the use of the citric acid methods for determination of the retrograde phosphate in superphosphate. He estimated the amount of soluble phosphate in his original substances, and again, after a period of time, and the inverted phosphate was the difference between the two results; and as the estimation of soluble phosphate was about the most accurate test of phosphoric acid that they had to deal with, it followed that the amount of error introduced might be neglected. He would perhaps have made his meaning clearer had he said soluble in water—instead of simply soluble—phosphate. The citric acid methods certainly were all more or less fallacious and were entirely dependent on conditions—whether one worked by the neutral or alkaline method made all the difference. In reply to Mr. Rhodes he would ask them to notice that it was the 26 per cent. superphosphate in which the reversion was greatest. Was it not because the lower superphosphates were made of the poorer phosphates, containing a larger proportion of oxide of iron?

With regard to Mr. Squire's remarks, undoubtedly in the after mixing one might get a certain amount of carbonate of lime coated with gypsum, but after a time had been given the chemical action would be complete and the carbonic acid would be expelled. This was his reason for directing attention to the very fine grinding of the original phosphate before the addition of sulphuric acid.

To the organic matter he might say he had been unable to trace any reversion nor could he see any reason for the reversion of the superphosphate by means of the minute quantities of organic matter that one got in such things as Peace River and Carolina phosphates. What struck him as possible was that many of those phosphates contained pyrites. Pyrites insoluble in hydrochloric acid was not reckoned, according to their methods of analysis in England, in the oxide of iron determined; but on exposure to the air oxidation would take place slowly and the sulphate of iron so produced would, no doubt, go on reverting a certain portion of the phosphate, and as pyrites might be there possibly to the extent of 1 per cent., it was perfectly obvious that the reversion might be very considerable and might very reasonably be attributed to the organic matter present.

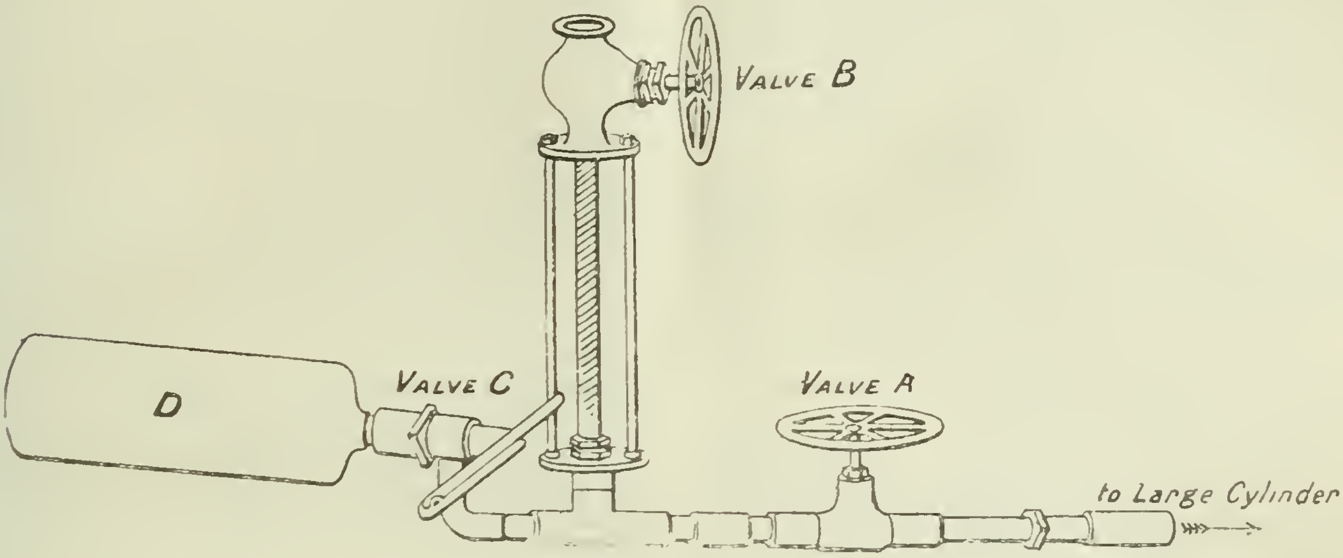
Dr. Kohn had said that it occurred to him that a phosphate might be originally in the mineral as phosphate of iron or aluminium phosphate, and then, of course, all the little theories went. It was hardly so, because in the analysis of raw phosphates no distinction was made between phosphate of lime and phosphate of iron and alumina. All phosphoric acid was calculated into its equivalent ot calcium phosphate and the prices wese based upon that. It, therefore, mattered little so far as the final result was concerned whether the iron and aluminium were originally present as oxides or phosphates.

* * *

## S. JACKSON'S APPARATUS FOR SAMPLING ANHYDROUS AMMONIA.

BY FRANK TATE.

The apparatus consists of a small steel cylinder D, to hold the sample of ammonia, fitted with an ordinary valve. To this is connected a small glass gauge with valves A and B, and the whole can be connected with the cylinder to be sampled by means of the union.



When required for use, the apparatus is coupled up to the cylinder to be sampled and the valve of the latter opened. Valve A is also opened until the ammonia has filled the gauge. A is then closed, and C is opened, and the sample obtained allowed to flow into the cylinder D. In warm weather it is necessary to cool cylinder D so that the temperature is lower than the temperature of the cylinder being sampled. Should the apparatus get full of gas and thus prevent the liquid ammonia from filling the gauge, as is probable after sampling two or three cylinders, it is necessary to slightly release valve B.

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# Manchester Section.

Rooms of the Chemical Club, Victoria Hotel.

*Chairman:* R. Forbes Carpenter.
*Vice-Chairman:* Edw. Schunck.
*Committee:*

G. H. Bailey.
F. H. Bowman.
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
F. Hart.
J. M. Irving.
E. Knecht.
I. Levinstein.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
W. Thomson.

*Hon. Local Secretary:*
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

SESSION 1894-95.

*Meeting held Friday, March 1st, 1895.*

MR. R. FORBES CARPENTER IN THE CHAIR.

## NOTES ON CERTAIN SILVER ALLOYS.

BY G. J. FOWLER, M.SC., AND P. J. HARTOG, B.SC.

The following notes form a record of some experiments undertaken* for the purpose of obtaining a silver alloy, which should possess the whiteness of silver, without its liability to tarnish, and should also be capable of electro-deposition. Our endeavours proved unsuccessful, but the results obtained are of some interest. Our experiments fall into two divisions:—

(I.) The preparation of alloys by fusion of their constituents.

(II.) The deposition of alloys by electrolysis.

(I.) Some time ago a company was formed for electroplating with an alloy of silver and cadmium, which was stated to be much less tarnishable than silver. For various reasons the company did not meet with great success, one being, doubtless, that the expectations with regard to the alloy were not realised in practice.

We have found indeed in all cases that the silver alloys we prepared were more easily tarnishable than pure silver; on the other hand a sulphide stain is in general more easily removed from the alloy than from the metal. We tested the alloys by the following rough but efficient means; two drops of ammonium sulphide were placed on the burnished surfaces of the alloy and of pure silver, respectively, at the same time, and removed at the same time, after an interval of a minute or two. It was then evident in all cases that the stain on the alloy was deeper in colour than that on the silver, while it was in general more easily rubbed off with a piece of chamois leather.

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* (At the suggestion of Messrs. Levetus Bros., of Birmingham.)

It is of course well known that silver sulphide forms a particularly good and tenacious coating on silver; it was to be expected that a heterogeneous mixture of sulphides would be less tenacious. The following lines contain a brief description of the alloys prepared.

1. *Silver Zinc Alloys*—The zinc was melted in a crucible under powdered charcoal, the molten silver added, the mixture stirred with an iron rod and poured into a mould.

(*a.*) Ag 95 %, Zn 5 %. Colour somewhat greyer than that of pure silver, but not easily distinguishable from it.

(*b.*) Ag 93 %, Zn 7 %. Colour easily distinguishable from that of pure silver.

(*c.*) Ag 90 %, Zn 10 %. Still malleable but greyer.

2. *Silver Nickel Alloys.*—These were obtained by melting the two metals together in a wind-furnace under a layer of charcoal, stirring and pouring into a mould.

(*a.*) Ag 95 %, Ni 5 %. Colour was good, silverlike, and the alloy takes a high polish.

(*b.*) Ag 90 %, Ni 10 %. Colour was "steely," the alloy malleable.

Both these alloys tarnish readily, and the stain is not very easily removed from their surface.

3. *Silver, Nickel, and Zinc Alloy.*—Ag 90 %, Ni 5%, Zn 5 %. The silver and nickel were melted together and poured on to the molten zinc, the contents of the two crucibles being covered with powdered charcoal. Colour too grey, malleable.

4. *Silver-Aluminium Alloy*, Ag 90 per cent. Al 10 per cent.—This alloy was highly crystalline and brittle: it broke to pieces on rolling. The surface was white and highly lustrous, but readily tarnishable.

5. *Silver-Tin Alloy.*—Ag 95 %, tin 5 % (by analysis).—According to Hiorns (Mixed Metals, 320), "the smallest quantity of tin renders silver brittle." This alloy is, however, perfectly malleable, yielding long spiral drillings. It has an excellent colour, and yields stains which are easily removable. Unfortunately tin is not easily deposited by the current, and the alloy is therefore unsuitable for our purpose.

6. *Silver-Copper-Zinc Alloys.*—In this case the silver and copper were melted together and added to the zinc, the operation being in other ways similar to that described previously.

(*a.*) Ag 75 per cent., Cu 15 per cent., Zn 10 per cent.—Colour too yellow. Malleable. Stain readily removable.

(*b.*) Ag 67·87, Cu 5·17, Zn 27·47.—Showed signs of brittleness on rolling; colour yellow and wanting in brilliancy. This alloy was analysed, and it was found that by operating in our usual way that no loss of zinc was incurred.

(c.) The above alloy was melted with a further quantity of zinc till the fracture was highly crystalline and of a bluish white colour. The percentage of silver was found on analysis to be 30·74.

*Electro Deposition of Alloys.*—The efforts of technical chemists have hitherto been directed to the separation of metals by electrical methods, rather than to their deposition simultaneously; but for some years the electro-deposition of brass and other alloys has become a commercial process. The mechanism of the process, however, is by no means easy to understand. An interesting, but incomplete note on the subject is due to Dr. Silvanus Thompson (Proc. Roy. Soc.) **42**, 387 (1887), who shows that since owing to imperfect diffusion, the counter electro-motive forces at the cathode depend on the current density, and since the variations of E.M.F., due to differences of concentration, are greater for copper than for zinc, that we can adjust the current density so as to obtain copper and zinc deposited in nearly equal quantities.

The law given by Berzelius to the effect that the most electro-negative metal is deposited first in electrolysis, is said by Ponthière (Traité d'Electro Métallurgie, Second Edition, 1891, 165) to be reversed when we use an anode composed of an alloy. For the present we shall only record the results of our experiments without discussing them. We hope at some future time to pursue the matter further.

We used in all cases a laminar cathode of German silver or Britannia metal, having a surface of about 4 square inches on each face. The cathode was greased, so that the deposit could be stripped off and analysed.

1. *Deposition from silver-zinc solutions.*—A solution of the cyanides of the metals in excess of potassium cyanide, togther with excess of ammonia was used. 17·15 grms. of silver per litre (about $2\frac{1}{2}$ oz. of silver to the gallon) were dissolved, together with zinc in the proportion present in alloy 1 (*a*). This alloy was used as anode. The specific gravity of the solution was 1·038. On heating to 40° C., a current of one ampère produced a good deposit, which was found to contain 99·8 of silver. Under these conditions practically no zinc is deposited.

2. *Deposition of Silver, Copper, and Zinc.*—A cyanide solution was made containing the above metals, in the proportions present in alloy 6 (*b*). The amount of silver per litre was the same as in solution described above. Alloy 6 (*c.*) was used as anode. With a current from four Bunsen cells the deposit was fairly even, but on analysis, was found to contain only about 1 per cent. of copper and zinc together.

The above solution was now mixed with an equal volume of brassing solution from which a good deposit of brass could be obtained with the current from two Bunsen cells. On analysing the deposit from the mixed solutions heated to 40° C., only a small amount of copper was found. With four Bunsen cells a black deposit (probably oxide) was given by this solution.

On increasing the amount of brassing solution the amount of copper in the deposit increased, until, when the amount of silver originally present in the solution was zero, a brass was obtained containing a little silver.

We have not worked out the exact conditions for obtaining an alloy containing an equal proportion of the three metals, silver, copper, and zinc; but it is evident that the amount of silver present in the solution and in the anode must be much in defect of the proportion required for the alloy.

3. *Deposition from solution containing Aluminium.*—In 1855 Thomas and Tilley took out patents (Nos. 2724 and 2756) for depositing alloys of aluminium and silver, aluminium, silver and copper, &c. A solution of aluminium hydrate in potassium cyanide, or in a mixture of sodium carbonate and potassium cyanide was used in their experiments.

We found that aluminium hydrate does not readily dissolve in potassium cyanide alone, for which we therefore substituted a mixture of caustic potash and potassium cyanide.

A cyanide solution was prepared containing aluminium and silver in the proportions present in the alloy (17·15 grms. of silver being dissolved per litre). On analysing the deposit given by this solution with a current of about 6 ampères, it was found to contain not more than 0·8 per cent. of aluminium.

A solution of aluminium was prepared containing 70 grms. of aluminium nitrate to the litre, the alumina then precipitated and redissolved in excess of potash and potassium cyanide. Using the silver alloy with 10 per cent. of aluminium as anode and a current of 8 or 9 ampères, at a temperature of about 50° C., a deposit was obtained which still consisted almost entirely of silver, only a faint precipitate being given by ammonia, after precipitating the silver as chloride and filtering.

Our results therefore tend to confirm those of C. Winkler (Chemical News, vol. xxvi., p. 157; Journ Chem. Soc. New Series, vol. x, p. 1134), who states that plating with aluminium cannot be effected by electro-deposition.

## Discussion.

The Chairman said that the paper now carried him back nearly thirty years, to the first research work he did under the late Professor Graham at the Mint on a series of nickel and silver alloys, in which considerable difficulty was experienced owing to their segregation and lack of uniformity. On rolling out the buttons obtained the lack of homogeneity was at once apparent. He would like to ask the exact conditions under which these fused alloys were prepared. Were they quickly cooled? In his own case he believed most were cooled slowly.

Mr. R. Pettigrew stated that silver alloys could be electro-deposited on a commercial scale, and he had two years' ago, at a meeting of the Institute of Electrical Engineers in London, shown, along with samples of every metal which could be electro-deposited, specimens of plates plated with an alloy of silver and cadmium, the percentage composition varying on the one side from 90 per cent. silver and 10 per cent. cadmium to 90 per cent. cadmium and 10 per cent. silver. The difficulty was not in getting these metals to deposit together as an alloy, but to regulate the current density and other features when an alloy process is worked on a commercial scale and where articles of varying size are plated, so as to get an even composition on all parts of the plated goods. The deposit on the inside of a large vessel, for instance, had often a different percentage composition from that on the outside, and hence a different colour readily detected by the experienced eye. This difficulty could, however, be got over by using varying sized baths, according to the class of articles to be plated, and keeping the articles moving. The percentage composition of electro-deposited alloys depended on many features, amongst others the current density, chemical composition of bath, relative amounts of metals in the bath to each other, free cyanide and impurities, as well as to the position of the metals to each other in the electro negative series; and he had found that silver and cadmium fulfilled the conditions more closely than any of the metals mentioned by the authors. He had tried electro-depositing zinc and silver together, but with a far less quantity of silver present than mentioned in the paper, and found that even with as low as an eighth of an ounce of silver to the gallon, and a pound of zinc, he only got down from 5 to 7 per cent. of zinc; and even then it was not possible on a large scale owing to the large current-density required, making the surface rough. Again zinc was so difficultly soluble in potassium cyanide that the zinc cyanide formed on the alloy anode could hardly be got to dissolve, even when an excessive amount of free cyanide was present. He had never tried tin and silver or aluminium and silver in aqueous solutions because tin was such a difficult metal to manage by itself in electro deposition, that it was hopeless to get it satisfactorily as an alloy. Aluminium he never considered suitable because it had yet to be got by itself from an aqueous solution, at least with current density suitable for silver plating, and in the analysis given in the paper he rather thought the aluminum got had not existed as metal but oxide. He had, however, succeeded in depositing these metals satisfactorily from fused salts, but of course this was out of the question for electro plating. With regard to fused alloys with silver he could corroborate most of what was said in the paper, and gave an instance of an alloy of silver 92·5 and aluminium 7·5 which was so brittle that when he tried to scratch figures on it it came away in fine powder—in fact, an ingot $\frac{1}{4}$-inch thick could be broken between the fingers. He also had noticed that alloys often had fine colours, and mentioned one of silver 60 per cent. and cadmium 40 per cent. which was hard and brittle, but the fracture of which had a lovely pink colour. Mention had been made in the paper of the tarnishing of silver as compared with electro-deposited alloys, but his experience was that electro-deposited alloys tarnished less rapidly than pure silver, and then the tarnish which did form was more easily removed and was of a brown colour—not the well known purple tarnish of pure silver. Fused alloys acted somewhat differently, and the difference of action had something to do with the chemical compounds formed, for a true alloy did not act as a mere mixture; and he had found that a standard alloy of copper and silver tarnished in spots and streaks, which tended somewhat to show that this alloy was not a definite compound but a mechanical mixture. Zinc and silver alloys he found tarnished usually of a greyish colour. The properties of electro-deposited and fused alloys had little relation to each other, as he considered that an electro-deposited alloy was not a definite compound but merely, as it were, a mechanical mixture. The authors gave their method of testing the lustre, but he considered it much better to work with a number of plates set in an oblong box, so that the number of reflections from a given point could be ascertained.

Mr. J. P. Hartog remarked that neither Mr. Fowler nor himself had had an opportunity of seeing any of the articles prepared by the defunct company, but as far as they could make out from the specimens which they had prepared there was exactly the same liability to tarnish, as in the zinc alloys. They had not themselves deposited cadmium; on the other hand, it was difficult to see why an electro deposit should tarnish less readily than a fused alloy. He agreed with Mr. Pettigrew that the great commercial difficulty was the impossibility of getting a constant density of current, and therefore they could not always obtain the same result. In some cases the order of deposition of these metals depended entirely on the solution in which they were placed. Here again they were met with the greatest difficulties, because they did not know the exact compounds present in solution. They got a formation of double salts, and consequently they were very much in the dark as to the effects which would be produced by the current.

Mr. Fowler, in reply to the Chairman, said the alloy was stirred in the crucible before pouring, and it at once set in the mould after pouring, there being no time allowed for segregation to take place.

---

# Newcastle Section.

*Chairman:* G. T. France.
*Vice-Chairman:* Alf. Allhusen.

*Committee:*

P. P. Bedson.
T. W. Hogg.
T. W. Lovibond.
W. Martyn.
John Morrison.
John Pattinson.
B. S. Proctor.
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
T. W. Stuart.
John Watson.

*Hon. Local Secretary and Treasurer:*
Saville Shaw, Durham College of Science, Newcastle-on-Tyne.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

*Meeting held in the Chemical Theatre of the Durham College of Science, Thursday, February 21st, 1895.*

MR. GEO. T. FRANCE IN THE CHAIR.

## ON TWO INTERESTING CASES OF ABNORMAL CONDITION IN PIG-IRON.

BY T. W. HOGG.

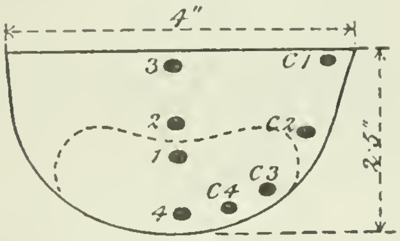
The specimens of pig-iron which I have here to illustrate this paper, present features of considerable interest in connection with the subject of segregation and matters intimately related to it.

Everyone who has frequent occasion to examine pig-iron is aware of serious local variations in composition in different parts of the pig, and so far back as 1881 (Newcastle Chem. Soc., Nov. 1881) I described an example of hematite pig, showing variations in the sulphur from 0·055 per cent. to 0·154 per cent. Since this time many cases have been published, the most complete information of any being that given by Stead (Iron and Steel Inst., May 1893), in which the same section of basic pig was shown to contain sulphur at different parts varying from 0·04 per cent. to 0·14 per cent., and hematite pig 0·022 per cent. to 0·055 per cent.

I have just recently come across a pig showing a much more extraordinary variation, and as it has been examined very thoroughly the results are brought together here, as the careful study of them, with the example to follow cannot fail to make one hesitate to draw any definite conclusions at present with regard to local variations in solidifying masses.

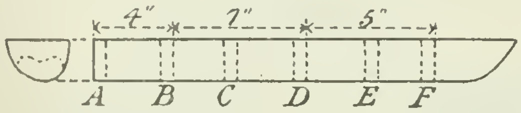
This pig shows for nearly one half of its area that peculiar fine grained texture so often indicative of iron of poor quality. This fine grained texture, however, is not always due to the same cause, and in the present case both the purest and most impure portions occur within it at one section of the pig, and in other sections the most impure metal is outside of the fine-grained portion. The following figure shows exactly where the drillings have been taken from, the dotted line giving the outline of the fine-grained portion which lies at the bottom of the pig—

Fig. 1.



and different sections of the same pig were taken at a considerable distance from each other, as in Fig. 2.—

Fig 2.



The results of the sulphur determinations are given in the following table, sections C and E not having been examined—

| — | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| A | 0·17 | 0·088 | 0·118 | 0·015 |
| B | 0·044 | 0·096 | 0·17 | 0 028 |
| D | 0·05 | 0·13 | 0·13 | 0·019 |
| F | 0·086 | 0·10 | 0·10 | 0·022 |

In section A complete analyses were made. These analyses are given in Table II.:—

| — | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent |
| Manganese | 1·73 | 2·02 | 1·80 | 1·76 |
| Combined carbon | 0·77 | .. | .. | 0·77 |
| Graphitic carbon | 3·39 | .. | .. | 3·17 |
| Silicon | 1·63 | 1·63 | 1·63 | 1·63 |
| Sulphur | 0·17 | 0·088 | 0·118 | 0·015 |
| Phosphorus | 0·04 | 0·04 | 0·036 | 0·035 |

In section D the following determinations were also made:—

| —— | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Phosphorus | 0·033 | 0·036 | 0·036 | 0·037 |
| Silicon | .. | .. | 1·76 | 1·77 |

The phosphorus was also determined in the section F at the parts giving the highest and lowest sulphur, but without finding any difference in this element, each result being 0·035 per cent.

Additional determinations of the sulphur were made in the first section (A) proceeding round the curve of the pig; the results were—

| —— | C. 1. | C. 2. | C. 3. | C. 4. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Sulphur | 0·11 | 0·12 | 0·048 | 0·018 |

It will be observed that we have in this pig a portion of iron probably to a depth of ½ in. from the outside at the bottom, and extending round a radius of 1½ in. of exceedingly pure iron, and that this layer runs along the whole length of the pig. The drillings taken from the position "1," just on the inside edge of the fine-grained fracture, show only in the first section A that the most impure metal is at that point. In the section B the most impure portion is situated immediately outside the fine-grained fracture, and in the section D this occurs at the point "3," ½ in. from the top of the pig.

The lowest sulphur determination is 0·015 per cent. and the highest 0·17 per cent. The borings were all taken by means of a ¼-in. drill, and in mentioning this perhaps it may be of some interest to stop for a moment to consider a highly important omission in most of the work which has been done in investigations of this kind.

It must be apparent that in solidifying masses of small dimensions the area upon the section containing the segregated impurities cannot be very great. In a large ingot of 30 inches in diameter, at its worst part the segregated matters are principally contained within a diameter of 2 ins., and it is highly probable that this diameter gradually decreases as we proceed towards the bottom of the ingot. As a rule evidence of segregation is soon lost, but may not this evidence be lost simply because of the diameter of the impure vein being reduced and the diameter of the drill being sufficiently great to take in enough of the purer mother-metal to hide it completely.

I gave in the following table the relative weights* of steel taken by drills of different diameters.

| Diam. of Drill.<br>Ins. | |
|---|---|
| $\frac{1}{16}$ | 0·395 |
| ⅛ | 1·580 |
| ¼ | 6·323 |
| ½ | 25·292 |
| ¾ | 56·930 |
| 1 | 101·205 |

If we now assume the presence of a vein of impure metal ¼ in. in diameter containing 0·20 per cent. of sulphur the following results would be obtained by using drills of different diameters, taking the mother-metal to contain 0·02 per cent. S.

| Diam. of Drill.<br>Ins. | |
|---|---|
| ¼ | 0·20 |
| ½ | 0·055 |
| ¾ | 0·040 |
| 1 | 0·031 |

---

* The figures given are the weights in grammes of solid cylinders of steel 1 in. in length.

Smaller veins of impure metal would be quite missed from this cause. It is not unlikely that in the small ingots used for the higher qualities of steel there may be veins of impure metal in quite as great a proportion as in the ingots of larger size, supposing we had the vein of impure metal only $\frac{1}{16}$ of an inch in diameter, it would never be detected in the ordinary method of examination, this is evident from the following table:—

| Diam of Drill.<br>Ins. | |
|---|---|
| $\frac{1}{16}$ | 0·20 |
| $\frac{1}{8}$ | 0·065 |
| $\frac{1}{4}$ | 0·031 |
| $\frac{1}{2}$ | 0·023 |
| $\frac{3}{4}$ | 0·021 |
| 1 | 0·021 |

From these observations it is evident that until we devise analytical methods capable of giving reliable results upon small quantities of material, we must not conclude that segregration does not take place in small ingots to so great an extent as in the large ones. If a series of observations be made upon an ingot 30 ins. in diameter with a $\frac{1}{2}$-in. drill, a corresponding series of observations upon an ingot 5 ins. in diameter would require the drill to be $\frac{1}{12}$ of an inch, and I need scarcely say that it would have to be most accurately centred. Reckless drilling is a prolific source of heterogeneous information. (See Howe, Metallurgy of Steel, p. 205.)

Returning now to our sample of pig-iron, on reference to the analyses given in Table II., it will be seen that we have here a case of only one element, the sulphur, varying to a great extent. The manganese was determined with the greatest care, as it is so well known that this element has the property of causing sulphur to segregate, yet the difference found does not correspond to what we might have expected. On a previous occasion I examined one of these pigs showing this peculiar fine grained appearance, and found differences in the carbon only, and in all the hematite pigs I have examined I have never found any great variation in the proportion of phosphorous, sulphur seems to be the most erratic of all.

Careful inspection of the fracture of the pig which I have been describing fails to reveal anything indicative of a portion of it consisting of extremely pure iron. In the second specimen of abnormal pig we have an unusual condition readily apparent to the eye, a portion of the section shows the presence of a layer of considerable thickness of white iron surrounded on all sides by grey. It is not difficult to understand that if we had an iron very liable to chill that such a condition might and does frequently exist, of the white iron being immediately on the outside,—in this specimen, however, it is grey iron that we have on the outside.

The contour of this white enclosure varies as you proceed along the pig until it finally disappears about 6 ins. from the end.

The following figures show the form of the enclosed white portion at the beginning of the pig and just before the white portion terminates:—

Fig. 3.

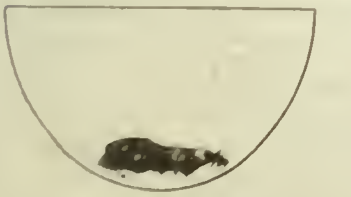
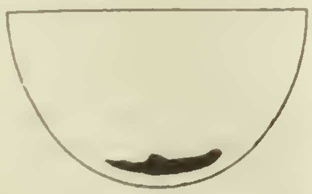


Fig. 4.



Vein of white iron shown in black. In Fig. 3 plates of white iron shoot out from the mass.

I have had this white enclosure carefully sawn out from the first section, and the analysis of this and the grey surrounding pig is given in the following table:—

| | White. | Grey. |
|---|---|---|
| Iron (by difference) | 93·267 | 92·768 |
| Manganese | 1·63 | 1·60 |
| Carbon (combined) | 3·88 | 0·98 |
| Carbon (graphitic) | 0·45 | 3·68 |
| Carbon, total | (4·33) | (4·66) |
| Silicon | 0·65 | 0·85 |
| Sulphur | 0·020 | 0·024 |
| Phosphorus | 0·039 | 0·034 |
| Copper | 0·064 | 0·064 |
| | 100·000 | 100·000 |

The grey portion shows the highest total carbon I have ever met with in pig-iron, the so-called impurities—sulphur and phosphorus—are practically identical in each, and there is only a slight difference in the proportion of silicon and carbon; of course the great difference is in the proportions of combined and graphitic carbon.

Although this grey pig-iron with white inside of it has been examined by other metallurgists recently, I think the present specimen sufficiently interesting and rare to bring before your notice. Especially as it is not unlikely that they may not all be produced in the same manner. A photograph kindly sent me by Prof. Howe shows this white iron well situated in the centre of the pig. In the specimens I show to-night this white iron is very nearly at the bottom.

It does not seem easy to satisfactorily explain the cause of the formation of this curious condition. Possibly the iron may be a critical one, that is, it is exceedingly liable to chill, and the first portion may run into the mold slowly enough to solidify, and then there is a rush of hot metal which surrounds it and cools slowly enough to enable the greater portion of carbon to separate as graphite. Where the white iron occurs in the centre, the condition may have resulted from cementation and I show a specimen of remelted Swedish grey pig-iron which has a portion of white in the centre which could hardly be formed in any other way.

Whilst determining the silicon in this pig-iron, I noticed a great difference in the bulk of the silica upon dissolving in dilute hydro-chloric acid, and thought it of sufficient interest to ascertain the relative proportions soluble and insoluble in this acid.

| | Grey. | White. |
|---|---|---|
| Silicon insoluble in hydrochloric acid | 0·16 | 0·34 |
| Silicon soluble in hydrochloric acid | 0·69 | 0·31 |
| | 0·85 | 0·65 |

After getting this decided evidence of varying condition of silicon, I also determined in the same way the proportion of silicon soluble and insoluble in the portions of the first sample of abnormal pig-iron giving the highest and lowest sulphur.

| D. Section. | 0·13 S. | 0·019. |
|---|---|---|
| | Per Cent. | Per Cent. |
| Silicon insoluble | 0·90 | 0·91 |
| Silicon soluble | 0·86 | 0·86 |
| | 1·76 | 1·77 |

These are therefore exactly alike. The silicon in all samples is perfectly soluble in $HNO_3$, 1·2 sp. gr. and also in cupric chloride.

Silicon has been frequently suspected to be able to exist in different conditions in its alloys with iron. So far as the evidence has gone no one has ever given definite proof of the occurrence of this element in its graphitoidal condition, but, apart from this may it not be capable of existing in two other conditions analagous to that of carbon in hardened and slowly-cooled steel, conditions which are so certain but so difficult to give unquestionable chemical evidence of. Considering the difficulties in the way of thoroughly proving the case for carbon, it would be important to know what special reactions might be taken to indicate any special condition the silicon might take up. Whilst experimenting upon alloys containing larger quantities of silicon, I obtained a somewhat remarkable result by submitting very finely-powdered siliceous spiegel containing 10 per cent. silicon to the prolonged action of 1·2 nitric acid in the cold, and at the end of four weeks the silicon seemed to be completely converted into a buff coloured residue which possesses the interesting property of turning almost quite black if heated out of contact with air. The alloy yielded 17 per cent. of this residue and the quantity of silica in it was found to be 76·41, the remainder being mainly combined water. A higher alloy containing 15 per cent. silicon obstinately refused to be decomposed under the same conditions.

These differences of solubility of the silicon are not accidental. May they not point towards the fact that, excluding the graphitic state, silicon like carbon may exist in more than one other condition.

# Nottingham Section.

University College, Nottingham.

*Chairman:* J. M. C. Paton.
*Vice-Chairman:* C. Spackman.
*Committee:*

L. Archbutt.
F. J. R. Carulla.
F. Clowes.
J. B. Coleman.
H. Forth.
J. F. Kempson.

T. Mason.
J. O'Sullivan.
S. J. Pentecost.
C. Taylor.
G. J. Ward.

*Treasurer:* J. T. Wood.
*Hon. Local Secretary:*
R. L. Whiteley, University College, Nottingham.

.—Mr. Jas. O. Sullivan: "Note on the Estimation of Cane Sugar."

## RECENT EXPERIENCES WHEN PUTTING UP A STEAM BOILER.

BY F. J. R. CARULLA.

### Errata.

Page 120, col. 2, line 3 from bottom, for "had a double-riveted flue," read "had been double-riveted."

Page 120, col. 2, line 2 from bottom, for "of a boiler" read "of the boiler."

Page 121, col. 1, line 3 from bottom, for "spaces" read "holes."

Page 121, col. 2, line 14 from bottom, for "in this way" read "in its way."

# Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
J. Cohen.
T. Fairley.
W. Leach.

W. McD. Mackey.
A. G. Perkin.
C. Rawson.
F. W. Richardson.
G. W. Slatter.
Thorp Whitaker.

*Hon. Local Secretary:*
H. R. Procter, Yorkshire College, Leeds.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1894-95.

April 1st:—
Prof. Hummel and Mr. W. M. Gardner, F.C.S. "The Chroming of Wool. Part IV."
Mr. A. G. Perkin, F.R.S.E., and Prof. Hummel. "The Tinctorial Properties of some Indian Dyestuffs."

*Meeting held Tuesday, March 5th 1895.*

MR. T. FAIRLEY IN THE CHAIR.

## THE ANALYSIS OF USED LIQUORS IN CHROME TANNAGE.

BY CARLTON B. HEAL AND H. R. PROCTER, F.I.C.

Without going into the early history of chrome-tanning it is necessary to mention as briefly as possible some of the efforts which have been made to carry out the same, previous to the particular process with which we have to deal in the present paper. As early as 1853 Hylten Cavalius attempted to tan skins by treating them first with a bath of bichromate of potash and then reducing them in a bath of ferrous sulphate; this, although it produced leather, was not a commercial success. In 1880 Dr. Christian Heinzerling patented a process by which the skins were tanned in a bath of alum, salt, and bichromate of potash. This process as worked by the Eglinton Chemical Company was described in a paper which appeared in this Journal in December 1884. In this process no attempt was made to reduce the bichromate other than that effected by the fibre of the leather itself, and the effect of light on the surface. The leather after tanning was stuffed with a mixture of paraffin wax and resin. Although it attracted considerable attention at the time, this process was not taken up to any serious extent.

In 1884 Augustus Schultz patented a process in the States (dated January 8, 1884) by which he treated skins first in an acidified bichromate of potash solution, and then reduced them in a bath of thiosulphate of soda, to which acid was added to set free $SO_2$. Later in the same year he added, in a supplementary patent, the use of acidified sulphite of soda as a reducing agent, and Zahn in 1888 added salt to the bichromate bath in another patent, and made alterations in the strength of solutions. By this reduction a great advantage was gained on the Heinzerling process, in that the chrome was fixed in the fibre in a much more permanent form, and thus gave a much faster tannage, and it is this process which we propose to consider in the present paper.

This process, generally known as the two, bath or Schultz and Zahn process, is carried out briefly as follows:—

The skins, having been brought into a suitable condition for tanning, are first treated in a solution of bichromate of potash, to which has been added sufficient acid to liberate a part of the chromic acid. In this solution they remain until the fibre is thoroughly struck through. They are then drained or pressed and passed into a second bath consisting of thiosulphate of soda, to which acid is added to liberate sulphurous or thiosulphuric acid. In this manner the chromic acid and bichromate in the fibre are reduced to a green chromium salt which fixes itself in the fibre, rendering it quite insoluble even in boiling water, in fact converting it into a very perfect kind of leather.

This method of tannage has been used most successfully for the production of light leathers, and more particularly for the tannage of goat and calf skins. Its application to heavy leather is more difficult, as it does not fill out the skin sufficiently and is apt to contract the fibre too much, but if these difficulties can be overcome its special properties of resistance to moisture, toughness, and small liability to stretch seem to render it well adapted for belting of certain kinds and for picker bands. In the United States, where this method originated and where it has been brought to a high state of perfection, large and increasing quantities of this chrome-tanned leather are produced, especially in glazed kid. In this important class of leather this process has almost entirely superseded the older method—namely, tawing with alum—both on account of its greater cheapness and superior wearing qualities. In the production of coloured calf and morocco leather this process has also met with success.

The special properties of chrome-tanned leather are its resistance to moisture and its toughness—properties which greatly increase its wearing capacity. Its indifference to moisture is best shown by the fact that neither the chrome nor the fibre are dissolved in any appreciate quantity even on continued boiling in water.

Chrome leather can be heated to 80° C. without the quality of the leather being in any way affected, whereas vegetable tanned leather cannot be taken higher than 45° C. with any safety. The resistance of this leather to heat renders the dyeing of it a special feature, and it has been found that alizarin colours inapplicable to any other class of leather can be applied with success to this already chrome-mordanted leather.

To ascertain the best method of applying this process of tanning, a series of experiments were carried out, and the following results were obtained, as regards the limits of concentration &c. of solutions :—

1. Strength of solutions:
   - For the bichromate bath: 10—30 grs. per litre bichromate seem to include the best proportions.
   - In the hypo bath: 25—50 grs. per litre thiosulphate.
2. Amounts of bichromate and thiosulphate required for a given weight of pelt:
   - 3—5 per cent. of bichromate on the weight of pelt gives good results.
   - 10—15 per cent. of thiosulphate on weight of the pelt are required for reduction.
3. Amount or proportion of acid in bichromate and hypo baths:
   - $\frac{1}{4}$—$\frac{3}{4}$ of the theoretical amount of acid required to liberate all the $CrO_3$.
   - $\frac{1}{2}$—$\frac{7}{8}$ of the theoretical amount of acid required to liberate all the sulphurous acid.

The skins should be kept in motion by suitable mechanical means, both in the chroming and reducing baths.

The kind of skins employed in these experiments was what is known as sheepgrain or skiver, a thin split off the grain side of a sheep-skin. It was obtained in a condition ready for tanning—that is after having been pured and drenched. The time required for chroming this kind of skin was found to be from 1—2 hours; for the reduction, one hour was sufficient.

For heavier kinds of skin, such as goat and calf, longer time is required, from six to twenty-four hours in chroming according to the thickness of pelt, and the reduction is always known to be complete when the skin shows a uniform green colour when cut through in the thickest part.

The acid used may be either hydrochloric or sulphuric, experiment showing that no marked advantage was obtained by the use of one rather than the other, the latter of course having the preference of greater cheapness. On the same score sodium bichromate may be substituted for the potassium salt. From the above figures it will be seen that variations as to quantities, &c. are fairly wide, and no exact figures can be given, as they must be worked out according to the style and quality of leather required.

To chemists no doubt the working of this process seems a fairly simple matter, but by many tanners with but slight knowledge of chemistry, the process after a few trials more or less successful would be given up as proving too uncertain. Accustomed to the use of alum or of vegetable tannins, they would consider, and not without reason, that the use of such powerful chemicals on a delicate fibre was attended with considerable risk.

Granted that the process is a comparatively simple one, yet success in working is not invariable, and the cause of failure being often quite unaccountable, it appeared to us to be very desirable to investigate the best methods for the analysis of the used liquors, hoping by this means to find out more thoroughly what actually takes place during the process.

The first and perhaps most important point was to determine what part the free chromic acid played in the chroming bath. To do this it was necessary to estimate the free chromic acid in the solution both before and after chroming.

A method given by N. McCulloch, in Chemical News (1887, 2), was tried and with slight modifications was found to give good results. He uses hydrogen peroxide and ether, which he adds to the bichromate solution, and titrates with a standard potassium mono-chromate solution until the blue colour disappears, which had been formed by the action of the hydrogen peroxide on the free chromic acid. The use of a large test-tube is recommended for holding the bichromate, stoppered with a paraffined cork, through which passes a narrow tube to admit the standard $K_2CrO_4$, and which is connected to the burette by a small piece of rubber-tubing.

The solution requiring frequent shaking during titration, it was found that the ether vapour was sometimes forced into the rubber tubing, and as this would give incorrect readings, a 4-oz. glass-stoppered separating funnel was substituted for the test-tube, which got over the difficulty, and also allowed of more thorough shaking between each addition of $K_2CrO_4$. A narrow stoppered bottle would no doubt answer equally well.

On trying the addition of excess of standard soda and titration back with standard acid, this method was found to give rather better results than the direct titration with standard $K_2CrO_4$, as the appearance of the blue was found to be somewhat sharper than its rather gradual disappearance, and also the variation in the quantity of $H_2O_2$ added was not found to vary the results, whereas with direct titration a variation of the amount of $H_2O_2$ added was found to slightly affect their constancy.

With 25 cc. $\frac{N}{2}$ $K_2Cr_2O_7$ ($\frac{N}{2} = 24 \cdot 56$ grs. per litre) from 15—30 drops or from 1—2 cc. of 10-vol. hydrogen peroxide are used.

The excess of standard soda is first added to the bichromate, then the $H_2O_2$, and ether to the height of about 1 inch above the bichromate; the standard acid is then added from a burette, shaking well between each addition.

The $H_2O_2$ should be previously carefully neutralised, as it is usually kept in an acid condition, and the ether should likewise be quite neutral.

To determine the amount of free $CrO_3$ in a sample of commercially pure bichromate—

1. 25 cc. $\frac{N}{2}$ $K_2Cr_2O_7$ + 15 drops $H_2O_2$ (10 vol. neutralised) + 5 cc. $\frac{N}{10}$ $Na_2CO_3$ and ether required 4·7 cc. $\frac{N}{10}$ HCl,

$\therefore$ Free $CrO_3 = 0 \cdot 3$ cc. $\frac{N}{10}$ $Na_2CO_3$.

2. Ditto required 4·6 cc. $\frac{N}{10}$ HCl,

$\therefore$ Free $CrO_3 = 0 \cdot 4$ cc. $\frac{N}{10}$ $Na_2CO_3$.

1. Ditto but with 20 drops $H_2O_2$, required 4·6 cc. $\frac{N}{10}$ HCl,

$\therefore$ Free $CrO_3 = 0 \cdot 4$ cc. $\frac{N}{10}$ $Na_2CO_3$.

2. Ditto required 4·7 cc. $\frac{N}{10}$ HCl,

$\therefore$ Free $CrO_3 = 0 \cdot 3$ cc. $\frac{N}{10}$ $Na_2CO_3$.

1. 25 cc. $\frac{N}{2}$ $K_2Cr_2O_7$ + 1 cc. $\frac{N}{10}$ $Na_2CO_3$ + 15 drops $H_2O_2$ + ether require 0·6 cc. $\frac{N}{10}$ HCl,.
 ∴ Free $CrO_3$ = 0·4 cc. $\frac{N}{10}$ $Na_2CO_3$.
2. Ditto require 0·7 cc. $\frac{N}{10}$ HCl,
 Mean : free $CrO_3$ = 0·35 cc. $\frac{N}{10}$ $Na_2CO_3$.

or free $CrO_3$ = 0·24 per cent. on the weight of bichromate.

In a sample of ordinary commercial bichromate, the free $CrO_3$ in 25 cc. was found to be = 0·6 cc. $\frac{N}{10}$ $Na_2CO_3$ or 0·41 per cent. on the weight of bichromate.

With practice a fair amount of accuracy can be obtained by this method, but the blue produced is at first very faint, although soon deepening on adding a few more drops $\frac{N}{10}$ acid, and it must be seen against a white background and in a good light.

Before investigating the above method attention was paid to a qualitative method given by Ed. Donath (Zeits. Anal. Chem. **18**, 78), in which he says that neutral manganese sulphate may be used as a reagent for detecting $K_2CrO_4$ in presence of $K_2Cr_2O_7$. By adding the reagent to a boiling solution, if any $K_2CrO_4$ is present, a brownish-black precipitate is formed. If therefore a mixture of $CrO_3$, KCl, and $K_2Cr_2O_7$ (*i.e.*, an artificial used chrome liquor) were titrated with standard soda and $MnSO_4$ were used as an indicator, the point at which the free $CrO_3$ was all converted into bichromate would be indicated by the manganese precipitate. This method on trial was not found to give concordant results, and other salts were tried instead of manganese sulphate.

Copper sulphate was found to give far better results than $MnSO_4$ when used in this way as indicator. To a portion of the bichromate solution to be tested is added a few drops (2—4) of a 5 per cent. $CuSO_4$ solution ; this on bringing to the boil is titrated with standard soda, the end point being well shown by the production of a brownish precipitate. This brown precipitate is, according to Max Rosenfeld (Ber. 13 Jahrg. 1880, 1469), a basic copper chromate of the formula $CrO_3.3CuO.2H_2O$.

In estimating the free $CrO_3$ in the samples of bichromate above mentioned, the results obtained did not vary by more than 0·1cc. $\frac{N}{10}$ soda with the results obtained by the $H_2O_2$ and ether method, and the free $CrO_3$ in liquors made up ready for tanning, when estimated by the two methods, was found to vary only to the same extent. Unfortunately however, the used chrome liquor was found most difficult to obtain sufficiently clear to be estimated by the copper method. The organic matter washed out of the skin during chroming, renders the liquor opaque, and even after boiling for 15 and 20 minutes the liquor failed to give a clear filtrate, by the usual methods of filtration.

We think, however, this copper method may prove of use to dyers and others using chrome liquors, and therefore give it in some detail. The fact also that the hydrogen peroxide and ether method cannot be worked by gas light, renders another method necessary when titrations are to be performed without the aid of daylight. The difficulty of clearing opaque liquors would perhaps yield to persistent effort.

The total chromic acid in a used liquor, both free and combined as bichromate of potash, was estimated by means of standard caustic soda, using phenolphthalein as indicator.

With practice this method will be found to give good results, and was preferred to other methods on account of its simplicity and quickness. Titration with standard thiosulphate, using KI and a little strong HCl in the chrome solution, and with starch as indicator, is also an accurate method and gives good results.

Analyses of a used liquor by both methods gave results which did not vary by more than ½ per cent.

The above methods of analysis having been tested, the following experiments were performed :—

*Experiment 1.*—To determine the rate at which the pelt absorbs free chromic acid from a chroming liquor, and also to what extent.

This experiment is really made up of three separate experiments, which we will call 1*a*, 1*b*, and 1*c*.

In experiments 1*a* and 1*b*, which are simply duplicates, 1,500 grs. of pelt were used, which was divided in two equal parts, of which one half was further divided into six parts.

The weight of each of these six parts was therefore 125 grs. or $\frac{1}{12}$th of the whole weight of pelt.

The kind of pelt used was pured and drenched sheep-grain. The chroming liquor was made up of a strength of 25 grs. of bichromate per litre, and the amount was 5 per cent. of bichromate on the weight of raw pelt. The liquor then for 1,500 grs. of pelt amounted to 3,000 cc. But 250 cc. liquor were required for titration before chroming commenced, raising the amount of liquor to 3,250 cc. The weight of bichromate required for 3,250 cc. $=\frac{3{,}250\times25}{1000}=81\cdot25$ grs. The amount of acid added equalled ¼ of the amount required to liberate the total $CrO_3$ present in the liquor, and for 81·25 grs. of bichromate equalled 137·8 cc. $\frac{N}{1}$ HCl.

The chroming was performed in a barrel-churn kept in motion by means of a small electric motor. At intervals of ½ hour one of the six pieces of pelt was abstracted and an amount of liquor which, together with the piece of pelt, weighed 380 grs. or $\frac{1}{12}$th of the total weight of pelt and liquor.

By this means the proportion of pelt and liquor left in the churn was kept constant.

The following were the figures obtained for free $CrO_3$, using the ether and $H_2O_2$ method for estimation, expressing the free $CrO_3$ in terms of $\frac{N}{10}$ $Na_2CO_3$ :—

| Free $CrO_3$ in 25 cc. liq. | Experiment A. | Experiment B. |
|---|---|---|
| Before chroming ... | 11·2 cc. $\frac{N}{10}$ $Na_2CO_3$ | 11·2 cc. $\frac{N}{10}$ $Na_2CO_3$ |
| After ¼ hour „ ... | .. | 0·418 „ „ |
| „ ½ „ „ ... | 0·508 „ „ | 0·415 „ „ |
| „ 1 „ „ ... | 0·518 „ „ | 0·301 „ „ |
| „ 1½ „ „ ... | 0·518 „ „ | 0·301 „ „ |
| „ 2 „ „ ... | 0·518 „ „ | 0·119 „ „ |
| „ 2½ „ „ ... | 0·463 „ „ | 0·179 „ „ |
| „ 3 „ „ ... | 0·463 „ „ | .. .. |

From the above figures it will be seen that almost all the free $CrO_3$ is taken up within the first 15 minutes.

Therefore another experiment, No. 1c, was performed, testing the liquor every five minutes. Also in this experiment a somewhat simpler and better method was employed to keep the liquors in motion, namely a Kent's "Speedwell" churn consisting of four cylindrical glass vessels held in a wooden frame and revolved as before by means of a small electrical motor.

The following were the figures obtained, expressed as before:—

Free $CrO_3$ in 25 cc. liq. :

| | |
|---|---|
| Before chroming.................. | 11·2 cc. $\frac{N}{10}$ $Na_2CO_3$ |
| After 5 minutes' chroming..... | 0·768 „ „ |
| „ 10 „ „ ..... | 0·369 „ „ |
| „ 15 „ „ ..... | 0·369 „ „ |
| „ 20 „ „ ..... | 0·369 „ „ |

Expressing the results in percentage :—

| Free $CrO_3$ :— | Exp. 1*a*. | Exp. 1*b*. | Exp. 1*c*. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Before chroming ............ | 100·0 | 100·0 | 100·0 |
| After 5 minutes' chroming... | .. | .. | 7·0 |
| „ 10 „ „ ... | .. | .. | 3·29 |
| „ 15 „ „ ... | .. | 3·72 | 3·29 |
| „ 20 „ „ ... | .. | .. | 3·29 |
| „ 30 „ „ ... | 4·53 | 3·7 | .. |
| „ 1 hour „ ... | 4·62 | 2·68 | .. |
| „ 1½ „ „ ... | 4·62 | 2·68 | .. |
| „ 2 „ „ ... | 4·62 | 1·06 | .. |
| „ 2½ „ „ ... | 4·13 | 1·59 | .. |
| „ 3 „ „ ... | 4·13 | .. | .. |

A correction had to be made for the dilution of the chroming liquor by the introduction of the raw pelt, which was found to give up approximately 85 per cent. of moisture on drying as the result of two experiments. As the diminution of bichromate in the liquors was less than that calculated for the dilution by the above amount of water, it was clear that the bichromate had not time to diffuse into the pelt so as to produce equilibrium during the time of experiment; and it was considered that this dilution would be best calculated by the diminution of the amount of $K_2Cr_2O_7$ in a given amount of liquor, estimated both before and after chroming by means of $\frac{N}{5}$ caustic soda and phenolphthalein. The amount of bichromate of potash being obtained by subtracting the free $CrO_3$, as obtained by the ether and hydrogen peroxide method, from the total $CrO_3$, both free and combined as bichromate, as obtained by the caustic soda method.

To every 25 cc. of chrome liquor are added 12·5 grs. pelt. The water in this pelt $= 12 \cdot 5 \times \frac{85}{100} = 10 \cdot 6$ cc.

If then water to the amount of 10·6 cc. had been added instead of 12·5 grs. pelt, the $K_2Cr_2O_7$, which before equalled 15·9 cc. $\frac{N}{5}$ NaOH., would now equal $15 \cdot 9 \times \frac{25}{35 \cdot 6}$ = 11·16 cc. $\frac{N}{5}$ NaOH.

By the figures given below it will be seen that the $K_2Cr_2O_7$ is not diluted to the extent given above, and that although it diffuses readily into the pelt, the latter has nothing like the attraction for $K_2Cr_2O_7$ that it has for free $CrO_3$.

| $K_2Cr_2O_7$ in 25 cc. liq. :— | Experiment 1*b*. | Experiment 1*c*. |
|---|---|---|
| Before chroming ...... | 15·9 cc. $\frac{N}{5}$ NaOH | 15·9 cc. $\frac{N}{5}$ NaOH. |
| After 5 minutes........ | .. | „ 13·15 „ |
| „ 10 „ ........ | .. | „ 12·85 „ |
| „ 15 „ ........ | 13·1 | „ 12·85 „ |
| „ 20 „ ........ | 13·15 | „ 12·85 „ |
| „ 30 „ ........ | 13·15 | .. |
| „ 1 hour........... | 13·15 | .. |

Limit of dilution calculated by water in pelt in 25 cc. liq. = 11·66 cc. $\frac{N}{5}$ NaOH.

*Experiment* 2.—To determine how much chromic acid a piece of raw pelt will take up from successive liquors of the same strength, in excess of what is required to produce a good leather.

Three pieces of pured and drenched sheep-grain used (marked 1, 2, 3), wt. of each 125 grs. as before.

The chroming liquors are of same strength and proportion as in Experiment No. 1.

*Liquor No.* 1.—The three pieces 1, 2, 3, chromed in this liquor, volume 750 cc., for ¼ hour.

*Liquor No.* 2.—The two pieces 2, 3, chromed in this fresh liquor, volume 500 cc., for ¼ hour.

*Liquor No.* 3.—Piece 3, chromed a further ¼ hour in this liquor, volume 250 cc.

On reducing and drying out the three pieces, it is seen that piece No. 1 is better than pieces 2 and 3, which show the effects of overchroming.

*Analysis of Liquors.*

| The free $CrO_3$ in 25 cc. liq. :— | Cc. $\frac{N}{10}$ $Na_2CO_3$. | Percentage of Total $CrO_3$. |
|---|---|---|
| | | Per Cent. |
| No. 1, before chroming........... | 11·2 cc. or | 100·00 |
| No. 1, after „ ........... | 0·17 „ | 1·51 |
| No. 2 „ „ ........... | 0·25 „ | 2·23 |
| No. 3 „ „ ........... | 4·5 „ | 40·17 |

These figures are corrected as before for dilution.

They serve to show that raw pelt will take up roughly 2⅓ times the amount of $CrO_3$ necessary to produce a good leather, and therefore that too much free $CrO_3$ in chroming must be guarded against, on account of the ease with which it is taken up.

*Experiment* 3.—Since the constituents of a used chrome liquor can now be determined by analysis, this experiment was performed to see the effect of chroming with a remade liquor.

Four pieces of sheep-grain used.

Weight of each is 100 grs.

The chrome liquor being the same in proportion and quantities as in previous experiments, amounts to 200 cc for each piece.

The weight of bichromate to be added to make up used liquor to original strength, is calculated from the figures obtained in Experiment No 1 to be 1·87 grs. The acid added in making up is the same as that used in fresh liquor, as the free $CrO_3$ is all absorbed each time.

Chroming the four pieces of pelt successively in this liquor it requires making up three times.

It is then made up a fourth time and analysed.

The free $CrO_3$ found = 9·85 cc. $\frac{N}{10}$ $Na_2CO_3$ per 25 cc. of liquor.

By calculation it should equal about 10·8 cc. $\frac{N}{10}$ $Na_2CO_3$ per 25 cc. liquor.

The $K_2Cr_2O_7$ found = 12·4 cc. $\frac{N}{5}$ NaOH per 25 cc. liquor.

In the fresh liquor the $K_2Cr_2O_7$ = 15·9 cc. $\frac{N}{5}$ NaOH per 25 cc. liquor.

From these figures it will be seen that the amount of $K_2Cr_2O_7$ added was rather under the amount required.

The probable reason for loss of free $CrO_3$ is that the liquor standing some hours before estimating, the free $CrO_3$ was reduced by the organic matter dissolved out of the four pieces of pelt.

On adding to this made-up liquor slight excess of ammonia a slight precipitate was obtained, which was found to be chromium hydrate; showing that the pelt reduces a small portion of the bichromate to sesquioxide. The amount, however, is very small.

The results, as regards leather produced, show a very slight deterioration in quality, scarcely sufficient to be noticed, however.

*Eperiment* 4.—To see how far the amount of bichromate can be reduced in a chrome liquor, keeping free $CrO_3$ constant.

Four pieces of sheep-grain are chromed with ¼, ½, ¾, and all the bichromate converted into free $CrO_3$; in other words, the $CrO_3$ existing in the solution as bichromate is reduced from $\frac{3}{4}$ the total $CrO_3$ to *nil*, the total free $CrO_3$ being in each case the same.

As regards leather produced, pieces 1 and 2 are equally good; piece 3 is little inferior to pieces one and two; piece 4 is rather harsh and shows effects of underchroming.

The analysis of the liquors shows that, as before, the free $CrO_3$ is taken up very thoroughly from the liquors. In liquor No. 4, in which all the $CrO_3$ should be liberated, a little bichromate is found, showing that the KCl present converts a portion of the $CrO_3$ in $K_2Cr_2O_7$, or rather that the liberation of the $CrO_3$ is not complete.

*Experiment* 5.—In the reduction of the chromed skin by means of acidified thiosulphate of soda, the sulphurous acid, supposing it to be produced, whilst reducing the $CrO_3$, is itself oxidised to sulphuric acid. This experiment was performed to determine to what extent the remaining thiosulphate in the reducing bath was acted on by this sulphuric acid.

Two baths, each containing 10 grs. pure sodium thiosulphate, were used to reduce two pieces of chromed pelt of equal weight, the amount of acid added to each bath, sufficient to reduce the skins, being 35 cc. $\frac{N}{1}$ HCl. If the thiosulphate were not acted on further than by the 35 cc. $\frac{N}{4}$ HCl. added to it, the available thiosulphate remaining in the bath should be 56·6 per cent. of the total. On analysis of the used liquors the available thiosulphate was found to be 51·82 per cent. and 48·81 per cent. respectively. This shows that the sulphuric acid produced by oxidation does not act to any considerable extent upon the thiosulphate.

The method of analysis employed was that of titrating the used liquor into a known quantity of $\frac{N}{10}$ bichromate of potash largely diluted, and acidified with a few cc. of concentrated HCl, using KI and starch as indicator, the starch being added towards the end of the titration.

We see from Experiment No. 1 that the free $CrO_3$ is very thoroughly and very rapidly taken up from the liquor by the pelt; although this is the case, sufficient time must be allowed for it to become thoroughly distributed throughout the fibre of the skin. Knowing this fact we should be careful in placing a large number of skins in a liquor, that the length of time occupied in this operation be as limited as possible, otherwise the first portions of the "pack," as it is called, will absorb more than their share of $CrO_3$. From the other experiments we see that pelt can be very easily overchromed; also that having the means of knowing the constituents of a used chrome liquor, it can be remade, and no loss of bichromate occur by running away liquors, as is often the case at present.

With regard to the question of reduction, whilst refraining from expressing any decided opinions, we think it well to indicate some of the points in it which have to be decided.

The statement that sulphurous acid—produced by the addition of acid to sodium thiosulphate—is the reducing agent, appears, on the face of it, a satisfactory explanation of the reduction process, but that this is not altogether the case, is apparent from the two following facts:—

Firstly, that sulphur dioxide dissolved in water, whilst reducing the chromic acid in the fibre, has not the power of fixing it in the fibre to anything like the same extent that an acidified thiosulphate solution has. For this reason the former is not suitable as a reducing agent.

Secondly, that sulphurous acid being a decomposition product of the unstable thiosulphuric acid first formed, sulphur as a precipitate should be found in considerable quantities in the bath. When, however, the acid is added to the thiosulphate gradually very little sulphur is precipitated. These two facts point rather to the conclusion that it is the unstable thiosulphuric acid first produced which is the reducing agent *per se*.

In conclusion, we hope that the methods for analysing the chrome liquor which we have explained in this paper, will enable this process to be worked, if not with more economy, at least with more certainty of obtaining good results.

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# Scottish Section.

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J. Stanley Muir, Chemical Laboratory, University of Glasgow.

SESSION 1894-95.

*Dates of Meetings for 1895.*

Glasgow.—Philosophical Society's Room, 207, Bath Street. May 7th.

Edinburgh.—Philosophical Institution, 4, Queen Street. April 2nd.

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*Meeting held in the Philosophical Society's Rooms, 207, Bath Street, Glasgow, on Wednesday, March 6th, 1895.*

MR. R. A. INGLIS IN THE CHAIR.

## THE ACTION OF GELATINE ON SALINE SOLUTIONS.

BY PROF. E. J. MILLS, D. SC., F.R.S., AND W. D. SAWERS, A.I.C.

ALTHOUGH gelatine is one of the most familiar of chemical substances, most of the questions relating to it have been hitherto very imperfectly investigated. It has accordingly engaged our attention; and we have now to report to the Society the first instalment of our results.

The gelatine we employed was "Nelson's No. 1" in flakes. It had very little colour, and was quite neutral. When quantitatively analysed, it furnished the following (mean) results:—

| | | |
|---|---|---|
| Carbon | 38·99 | 81·46 |
| Hydrogen | 7·50 | |
| Nitrogen | 13·90 | |
| Oxygen | 21·07 | |
| Ash (corrected) | 2·10 | |
| Water | 16·44 | |
| | 100·00 | |

The ash amounted to 2·60 per cent.; from this we have deducted 0·50, being the amount of carbonic dioxide it contained. Qualitatively, the ash consisted of calcic and magnesic carbonates and phosphates.

We examined one of our chromium compounds for this ash, but could find none remaining.

Apart from ash and water, our gelatine had the following composition:—

| —— | — | $C_{78}H_{180}N_{24}O_{32}$ |
|---|---|---|
| Carbon | 47·86 | 47·65 |
| Hydrogen | 9·21 | 9·17 |
| Nitrogen | 17·06 | 17·11 |
| Oxygen | 25·87 | 26·07 |
| | 100·00 | 100·00 |

Schutzenberger (*Comptes rend.* lxxxii. 262) suggests the expression $C_{76}H_{124}N_{24}O_{29}$. We shall abbreviate our own formula to the symbol G; and, for the sake of simplicity, we shall represent our gelatine derivatives as additive compounds.

### *Chrome Alum (Potassic).*

(A.) A litre of a 7½ per cent. solution of this alum (*i.e.* about 3 per cent. of chromic sulphate) was made up in the cold; and 60 grms. of gelatine, cut up into strips, were introduced into it. The experiment was carried out in a closed white Winchester bottle, at the ordinary temperature, and lasted seven days, the bottle being occasionally shaken. The gelatine, which did not swell up, was observed to turn gradually of the same colour as the solution, which became visibly paler; these effects reached their maximum between the third and fourth days. The results were:—

| —— | Chromic Oxide. | Sulphate ($SO_3$). |
|---|---|---|
| 100 cc. contained before treatment | 1·53 | 3·14 |
| „ „ after „ | 1·36 | 2·78 |
| Absorbed by gelatine ............ | 0·17 | 0·36 |

Thus the total chromic oxide absorbed by the gelatine was 0·17 × 7·3 = 1·241 grms.; and the total sulphate 0·36 × 7·3 = 2·628 grms. The relation between the gelatine and the absorbed sulphate is expressed very nearly by the expression $3G.Cr_2O_3.{}_4SO_3$. In all probability, therefore, the chrome alum had been taken up unaltered.

The liquid standing over the gelatine having been removed, the gelatine was thoroughly washed with eight waters—until, in fact, it ceased to yield any practical quantity of sulphate. It was found to contain[*] per cent.

| | |
|---|---|
| Water.............................. | 19·59 |
| Sulphate............................ | 5·19 |
| Chromic oxide...................... | 4·43 |

These numbers correspond to $4G.3Cr_2O_3.7SO_3$. This compound has the colour of chrome alum. It is quite insoluble in boiling water. An equal weight of acetic acid diluted with about twice its weight of water, slowly dissolves it at a gentle heat. This solution has been in request for many years as a photographic varnish; it leaves a residue of insoluble gelatine when it is dried up.

If we compare the formulæ of the gelatine compounds before and after treatment with water, we see that gelatine must be capable of decomposing weak solutions of chrome alum, and that water decomposes neutral chrome-alum-gelatine; the result being that a basic chromic sulphate remains combined with the gelatine.

(B.) Being desirous of increasing the acid effect of gelatine as thus observed, we made up another solution of very nearly the same strength as before; to this a 30·24 per cent. solution of caustic potash ("pure by alcohol") was added until a permanent precipitate was produced. The amount of potash employed was 9·33 grms. The clear filtered liquid was allowed to stand by itself for some days, but deposited nothing. 750 cc. of the solution and 60 grms. of gelatine were used as before.

It was noticed that the gelatine took on the chrome alum colour much faster than in (A); and the colour was deeper at the end. During the last three days of the digestion, a fine whitish crystalline precipitate settled to the bottom of the bottle; this was separately analysed. The results were:—

| —— | Oxide. | Sulphate. |
|---|---|---|
| 100 cc. contained before treatment... | 0·90 | 1·79 |
| „ „ after „ ... | 0·47 | 1·48 |
| Absorbed by gelatine and in the precipitate. | 0·43 | 0·31 |
| In the precipitate .................... | 0·01[†] | 0·029 |
| Absorbed by gelatine ................ | 0·42 | 0·281 |

Thus the gelatine compound under the liquid had the composition $5G.4Cr_2O_3.4SO_3$. This was washed and air-dried as before; it gave the following percentage results on analysis:—

| | | |
|---|---|---|
| Water ...................... | 20·01 | 97·42 |
| Sulphate.................... | 6·43 | |
| Chromic oxide .............. | 6·01 | |
| Nitrogen.................... | 11·11 = 64·94 gelatine | |
| Water of combination....... | 2·58 | |

The nearest symbolic expression is $5G.6Cr_2O_3.12SO_3$.

Thus the sulphate has been reduced, by the addition of caustic potash, only very slightly (in proportion to the oxide); but there has been a very considerable increase in the amount of basic sulphate taken up.

This compound also is insoluble in boiling water.

C. In this case, caustic potash was added, to a new and similar solution of chrome alum, until a large precipitate had been formed. After nine days repose, the liquid was filtered, and digested with gelatine. We obtained in this way a compound, which we partially analysed, and found to be still more basic; it also contained potash.

### *Alumina Alum (Potassic).*

In this, as in the subsequent cases, the solutions were ultimately made up of such a strength that the characteristic sulphate was present in the proportion of about 3 per cent. Purified caustic potash was added to this solution until a faint precipitate permanently remained. Into the Winchester containing 713 cc. of the filtrate, 20 grm. gelatine were introduced. Between the third and fourth day, a very slight precipitate made its appearance. The usual treatment was resorted to—

| —— | Oxide. | Sulphate. |
|---|---|---|
| 100 cc. contained before treatment ... | 0·3145 | 2·095 |
| „ „ after „ ... | 0·1655 | 1·950 |
| Absorbed by gelatine ................ | 0·1490 | 0·145 |

It will be found that the absorption corresponds to a ratio $4G.5Al_2O_36SO_3$. The washed and air-dried product contained 20·31 per cent. of moisture. The anhydrous substance contained 5·71 per cent. of alumina, and 3·41 per cent. of sulphate; its composition being therefore $4G.9Al_2O_3.4SO_3$. It is evidently much more easy to make a basic aluminium compound than a chromium compound.

The aluminium compound dissolves slowly in boiling water.

### *Nickelous Sulphate.*

This salt was treated with ammonia until only a small quantity remained undissolved, and the solution was made up of the usual strength. Into 775 cc. of it, 20 grms. of gelatine were introduced. The results were:—

| —— | Oxide. | Sulphate. |
|---|---|---|
| 100 cc. contained before treatment ... | 0·8139 | 1·0168 |
| „ „ after „ ... | 0·8739 | 1·0530 |

It is clear from these figures that the gelatine effected a considerable concentration of the solution; and that it had taken up more sulphate than oxide. The washed and air-dried product contained 20·79 per cent. of moisture; only traces of sulphate were present, the percentage of oxide in the anhydrous substance was 4·23; which would correspond to the expression 6G.7NiO. Nickelous gelatine, as thus prepared, was only partly soluble in water, a decided amount of green nickelous hydrate remaining behind on heating. We think it very probable that the soluble compound is G.NiO. The solidified solution was a dirty-green jelly, transparent by transmitted light, but opaque by reflected light.

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[*] Our analytical statements are in most cases means of two or more accordant determinations.

[†] Calculated from the sulphate, on the supposition that the liquid and precipitate were of the same composition.

*Cobaltous Sulphate.*

An ammoniacal solution of cobaltous sulphate was made up in the ordinary way, filtered, and allowed to stand for some days in a bottle having an air-tight stopper. Some cobaltamine sulphates nevertheless made their appearance. 20 grms. of gelatine were introduced. All attempts to analyse the solution, before and after the introduction of the gelatine, failed, owing to the presence of amines.

The washed and air-dried gelatine had a red-brown colour, and contained 20·32 per cent. of moisture, only a trace of sulphate was present. After drying at 100°, it contained 3·70 per cent. of cobaltous oxide. This would correspond to the relation $\mathrm{G.CoO}$.

Cobaltous gelatine dissolves completely in boiling water. The solution is red-brown and transparent by transmitted light; nearly black and opaque by reflected light.

*Zinc Sulphate.*

An ammoniacal solution of this sulphate was prepared as before, and treated with 20 grms. of gelatine.

| —— | Oxide. | Sulphate. |
|---|---|---|
| 100 cc. contained before treatment ... | 1·1180 | 1·4914 |
| „ „ after „ ... | 1·1000 | 1·4750 |

Thus the gelatine took up a small amount of oxide, and concentrated the solution. While under the liquid, it was very much swollen up. When thoroughly washed, it was found to contain neither zinc nor sulphate.

*Cupric Sulphate.*

This salt was dissolved in water, and ammonia added in quantity just insufficient to redissolve the usual precipitate. 20 grms. of acid to 790 cc. of the liquid.

| —— | Oxide. | Sulphate. |
|---|---|---|
| 100 cc. contained before treatment ... | 1·1550 | 1·4100 |
| „ „ after „ ... | 1·2950 | 1·4500 |

There had thus been a concentration of the liquid; but the gelatine had taken up more sulphate in proportion than oxide. The gelatine was very much more swollen up than in any of the other experiments.

The washed and air-dried product was blue-green, it contained 23·25 per cent. of moisture. When dried at 100° it contained 4·69 per cent. of cupric oxide, and practically no sulphate,—a result closely corresponding with the expression $5\mathrm{G.6CuO}$. Cupric gelatine, as thus prepared, does not wholly dissolve in boiling water; and it is very possible that the soluble portion of it has the simple formula $\mathrm{G.CuO}$. The solidified solution is a dirty-grey jelly transparent by transmitted light, but opaque by reflected light.

Our best thanks are due to Mr. Jno. Morrison and Dr. A. R. Ewing, for valuable assistance in this investigation.

*Note.*—As it was desirable to discover if a perfectly homogeneous gelatine was obtainable, since the conclusion of the above research we have had the subject under continued investigation. We have now succeeded in finding a method of fractionating gelatine which shows us that the gelatine we worked with was, if not absolutely pure, a nearly homogeneous body. We are of opinion, therefore, that the formulæ we have adduced are not likely to be altered by later experiments.

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*Meeting held at the College of Pharmacy, Monday, 4th February 1895.*

MR. A. H. MASON IN THE CHAIR.

## A COMPARISON OF THE OFFICINAL METHODS FOR THE ASSAY OF OPIUM AS PRESCRIBED IN THE U.S. PHARMACOPŒIAS OF 1880 AND 1890.

BY J. H. WAINWRIGHT.

For the past 10 or 15 years the literature on the subject of the morphiometric assay of opium has been probably more voluminous than upon any other analogous subject, and has engaged the attention of many of the most eminent authorities both in this country and Europe, who have proposed many processes of assay and modifications thereof.

It is not my purpose to enter into a discussion of the subject of the morphiometric assay of opium in general, but simply to compare the present officinal process of the U.S. Pharmacopœia with the one which it has superseded; and, in doing so, I shall endeavour to demonstrate the undoubted superiority of the one over the other, since these two processes may, in a measure, be regarded as fairly typical of all the methods of any value which have been from time to time proposed. All of these various methods, or, at least, such of them as are of practical value, are merely more or less elaborate modifications of one or the other of the two under discussion, mainly in relation to the details of manipulations, &c.

The requirements of a method for the assay of a drug such as opium, having all the authority of an officinal standard, are that it should yield results accurate within reasonable limits (say 0·32 to 0·3 per cent.) and that its manipulation should be simple enough to be within the range of the average pharmacist.

The former method of assay (which I shall refer to as the "U.S.P. 1880") is, in brief, as follows: A given weight of the drug (7 grains) is triturated with a given weight of freshly-slaked lime and a given volume of distilled water; the resulting mixture is thrown on a filter and an aliquot part of the filtrate transferred to a flask, alcohol and ether in prescribed proportions added, and the alkaloid precipitated by the addition of a given weight of ammonium chloride. After standing, the precipitated crystals are collected on a filter, washed, dried, and weighed.

The method of assay *at present officinal* in this country (U.S.P. 1890) is substantially the one first proposed by Dr. E. R. Squibb in "Ephemeris" in 1882, as a modification of the "Flückiger" process, and subsequently treated of by the same eminent authority in succeeding numbers of "Ephemeris" in which the details were somewhat elaborated and modified. This most excellent process consists in exhausting a given weight (10 grains) of the drug with distilled water, filtering and concentrating the *entire* filtrate and washings to small bulk, to which is added alcohol and ether in prescribed proportions and from which the alkaloid is precipitated by means of ammonia. The precipitated crystals are collected on a filter, washed, dried, and weighed, from which the percentage is calculated.

In order to prevent confusion, I shall refer to the present officinal process as the "Squibb process"; and for the details of this and other processes it will be sufficient to refer to the voluminous literature on the subject from the pens of such well known authorities as Professor Flückiger, Eugen Dietrich, Dr. E. R. Squibb, Professor Cornwall, Mr. C. M. Stillwell, Mr. D. B. Dott, Dr. O. Hesse, Dr. J. F. Geisler, and others. The radical differences in the two methods under discussion are, in the one case, the use of lime in the extraction of the opium, the precipitation of the alkaloid in an aliquot part of the filtrate, and in the use of ammonium chloride as a precipitant; in the other case the exhaustion of the drug is effected by means of distilled water alone, the *entire* filtrate and washings being reduced to small bulk, and ammonia used as the precipitant.

The "U.S.P. 1880" process is simple, rapid, easy to manipulate, and gives very nearly pure crystals of the alkaloid, but it is generally admitted that it appears to yield less morphia than the drug contains, notwithstanding the fact that concordant results are readily obtained if the process be conducted with care and nicety. Dr. Squibb has stated that the deficiency is usually from 1 to 3 per cent., although my results have in many cases shown the deficiency to be much less. This quantitative defect has been ascribed by various authorities to several causes, among which may be mentioned, that the use of lime probably prevents the precipitation of a considerable proportion of morphia; that ammonium chloride is not so good a precipitant as free ammonia; that the assumption that an aliquot part of the filtrate represents an aliquot part of the weight taken is erroneous, since it is probable that the discarded portion is apt to contain a relatively larger proportion of the partially soluble substance than the part taken; that the precipitation of the alkaloid is effected in too dilute a solution, &c.

It is true that the "Squibb process" is somewhat more tedious than the "U.S.P. 1880" inasmuch as more time is consumed in extracting the opium, filtering the infusion, washing the insoluble residue, and concentrating the resulting filtrate and washings to a small bulk; but I believe all this to be absolutely necessary in order to obtain all the morphia the sample will yield.

It is equally true that the crystals of morphia yielded by the "Squibb process" are apt to contain a greater amount of impurities than those yielded by the "U.S.P. 1880" process; but, although more elaborate in detail and consuming more time, it is extremely simple, and, if conducted with care, can be made to yield very nearly the true per cent. of morphia. The amount of impurity in the crystals is nearly always insignificant, and may usually be neglected, especially if the crystals are tested qualitatively with limewater as directed by Dr. Squibb, or better still, if treated with limewater and titrated with decinormal oxalic acid ("Ephemeris," Vol. III., p. 1159) in cases where extreme accuracy is required.

The defect in the "U.S.P. 1880" process is admitted to be *quantitative*, but its *particular nature* has not as yet been treated upon so far as I know. Experience teaches one that it is a defect inherent to any process for the assay of opium based upon the principle embodied in this one, viz.: the assumption that an aliquot part of the filtrate represents an aliquot part of the opium taken, and that it is of such a nature as to entirely vitiate any process, however simple, and to render it entirely worthless as an officinal process of assay by means of which the strength of a drug such as opium is to be determined. It is quite possible that the use of lime in the extraction, the precipitation of the alkaloid in a comparatively dilute solution, and the use of ammonium chloride instead of free ammonia to effect this precipitation, may in a measure account for or contribute to the defect in the process, but the chief cause appears to me to be as stated.

If the results yielded by an arbitrary process of assay, such as the "U.S.P. 1880," or modifications thereof which had been proposed (the results being admittedly too low) are intended to indicate in any sense the *measure* of the percentage of morphia contained in a given sample, it should be possible, in order to express the *true* percentage, to apply to them a plus or minus correction, which correction *should be a constant factor*. In other words, the ratio between the true percentage and the arbitrary result of any process of assay should be *constant* in all cases. This necessary constant ratio cannot be established for the very obvious reason that the portion of opium soluble in cold water may vary widely in different samples, and therefor 50 cc. of the filtrate from 7 grms. may contain the soluble part of 5 grms., more or less, according to the composition of the sample. The same would of course be true were any other proportions used.

The fact that any particular process of assay will yield concordant results by itself is, as is well known, apt to be misleading, and is only of secondary importance in forming an opinion as to its value, the true test of which should be, how accurate are the results in establishing a measure or standard of strength which is uniform in all cases within a reasonable margin or error?

That the "Squibb process" meets the requirements of this question admirably will, I think, be readily admitted; that the "U.S.P. 1880" process does not come up to it in any particular, I believe to be clearly demonstrated by the following figures which are the results of assays of three different lots of Smyrna opium which I made sometime ago to test this very question, and which shows the results obtained by the "Squibb process" conducted substantially as prescribed in the present U.S. Pharmacopœia, and by the "U.S.P. 1880" process applied side by side, to 55 different samples, the crystals in both cases being dried at 100° C., before weighing:—

10 *Samples.*

| "Squibb Process." | "U.S.P. 1880." | Difference. |
|---|---|---|
| 9·3 | 9·0 | 0·8 |
| 10·0 | 9·6 | 0·4 |
| 9·8 | 9·7 | 0·4 |
| 10·0 | 9·6 | 0·4 |
| 9.7 | 9·0 | 0·7 |
| 10·1 | 9·1 | 1·0* |
| 10·1 | 9·6 | 0·4 |
| 10·1 | 9·3 | 0·8 |
| 9·8 | 9·7 | 0·1† |
| 9·5 | 9·3 | 0·2 |

* Greatest difference. † Least difference.

20 *Samples.*

| "Squibb Process." | "U.S.P. 1880." | Difference. |
|---|---|---|
| 9·5 | 8·8 | 0·7 |
| 9·4 | 8·6 | 0·8 |
| 9·8 | 8·7 | 1·1 |
| 9·5 | 8·8 | 0·7 |
| 9·7 | 9·1 | 0·6 |
| 9·1 | 8·5 | 0·6 |
| 9·8 | 8·7 | 1·1 |
| 9·5 | 8·5 | 1·0 |
| 9·6 | 8·7 | 0·9 |
| 9·7 | 8·5 | 1·2 |
| 10·3 | 9·2 | 1·0 |
| 10·1 | 8·9 | 1·2 |

| "Squibb Process." | "U.S.P. 1880." | Difference. |
|---|---|---|
| 9·7 | 8·8 | 0·9 |
| 9·8 | 8·9 | 0·9 |
| 10·6 | 9·6 | 1·0 |
| 10·7 | 10·4 | 0·3† |
| 10·2 | 8·9 | 1·3* |
| 9·9 | 8·8 | 1·1 |
| 10·1 | 8·9 | 1·2 |
| 10·3 | 9·5 | 0·8 |

* Greatest difference. † Least difference.

25 *Samples.*

| "Squibb Process." | "U.S.P. 1880." | Difference. |
|---|---|---|
| 9·4 | 9·0 | 0·4† |
| 9·4 | 9·0 | 0·4† |
| 9·4 | 8·8 | 0·6 |
| 9·3 | 8·8 | 0·5 |
| 9·3 | 8·6 | 0·7 |
| 9·6 | 8·4 | 1·2 |
| 9·8 | 9·0 | 0·8 |
| 9·5 | 8·8 | 0·7 |
| 9·1 | 8·2 | 0·9 |
| 9·4 | 8·4 | 1·0 |
| 9·2 | 8·6 | 0·6 |
| 9·0 | 8·0 | 1·0 |
| 8·5 | 7·6 | 0·9 |
| 9·7 | 8·5 | 1·2 |
| 9·9 | 8·6 | 1·3 |
| 9·5 | 8·7 | 0·8 |
| 9·2 | 8·7 | 0·5 |
| 9·1 | 8·1 | 1·0 |
| 9·8 | 9·0 | 0·8 |
| 9·3 | 8·6 | 0·7 |
| 9·2 | 8·2 | 1·0 |
| 9.1 | 8·7 | 0·4 |
| 8·4 | 6·6 | 1·8 |
| 9·5 | 8·2 | 1·3 |
| 9·2 | 7·3 | 1·9* |

* Greatest difference. † Least difference.

These assays were conducted with great care. In the case of the "U.S.P. 1880" process the directions as prescribed were followed explicitly, and in the "Squibb process" the crystals of morphia were tested with lime water in every case. The majority of the figures are the results of the means of duplicate tests by each process, and, assuming that the "Squibb process" yields very nearly the true percentage of morphia, would seem to show conclusively that the results of assays by the "U.S.P. 1880" process are not uniformly proportional to the morphiometric strength of all samples, and that it is not possible to determine a *constant* factor to be applied to its results and thus make them agree in all or in any considerable number of cases with the true percentage, as shown by the "Squibb process." It therefore follows that the yield of morphia by the "U.S.P. 1880" process is very rarely a measure of the morphiometric strength of the drug or anywhere near it, and I believe this fact to be of far greater importance than the mere question of simplicity in the details of manipulation or time consumed as between the two processes when the great importance of the establishment of an officinal standard is considered.

Having had occasion, during the last eight or ten years to assay several thousand samples of opium of all kinds, I am firmly convinced that the principles embodied in the process as prescribed in the U.S.P. of 1890 are the only ones which yield results anywhere near the truth, and by following out the process in all its minor details, concordant results, well within the limits of analytical error, may be readily obtained.

## Discussion.

Dr. Squibb:—I have first of all to give in my adhesion to the use of the word "officinal." I support it, not because the word official is incorrect, nor because it is not in more general use, but it does not differentiate a very important class of preparations as I should like to see them differentiated, when much of the progress of the day is aided in precision by drawing fine distinctions. There is another reason for the use of officinal. You cannot very well talk of an official fat as you can of an official document, and to speak of many articles which are embraced in the pharmacopœias as "official," sounds strangely at least, and does not tend to a distinctive precision of meaning, which is more needed every day.

In regard to the opium question, in my paper, which Dr. Wainwright has alluded to, I stated that not more than 1 in 20 of the assays in opium required a correction by the lime-water test. This I beg to correct, now and here, because it is a mistake. There is a much larger proportion in my later experience. Dr. Wainwright has used the lime-water test simply as a qualitative test, not for correction of results. I have here a memorandum of the results of the assays of opium in my laboratory during the past year, which I thought it worth while to bring for the purpose of showing that the lime-water correction is a very necessary one, and I only regret that it was not embraced in the pharmacopœia process. There are here assays of 28 cases of opium in 14 different lots, and each assay was made by several persons—generally three or four—and it may be interesting to read the results.

The first assay was of five cases; and I beg to call Dr. Wainwright's attention to the fact that in these assays the opium is of a higher grade than his. His highest grade is 10·7 per cent. My grades are from 12 to 15 or 16 per cent. In the first instance, the four assays agreed as closely as this:—13·82, 13·79, 13·84, 13·81 per cent. When corrected by the lime-water test they gave 12·82, 12·72, 12·65, 12·81 per cent., and the differences which were subtracted by the lime-water test were, 1·00, 1·07, 1·19, and 1·00 per cent., agreeing pretty well among themselves, as the limit of error in the process is 0·2 to 0·3 per cent. The same lot was then dried and powdered and assayed together. The powder gave 16·71, 16·73, 15·74 (evidently a mistake), and 16·31 per cent. Corrected by the lime-water test, 15·94, 15·77, 14·71, 15·26 per cent. Differences by lime water correction, 0·77, 0·96, 1·03, 1·05 per cent.

The next lot was one single case. This gave of morphia 13·91, 13·49, 12·9, 13·57 per cent. Corrected, 13·63, 12·87, 12·66, 13·37 per cent. Differences, 0·28, 0·62, 0·24, 0·20 per cent.

The next lot of five cases gave 13·26, 13·12, 12·7, 13·45 per cent. Corrected, 12·60, 12·46, 11·92, 12·41 per cent. Differences, 0·66, 0·66, 0·78, 1·04 per cent. A portion of those five cases was then dried and powdered and gave 16·71, 16·57, 16·07, 16·35 per cent. Corrected, 15·61, 15·91, 15·59, 15·22 per cent. Differences, 1·10, 0·66, 0·48, 1·13 per cent.

The next five cases are about the same as the former five cases.

The next was a lot of one case, which gave 13·15, 13·04, 13·09 per cent. Corrected, 12·22, 12·1, 12·0 per cent. Differences, 0·93, 0·94, 1·09 per cent.

OPIUMS ASSAYED IN 1894.

28 *Cases of High-Grade Opium assayed in* 14 *lots.*

| Date. | — | Crude Morphia. | Corrected Morphia. | Difference. |
|---|---|---|---|---|
| Jan. 20 | Gum, 5 cases......... | 13·82 | 12·82 | 1·00 |
| | | 13·79 | 12·72 | 1·07 |
| | | 13·84 | 12·65 | 1·19 |
| | | 13·81 | 12·81 | 1·00 |
| „ 20 | Powder (same lot)... | 16·71 | 15·94 | 0·77 |
| | | 16·73 | 15·77 | 0·96 |
| | | 15·74 | 14·71 | 1·03 |
| | | 16·31 | 15·26 | 1·05 |
| Feb. 3 | Gum, 1 case.......... | 13·91 | 13·63 | 0·28 |
| | | 13·49 | 12·87 | 0·62 |
| | | 12·9 | 12·66 | 0·24 |
| | | 13·57 | 13·37 | 0·20 |
| „ 24 | Gum, 5 cases......... | 13·26 | 12·60 | 0·66 |
| | | 13·12 | 12·46 | 0·66 |
| | | 12·7 | 11·92 | 0·78 |
| | | 13·45 | 12·41 | 1·04 |
| „ 24 | Powder (same lot) ... | 16·71 | 15·61 | 1·10 |
| | | 16·57 | 15·91 | 0·66 |
| | | 16·07 | 15·59 | 0·48 |
| | | 16·35 | 15·22 | 1·13 |
| March 10 | Gum, 5 cases......... | 13·99 | 13·20 | 0·79 |
| | | 13·90 | 13·46 | 0·44 |
| | | 14·06 | 13·32 | 0·74 |
| | | 14·04 | 13·29 | 0·75 |
| „ 10 | Powder (same lot)... | 16·51 | 16·35 | 0·16 |
| | | 16·97 | 16·22 | 0·65 |
| | | 16·84 | 16·23 | 0·57 |
| April 7 | Gum, 1 case.......... | 13·15 | 12·22 | 0·93 |
| | | 13·04 | 12·1 | 0·94 |
| | | 13·09 | 12·0 | 1·09 |
| May 10 | Gum, 1 case ......... | 12·21 | Soluble. | |
| | | 12·24 | | |
| July 11 | Gum, 6 cases ........ | 12·4 | 11·9 | 0·5 |
| | | 12·95 | 12·3 | 0·65 |
| „ „ | Powder (same lot) ... | 16·10 | 15·16 | 0·94 |
| | | 15·90 | 15·05 | 0·85 |
| August 6 | Gum, 1 case.......... | 12·04 | 11·15 | 0·89 |
| | | 11·86 | 11·17 | 0·69 |
| „ 17 | Gum (Smyrna), 1 case | 12·53 | Soluble. | |
| | | 12·32 | | |
| Dec. 21 | Powder, 2 cases...... | 17·5 | Soluble. | |
| | | 17·9 | | |

Then comes a lot where there was no correction—where the whole precipitate was soluble in lime water.

Then six cases, with about the same results.

Then another case of crude opium, with about the same results.

Then two lots in which the precipitates were totally soluble in lime water and no correction to make; and here it is noticeable that where the precipitate is all soluble and no correction needed, the figures agree very closely with the other cases where the lime-water correction was applied.

I trouble you with these simply to show that I must have been much mistaken in stating that but 1 case in 20 would require the lime-water correction. Here are 14 assays where only 3 escaped the lime water correction. Whether the difference in the grades of opium embraced in these assays makes any great difference in the amount of correction required, I should like to hear Dr. Wainwright's opinion. My own impression is that there may be something in that. One of the highest grades here needs no correction, and one of the lowest.

I observe that Dr. Wainwright dries his morphia at 100° C. This makes anhydrous morphia, and if his results are to be brought to the usual way of stating these results, namely, in crystallised morphia, about 7 per cent. must be added to his figures. In these assays it is better that the crystals be dried at 60° C., as that does not decompose the hydrate. If the drying be done beyond that, some degree of decomposition or driving off the water of crystallisation is liable to occur. An important point in the drying of the crystals from the assay is that they be freely percolated, first with morphiated alcohol to displace the water, and then with ether to displace the alcohol. Then drying is easily done to a constant weight in an hour or two at a temperature below 60° C.

Dr. GEISLER: In 1888 I had occasion to go over these very important processes critically,* and I found that the very point that the author brings up here were actual errors in the methods. Most of the morphia was lost in the mother-liquor. The aliquot part 50 cc. did not accurately represent 5 grms. of opium. As near as I can recollect the highest difference which I found between the 1880 method and Squibb's was 1·79 per cent., and, as a rule, the differences did not run over 0·4. As to the drying of the crystals, in drying above 60° C. they lost water of crystallisation. They averaged about 6·8 of water.

Mr. STILLWELL: When this subject came up ten or twelve years ago, I made a very careful examination of the whole thing, and my experience confirms Dr. Wainwright that the aliquot method is good for nothing. You must have a thorough extraction in order to get comparative results. You take duplicates of the same opium, run them side by side, and one will crystallise and the other duplicate will have quite a deposit on the bottom of the flask. When corrected the results will come very close, within 0·1 or 0·2 per cent. In cold weather there are larger differences. With the different grades of opium I have found that the higher grades need very little correction. Perhaps not more than 0·1 or 0·2. I compared both the lime water and alcohol methods and found no difference between them. I used the alcohol method because it gives a saturated solution of morphia in alcohol. I found it was necessary to purify the precipitate by a solution of alcohol saturated with morphia, and as to the washing with water saturated with morphia, I used that because it was recommended. I think Dr. Squibb called attention to the fact that pure water alone made very little difference. In testing all kinds of opium I do not dare to report without testing the final crystals. In regard to the drying, in the final washings, I use a larger amount of ether than I have ever seen recommended anywhere, and that thoroughly washes out all the alcohol, so that the crystals dry in 15 or 20 minutes. If the drying were continued for an hour or two at 100°, I suppose there would be a difference.

Dr. V. COBLENTZ: My experience with opium assay has been its application among 150 to 200 students each college term. Should there be any weak points in a method, they will certainly develop them. Working with the lime method of the old Pharmacopœia, our students obtained very discordant results. In fact, after a few trials, we abandoned it for the Flückiger method. We were always able to extract considerable quantities of morphia from the mother liquors left over from the former process. The present Pharmacopœia method we have employed during the past three years, with exceedingly satisfactory results, it being readily comprehended by the students. Out of 200 analyses made a short time ago, fully three-fourths of them corresponded within one-half of 1 per cent., which is remarkably well considering students' work. What I have said in regard to students will also apply to the apothecary, who, not being skilled in applying analytical methods, is certain to meet with difficulties, particularly so in such work as opium assay. The present U.S.P. method is therefore calculated to give great satisfaction, not only because of its accuracy, but also its simplicity. I for my part am very much prejudiced in favour of our present method, as the result of a long series of experiments carried out for the "Revision Committee" of the Pharmacopœia of 1890.

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* "Notes on the Morphiometric Assay of Opium." Proceed. of the Amer. Pharm. Assoc., Vol. 36; Jour. Amer. Chemical Soc., Vol. X., p. 143.

The Chairman: I would like to ask Mr. Wainwright whether the formula prescribed in the U.S. Pharmacopœia for the estimation of morphia and opium is the one adopted by you as the standard, officially?

Dr. Wainwright: The method as at present prescribed in the Pharmacopœia is substantially the same method that has been used in the United States Laboratory since about 1883.

The Chairman: And in case of a dispute that would be the standard?

Dr. Wainwright: So far as we are concerned it would. Sometime ago there was a question raised as to the propriety and legality of assaying opium by any other method than that of the Pharmacopœia. I mean the Pharmacopœia which was then officinal, viz., that of 1880. We had discarded that method, having satisfied ourselves that it was worthless, and had assayed opium for a long time as prescribed by the Squibb process. Dr. B. F. Davenport, of the Massachusetts Board of Health, objected to that because the Treasury regulations prescribed that imported drugs which were required to conform to a standard of strength should be referred to the pharmacopœia of the country from which they were exported, and in the absence of any such pharmacopœia the United States Pharmacopœia was to be taken as the standard. He held that the process by which the assay is made is as much a part of the standard as the percentage prescribed. We took issue with him on that point, and held that the Treasury regulations meant that the opium should contain 9 per cent. of morphia, because the various standards of the pharmacopœia had been subject to variation since the first enactment of the statute upon which the Treasury regulation is based, which was sometime about the year 1847, I believe. We claimed that we were required to report the amount of morphia the opium contained by the best process that we had at our disposal, and the Treasury department upheld us. The Squibb process, as I have called it, was the one used to establish or determine the percentage of morphia. I think this discussion took place some time in 1888. In regard to the lime-water test, on which Dr. Squibb lays a great deal of stress, and quite properly, too, in our work it is not necessary to obtain close analytical results. It is sufficient for our purpose to know that the opium contains more than 9 per cent. of morphia.

The Chairman: Is the duty on opium levied in accordance with the morphia percentage?

Dr. Wainwright: Opium, except such as is prepared for smoking, is free. There was formerly a specific duty of one dollar a pound. There never has been an *ad valorem* duty on it as far as I know.

My experience has been in regard to the use of the lime-water test and the amount of impurities it shows, that the higher the percentage of morphia in opium the greater likelihood there is of its being impure. In the case of a lot of Persian opium assaying as high as 19 to 22 per cent. of morphia, when corrected by the lime-water test the percentages were reduced from 3 to 5 per cent. The commoner kinds of opium yield from 7 to 12 per cent. Applying the method as we do in the Custom-house the crystals of morphia are tolerably pure and require very little correction. Where the percentage of morphia runs up to anything over 15 per cent. we are always suspicious of it, and it is necessary to apply the correction test to it. I have had Persian opium run 16 and 17 per cent., and after correction by lime-water brought the percentage down to 11 per cent. Now the testing of powdered opium is something that we very rarely have occasion to do. I have done it quite often for experimental purposes. The yield of morphia from powdered opium in both the old process and new process generally carries with it considerably more impurity than in the case of green opium; it is generally much darker in colour and more difficult to work. The drying of the opium itself seems to cause it. The solutions are difficult to filter, and seem to show a tendency to gum up. In regard to the drying at 100°, I would not like to have it understood that it is our practice always to dry at 100°. I simply dried at 100° in these special lots of tests for the purposes of this paper and to make the comparison absolutely uniform; the percentages are therefore of anhydrous morphia. That is not the way we report it in practice. We generally dry at not over 60° or 62°, and never let the temperature run up to 100°. In working the process I always use considerably more ether than is prescribed, and my experience in that respect is about the same as Dr. Stillwell's. It usually frees the morphia from the impurities, and, after washing, it makes the drying very much easier. We do that as much to save time as anything else.

Dr. Stillwell: Up to about a year ago I had used a filter paper Schleicher and Schüll 595; but since then I have used 597, and I find it makes a difference of about two hours in the last stages of filtering the precipitated morphia. It filters much more readily.

The Chairman: It would be presumption on my part to take issue with Dr. Squibb on the use of the word officinal. In a recent discussion which I heard on this subject I was shown the first page of the United States Pharmacopœia, where there was a Goverment stamp stating that that was the official document for the preparation. That was my object in asking Dr. Wainwright whether the process enjoined by the United States Pharmacopœia was the one by which he would pass a sample of opium. Dr. Rice, I think, has taken up that question, lately, too, and, if I mistake not, he rather favours the use of the word official. I take it that the descriptions in the United States Pharmacopœia are intended, perhaps, more for the use, and the tests employed are intended more for the easy application of pharmacists, so that they may be able to value the quality of the drugs which they purchase. I understand that this is in consideration in the compilation of that work.

I think that the evidence which we have had this evening tends to show that the process which is given in the Pharmacopœia for the test of morphia in opium is the most simple one which has been employed for the correct estimation of that substance, and that we are indebted to Dr. Squibb for that process.

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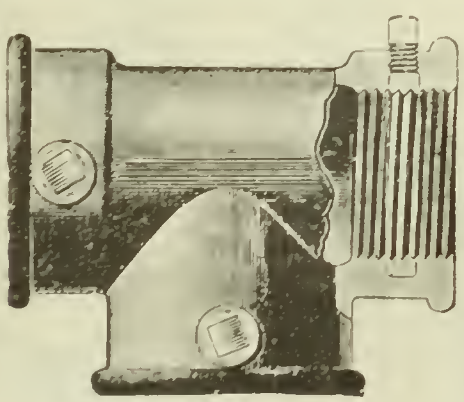
## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

*A New Device for Making Pipe-Joints Tight.* Eng. and Mining J. 1895, **59**, 32.

The fitting described is similar to an ordinary fitting, but with a groove cast in the screwed portion into which a screwed collar or ring of lead is run, of slightly smaller internal size, so that the lead projects beyond the thread of the bore of the fitting. A small set-screw is inserted, which bears on the lead collar. If a pipe be screwed into the fitting it will expand the lead packing; and if the joint is not made tight by this means, one or more turns of the set-screw will make the joint absolutely tight.—A. W.



*The Action of Fatty Lubricating Oils on Metals.* Ed. Donath. Dingler's Polyt. J. **294**, 187.

*See under* XII., *page* 283.

## PATENTS.

*An Improved Mode of and Apparatus for Effecting the Separation of Water from Calcareous Impurities.* A. Dervaux, Brussels. Eng. Pat. 3684, November 20, 1893. (Under International Convention.)

A closed cylindrical vessel is divided into two parts by a conical diaphragm, and into the upper part, the impure water is introduced by a vertical pipe, while another pipe conveys exhaust steam into the chamber for heating the water up to boiling point, thereby causing the deposition of the carbonate of lime in solution. The turbid water is drawn by means of an exhaust pump into the settling chamber below, and the clear liquid afterwards escapes from a point near the top of this chamber, by means of an outlet pipe. In order to effect an intimate mixture between the water and steam in the upper chamber, the incoming water first falls on to a dished plate and, escaping over the edge in a fountain-like stream, comes into intimate contact with the steam; the sludge collecting at the base of the apparatus is drawn off by a suitable outlet.—E. G. C.

*An Improved Filter for Wines and other Liquids.* T. F. Seitz, Kreuznach, Germany. Eng. Pat. 5221, March 13, 1894.

Within a closed rectangular casing are a number of V depressions or cells, with sides formed of fine wire gauze, and having an outlet pipe and discharge cock below, for the escape of the filtered liquid. The wine or other liquid is run into a hopper, where it is mixed with the filtering material, consisting of asbestos or the like, torn into fine shreds or fibres. After passing through a coarse strainer it falls into the cells, and the liquid flows off through the layer of filtering material, which forms on the sides and is unable to get through the finely-meshed gauze. In a modified arrangement, adapted for small quantities of liquid, the vessel is cone-shaped and surrounded by an enveloping cone, which receives the filtered liquid.—E. G. C.

*A New or Improved Hydro-Extractor.* J. E. Tolson and G. Tolson, both of Dewsbury, Yorkshire. Eng. Pat. 6716, March 27, 1894.

Within a closed casing, a perforated conical cage is revolved on a horizontal axis, by means of belting, and to lessen the power required to drive it, the conical cage is supported on friction rollers. The materials to be dried, are fed into the smaller end by means of a hopper, and while being carried round and the water extracted by centrifugal force, they gradually pass to the lower end and fall into a suitable receptacle; a trough in the outer casing collects and runs off the extracted moisture. In a modified arrangement, the cage is mounted upon a vertical spindle, and the fabrics are delivered at the centre, and, gradually working outwards, are thrown over the edge of the revolving cone into the outer casing.—E. G. C.

*Improvements in Evaporating Apparatus.* H. H. Lake, London. From H. See, New York, U.S.A. Eng. Pat. 21,633, November 9, 1894.

Within an upright cylindrical evaporating vessel, a number of steam coils are arranged, connected to annular steam-chests above and below, and arranged diagonally, so that a greater number of coils can be packed within a given annular space. Each coil has a diameter gradually augmenting from below upwards, to prevent films of steam forming and retarding the upward water current, while the piping is oval in cross section, so that on expansion the scale is cracked and falls off. The salt water or other liquid to be evaporated, is admitted into the evaporator by a suitable cock and expanding inlet pipe, and becomes heated by circulating around the coils, the vapour passing upwards past a diaphragm plate intended to throw back any unvaporised water particles, and into the upper chamber, from whence it is drawn into a condensing arrangement of any suitable type. To render the coils as efficient as possible, the steam enters the upper steam-chest first and passes downwards into the lower and larger steam-chest, meeting the colder water in its passage, and thus more efficiently heating and evaporating the liquid.—E. G. C.

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* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

## II.—FUEL, GAS, AND LIGHT.

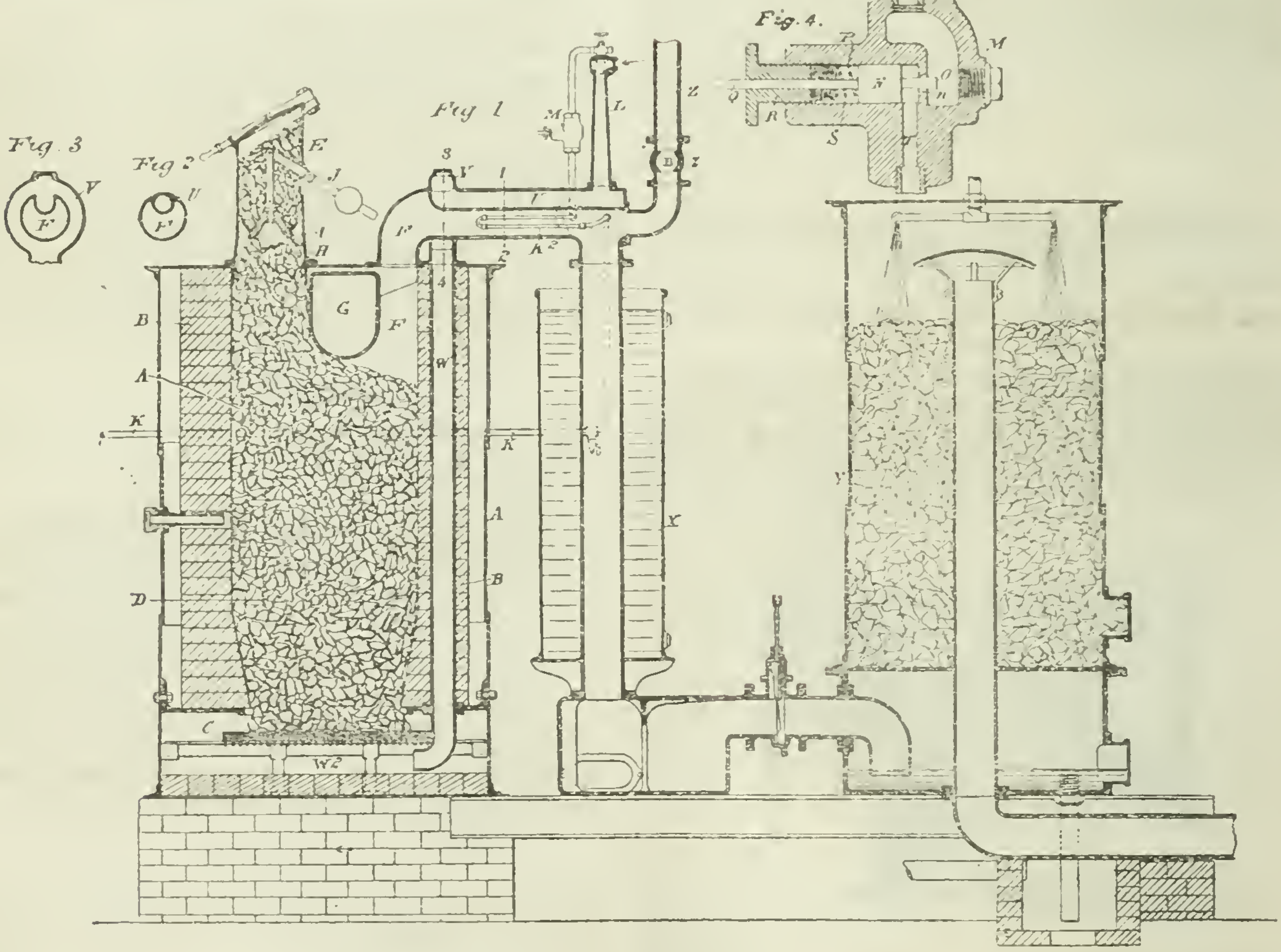
### PATENTS.

*Improvements in and Apparatus for the Manufacture of Gas, suitable for use in Gas Engines or for Heating Purposes.* C. W. Pinkney, Smethwick. Eng. Pat. 4189, February 27, 1894.

In the various arrangements of apparatus wherein superheated steam and air are forced through incandescent carbonaceous matter, great difficulty has hitherto been experienced in obtaining an even quality of gas. The present inventor has found that, in order to obtain good results, it is necessary (1) to provide a practically constant depth of fuel in the generator, (2) to maintain a uniformly heated mass of fuel in the generator, and (3) to uniformly heat the air and steam as they pass to the generator.

To carry out these principles in practice, there has been designed the apparatus represented by Fig. 1 in longitudinal vertical section. Figs. 2 and 3 are transverse sections on the lines 1—2 and 3—4 respectively of Fig. 1. Fig. 4 is a sectional elevation, on an enlarged scale, of the automatic valve, M in Fig. 1, for controlling the pressure of the steam admitted to the apparatus.

In the figures, B is the firebrick lining of the producer; A and D the mass of incandescent fuel contained by it. Near the top, is arranged the deflecting block or equivalent structure G, which keeps separate the fuel-inlet H from the gas-exit F. The hopper E is kept fully charged with fuel, and from time to time the weighted lever J is made to open the valve I. When this takes place, I touches or depresses the fuel beneath and indicates the height of the fuel-column in the generator, and whether fresh fuel is required or not. While the fuel is in H, it parts with any extraneous moisture, and this may be let out from time to time at the hopper lid.



The steam, entering from a steam generator through K K, traverses the coil $K^2$, which is fixed in the gas conduit F. The now highly heated steam passes through the valve M to a steam-jet in the blower box L. Here it induces a current of air, and the mixed gases pass through U, V (see Figs. 1, 2 and 3), and W, to enter the chamber $W^2$, below the fire-bars C. In passing through U, V, and W, the steam becomes superheated. The manufactured producer-gas passes by F F through any suitably arranged coolers and scrubbers, such as X and Y, to the gasholder.

Z, closed or opened by *z*, affords a blow-off, or is used when initially heating up the generator.

There remains to be described the automatic regulator of the steam pressure (see Fig. 4) This consists essentially of the piston N, fitted to slide in the chamber P, and carrying a conical projection O, which controls the passage *n*, through which the steam passes from T to the blower-box L. The stem, Q, of the piston lies in a passage in the adjusting nut R, and between R and N is the spring S. By screwing R in or out, S is more or less compressed, so that the valve O may be initially set to the working pressure of steam required. Any subsequent variations in the pressure of the steam as supplied are automatically controlled, for, with greater pressures, N tends to compress S, and in so doing draws O farther and farther into *n*, whose calibre is thereby narrowed, and conversely for lower pressures.—E. R. B.

*Improvements in Treating and Utilising certain Gases resulting from Carbonisation of Coal.* R. Dunlop, Airdrie, Lanarkshire. Eng. Pat. 4506, March 3, 1894.

Ordinary gas obtained from coal-shale or mineral oils, suffers great loss of illuminating power when compressed; and, if such gas is to have good illuminating power after compression, it must be made from such oils or materials as will yield a gas of very high illuminating power in the first instance. Such gas is expensive.

Large quantities of gas are, however, now produced at coking and other coal-carbonising works; which gas, scrubbed or washed as it is with creosote oil, &c., possesses little illuminating power, but suffers correspondingly little if compressed. The patentee proposes to utilise this gas, which may be produced or purchased very cheaply, for the illumination of railway trains, tramcars, &c.; these vehicles being provided with cylinders of such compressed gas, the gas on its way to the burners, passing through a small chamber, in which are benzol, gasoline, or similar substances, where it is enriched. In this way, a gas of high illuminating power is cheaply and conveniently produced. —E. R. B.

*Improved Portable Apparatus for Generating Oil, Gas, or Vapour for Heating, Drain-testing, and other Purposes.* G. Ross, Bishopbriggs. Eng. Pat. 4919, March 8, 1894.

This apparatus consists of an oil tank, provided with an air-pump for forcing the oil up to the burner, by pumping in air. Fitted to the tank is a stand-pipe, provided with a valve, which conveys the oil to the vaporising chamber. The latter is annular and of slightly larger diameter at the centre than at the ends. From the vaporising chamber, a bye-pass conveys the oil vapour to the burner, which is situated opposite the back end of the hollow central part of the vaporising chamber, so that the flame from the burner passes through it and effects the vaporisation of the oil entering the chamber. The apparatus is started in the usual manner by burning oil-saturated "waste" in a suitably placed iron saucer.—R. B. P.

*Manufacture of Artificial Fuel from Petroleum.* C. Weygang, West Willow, Romsey, Hants, and the Petroleum Products Syndicate, Limited, London. Eng. Pat. 23,996, December 10, 1894.

The patentees describe the manufacture of two fuels. In the first of these, 3 parts of rosin are treated with a sufficient quantity of "soda" to convert it into "rosin soap," and the solid soap separated from the leys, is mixed with about 12 parts of petroleum and about 6 parts of gypsum (preferably freshly calcined). These ingredients are thoroughly mixed by stirring, which is continued until the mixture becomes so viscid that the ingredients do not separate: after a few hours' standing, the mass sets solid.

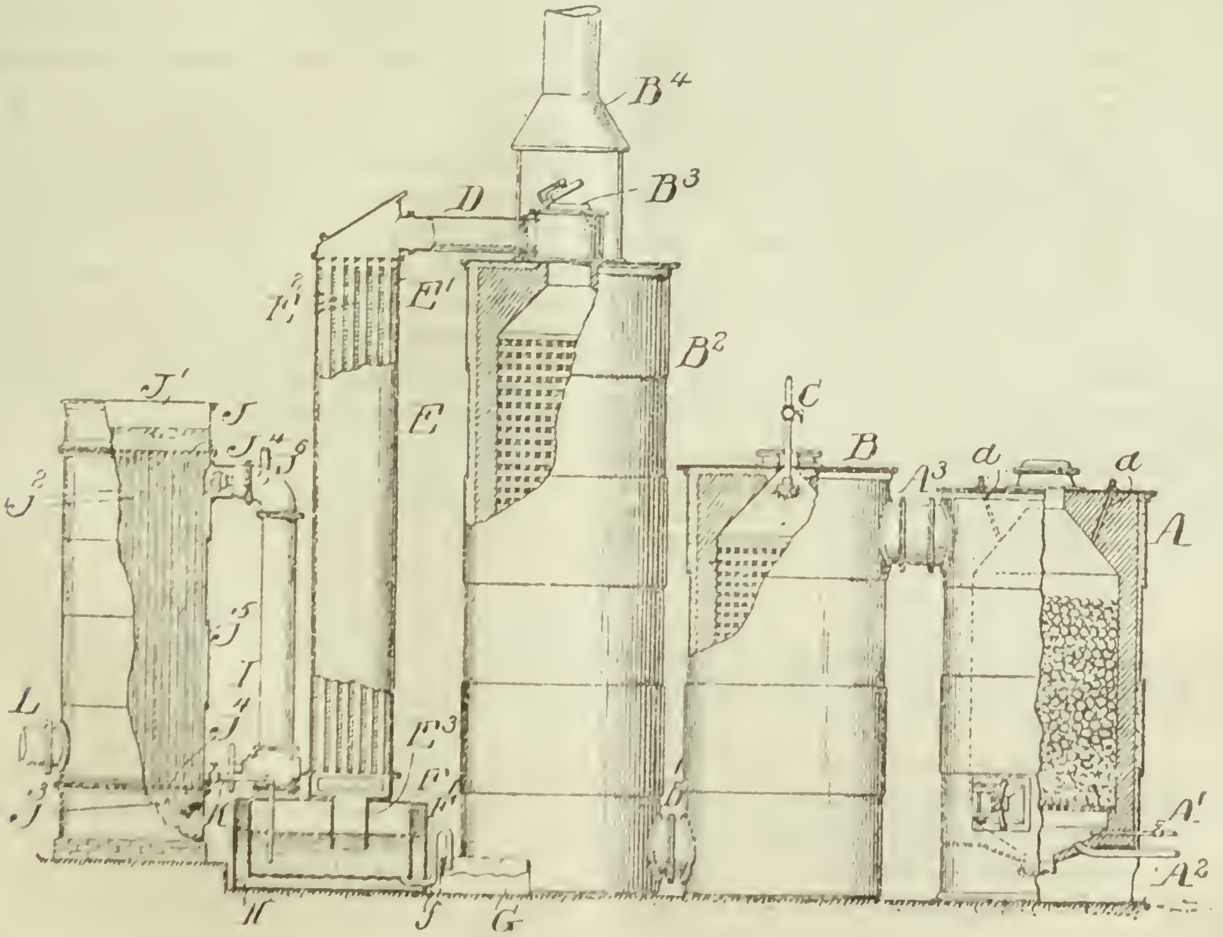
Either before or after setting takes place, the inventors may add carbonaceous matters, such as small coal, coke dust, &c. (50—100 parts), to the above mixture (100 parts).

To produce their second fuel, the inventors melt 120 parts of petroleum and 20 or more parts of rosin together, and to the slightly cooled mixture, gradually add 20 parts of "a strong solution" of silicate of soda and 10 parts of a saturated solution of caustic soda. The mixture is actively stirred and heated to the boiling point. As soon as solidification commences, 15 parts of calcium chloride (dissolved in as little water as possible) are worked in. The uniform putty-like grey substance so produced, may be used as a fire-kindler.—E. R. B.

*Improvements in the Method and Apparatus for Carburetting Water-Gas.* A. G. Glasgow, Westminster. Eng. Pat. 24,005, December 10, 1894.

In this process, the water-gas and oil vapours are passed through carburetters maintained at a heat not substantially higher than that required for producing a gas of maximum illuminating power from the oil used, so that the production of soot and gas of low power is avoided.

The gases and unfixed oil-vapour, which is of necessity present, are then passed through suitable surface condensers, with the result that the unfixed oil-vapour is condensed. These condensed products are then used again for carburetting fresh water-gas, but as they are "heavier" than the



oil used in the first instance they are introduced into the hottest part of the plant, namely, the generator. There, any part of the oil that is not vaporised remains as "oil-cake" and forms an addition to the fuel charge in the generator.

To obviate the condensation of any undecomposed steam in the water-gas along with the heavier oil, which is undesirable, the water-gas from the generator is passed through a suitable receiver, in which all water-vapour is condensed, before it goes into the carburetter. Fig. 1 shows the apparatus for carrying out this process. In it, A is a water-gas generator of usual construction, B and $B^2$ the carburetting and fixing chambers, C the oil injector, and E the surface condenser. The gases pass through the pipes $E^2$, which are surrounded by a water-jacket $E^1$. F is a liquid seal, preferably filled with oil, which prevents the gases drawing back if the action of the generator fluctuates. The gases next pass to another surface condenser $J^1$ or to a suitable devaporising chamber, and thence to further condensers or cleaners, or to a gas-holder.—R. B. P.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Remarks on an article "Progress in the Naphtha Industry."*
D. Holde. Chem. Zeit. 1894, **18**, 1737—1738.

J. Hirsch, Director of the Pardubitz Mineral Oil Refinery, in an article contributed to the Austrian Society of Chemical Industry (Ber. d. Oesterr. Ges. z. Förderung d. Chem. Industrie, 1894, Nos. 7 and 8), in supplementing Dr. Holde's remarks on the Ekenberg process (this Journal, 1894, 891) for refining lubricating oils (Chem. Zeit. 1894, **18**, 709), states that the preservation of the oil from the oxidising action of atmospheric oxygen by this process appears to be unimportant, and that Schestopal's researches on this point are not sufficiently conclusive.

Holde, in contravention of this opinion, cites the researches of Schestopal, Engler, Donath, R. Haack, and others on the effect of oxygen on some of the constituents of petroleum, which show that resinous, asphaltic, and acid products are the result of this action, and that the same is facilitated by the presence of bodies having an alkaline reaction. Schestopal assumed that the employment of compressed air for mixing the oil and soda, led to the formation of the salts, which are found to separate out in flakes when the oil has stood awhile, and his experiments on a large scale confirmed this view.

Information from a practical source, indicates that the process of neutralising the free acid is regarded as the most critical point in the purification of the oil, on account of the energetic action of oxygen at this stage, forming compounds which give rise to a dark colour.

Holde considers therefore that the employment of a mechanical mixer, such as Ekenberg's centrifugal apparatus, is preferable to compressed air, as avoiding the risk of oxidation, and expresses himself anxious to learn what are the practical experiences said to confute those of Schestopal. His own researches show that oxidation of pure mineral oil occurs even at ordinary temperatures, and without the addition of any reagent.—C. S.

*Characterisation of Petroleums.* A. Riche and G. Halphen. J. de Pharm. et de Chim. 1894, **30**, 289.

*See under* XXIII., *page* 313.

*Progress in the Ceresin (Cerasin) Industry.* B. Lach. Chem. Zeit. 1894, **18**, 1889.

*See under* XII., *page* 282.

### PATENT.

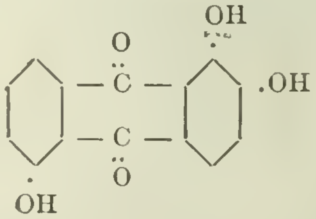
*A Process of and Apparatus for Distilling and Condensing Nitric Acid, Tar, and other Liquids.* W. B. Maxfield, Leicester. From W. Dieterle, Feuerbach, near Stuttgart, and L. Rohrmann, Krauschwitz, near Muskau, Germany. Eng. Pat. 14,520, July 28, 1894.

*See under* VII., *page* 272.

## IV.—COLOURING MATTERS AND DYES.

*Anthracene Derivatives; Hydroxyanthraquinones.*
H. Offermann. Annalen, **280**, 1—35.

Of the ten possible dihydroxyanthraquinones, nine have been isolated, and the constitution of five of these, viz., alizarin (1.2), quinizarin (1.4), purpuroxanthin (1.3), hystazarin (2.3), and anthrarufin (1.4′) has been conclusively proved. The present investigation was undertaken with the object of determining the constitution of the remainder as well as that of certain trihydroxy derivatives, and the author ascribes the following constitutions to these substances: *m*-benzyhydroxyanthraquinone (1.2′), anthraflavic acid (2.3′), isoanthraflavic acid (2.2′), and chrysazin, most probably (1.3′). With regard to the trihydroxy derivatives, the constitution of anthragallol (1.2.3) and purpurin (1.2.4) was known, and, according to the present work, oxychrysazin is most probably (1.2.4′), whilst flavopurpurin and anthrapurpurin have the constitutions (1.2.3′) and (1.2.2′) respectively. The presence of two hydroxyl groups in the ortho position in these two latter was determined by the action of sulphuric anhydride on alizarin. Under suitable conditions the sulphuric ether of an alizarin disulphonic acid is formed, which, on boiling in acid solution, is converted into the corresponding disulphonic acid. This, however, is a mixture of two disulphonic acids, the sulphonic groups in both being heteronucleal. It is found that it is only possible to eliminate the sulphonic acid group ortho to the hydroxyls, and the resulting monosulphonic acid on fusion with potash gives a mixture of flavo- and anthrapurpurin. The position of the third heteronucleal hydroxyl follows, amongst other evidence, from the formation of anthrapurpurin from *m*-benzdihydroxyanthraquinone and iso-anthraflavic acid by fusion with potash. With regard to oxychrysazin, according to Liebermann and Dehnst, its constitution must be either (1.4.1′) or (1.2.4′); but since, according to the theory of Liebermann and Kostanecki, only those polyhydroxyanthraquinones which contain at least two hydroxyls in the ortho position are capable of dyeing mordanted fibres, and as oxychrysazin is a mordant-dyeing colouring matter, it most probably has the constitutional formula—



—T. A. L.

*The Adulterations of Cochineal Carmine and their Detection.* E. Donath. Dingler's Polyt. J. **294**, 188.

*See under* XXIII., *page* 305.

## PATENTS.

*Production of o-Oxyanthraquinone.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 18,908, October 9, 1893.

The methoxyanthraquinone produced according to Eng. Pat. 17,542 of 1893 (this Journal, 1894, 878), by treating nitro-anthraquinone with caustic alkalis in a solution of methyl alcohol, can be converted, by heating with concentrated or dilute mineral acids, with or without pressure, into *o*-oxyanthraquinone, which, as well as the acetyl derivative prepared therefrom, has the well-known properties and boiling points.—T. A. L.

*Manufacture of New Bases and their Sulpho-Acids.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 3842, February 22, 1894.

This is an extension of Eng. Pat. 23,310 of 1893 (this Journal, 1894, 1055), dealing with the production of new amido compounds from benzaldehyde and chrysoidines, the latter, according to the present specification, being obtained by combining tetrazo compounds or their substitution products with *m*-diamines, of which the following is an example:—21 kilos. of the product obtained by combining one molecular proportion of tetrazodiphenyl with two molecular proportions of *m*-phenylene diamine, are heated on the water-bath with 11 kilos. of benzaldehyde, 22 kilos. of hydrochloric acid, and 50 kilos. of glacial acetic acid, until the whole forms a clear solution, when the melt is poured into water, filtered, and the base precipitated from the filtrate by adding sodium carbonate. So-called mixed chrysoidines, obtained by combining one molecular proportion of a tetrazo compound with one molecular proportion of *m*-phenylene diamine and one molecular proportion of some other component, may also be employed. In a similar manner to that previously described, all these products may be sulphonated by the action of fuming sulphuric acid.—T. A. L.

*Manufacture of Colouring Matters.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 3843, February 22, 1894.

In Eng. Pat. 23,310 of 1893 and 3842 of 1894 (see above) the manufacture of certain new bases and their sulphonic acids is described. They are obtained, as mentioned in the preceding patent, by the action of benzaldehyde on the chrysoidines, and the present specification describes the preparation of dyestuffs from these compounds. For instance, 30 kilos. of the amidotriazine obtained by combining benzaldehyde with diamido-azobenzene, are diazotised with 7 kilos. of sodium nitrite and added to an alkaline solution of 35 kilos. of the sodium salt of β-naphthol disulphonic acid (R salt). The colouring matter separates as a red precipitate, which is filter-pressed and dried. It dyes wool red from an acid bath. The triazine derivatives obtained from chrysoidines, which are derived from benzidine and similar compounds, yield after diazotisation and combination, colouring matters which dye not only wool, but also unmordanted cotton. The introduction of a sulphonic acid group does not produce much difference in shade.—T. A. L.

*Manufacture of a New Naphthylenediamine Disulphonic Acid and of Colouring Matters therefrom.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin. Eng. Pat. 3844, February 22, 1894.

The method of preparing this new 2:7-naphthylenediamine disulphonic acid consists in heating 2:7-dihydroxynaphthalene disulphonic acid (obtained by sulphonation of 2:7-dihydroxynaphthalene) with ammonia under pressure. The disulphonic acid thus produced is sparingly soluble in water, but its sodium salt dissolves readily, and may be precipitated from its solution by the addition of salt. Valuable colouring matters are obtained from the new acid by the following processes:—1. Combining two molecules of it in an alkaline or weakly acidulated solution (addition of sodium acetate) with one molecule of the tetrazo compounds of paradiamines such as benzidine, orthotolidine, diamidophenyltolyl, diamidodiphenyl ether, diamidostilbene, or alkyl oxybenzidine. 2. Combining one of the two diazo groups of the tetrazo compounds of the paradiamines just mentioned, with 2:7-naphthylenediamine disulphonic acid, and the other with an amine or diamine, a phenol, an amido-phenol, or the corresponding sulphonic and carboxylic acids. 3. Combining the new acid with the diazo compounds of amido derivatives, such as aniline, nitraniline, the toluidines, naphthylamines, anisidines, amidonaphthol ethers or their sulphonic or carboxylic acids, dehydrothiotoluidine, dehydrothioxylidine, primuline, and other thioamido compounds, amido-azobenzene and its homologues or analogous compounds and their sulphonic acids. 4. Combining one molecule of the tetrazo compound of the new acid with two molecules of an amine, phenol, amidophenol, or their sulphonic or carboxylic acids, or one molecule of any two of these bodies.—F. M.

*Manufacture or Production of Azo Colouring Matters.* H. E. Newton, London. From "The Farbenfabriken vorm. F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 4373, March 1, 1894.

In place of the mono-nitro benzidine tetrazo compound used in the process of producing a mixed diazo dye, in the manner described in Eng. Pat. 13,475, July 23, 1892, the tetrazo derivative of mono-nitro tolidine (1:3) is combined with one molecule of salicylic or orthocresotic acid and one molecule of $\alpha_1$-naphthol $\alpha_2$-monosulphonic acid or the alkaline salts of these acids. The new dye produces on wool in an acidulated bath, fine bluish-red tints distinguished by great fastness. The composition of the colouring matter obtained with salicylic acid is represented by the formula—

$$C_6H_3(OH)(COONa).N{:}N.C_{12}H_5(CH_3)_2(NO_2).$$
$$N{:}N.C_{10}H_5(OH)(SO_3Na).$$

—F. M.

*Processes for the Production of Certain Salts of Beta-Sulphonaphthalene, and for the Separation of Alpha- and Beta-Sulphonaphthalenes.* Burt, Boulton, and Haywood, London, and H. Fergusson, Silvertown. Eng. Pat. 4459, March 2, 1894.

The separation of the α- and β naphthalene sulphonic acids and the preparation of pure β-naphthalene sulphonates is effected by adding to the diluted aqueous solution of the crude acid any salts (preferably sulphates) the bases of which form with β-naphthalene sulphonic acid sparingly soluble salts, which are obtained in the shape of a crystalline precipitate. The salts of the following metals are cited as giving crystalline precipitates with the β-naphthalene sulphonic acid: copper, iron, manganese, nickel, cobalt, zinc, magnesium, calcium, cadmium. Of the various salts which can be used for precipitating the β-naphthalene sulphonic acid, special mention is made in the specification of those of iron and magnesium; ferrous β-naphthalene sulphonate being soluble to the extent of only 0·5 and magnesium β-naphthalene sulphonate of 0·5 to 0·75 part in 100 parts of water at the ordinary temperature.—F. M.

*Manufacture of Poly-Azo Colouring Matters.* O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 4160, March 2, 1894.

These colouring matters—which give violet-grey to blue-black shades on unmordanted cotton, and are said to be very fast to light and washing, which may be increased by treatment with metallic salts, or in certain cases by rediazotisation and development on the fibre—are obtained by combining the tetrazo compound from benzidine, tolidine, ethoxy-benzidine, diamido-phenyl-tolyl, diamido-stilbene, or diamido-diphenol ethers with one molecule of α-naphthylamine, rediazotising with one molecule of nitrous acid, and combining this derivative with two molecules of the dihydroxy-naphthoic monosulphonic acid of Eng. Pat. 14,161 of 1892 (this Journal, 1893, 597), or with two molecules of the amido-hydroxy-naphthoic monosulphonic acid of Fr. Pat. 224,260 of 1892. In place of the two molecules of dihydroxy-naphthoic monosulphonic acid employed, if only one be taken, the resulting intermediate compound may be combined with another component.

These are two special cases of the general claims, one of which is for combining a tetrazo compound or intermediate compound containing a free diazo group with dihydroxy-naphthoic monosulphonic acid or with amido-hydroxy-naphthoic monosulphonic acid. In the second claim, the intermediate compounds, obtained by combining equimolecular proportions of a tetrazo salt, and one of the above-mentioned compounds, are to be combined with a suitable dyestuff component, such as an amido-naphthol sulphonic acid.—T. A. L.

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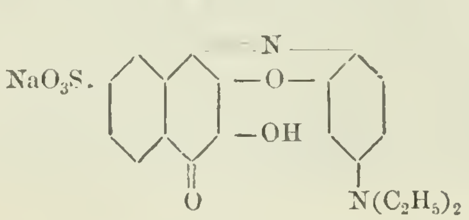
*The Manufacture or Production of Colouring Matters.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5056, March 10, 1894.

The blue oxazine dyestuffs prepared according to Eng. Pat. 8093 of 1893 (this Journal, 1894, 510) by the action of nitroso derivatives of alkylated *m*-amidophenols and higher homologues on 1.2-naphthohydroquinone and similar bodies and their derivatives, can, according to the present patent, be prepared by using, instead of the nitroso compounds, the amido compounds obtained from them by reduction. With regard, however, to the use of the sulphonic, carboxylic, and hydroxy-, or other derivatives of 1.2-naphthohydroquinone, only those corresponding to the *o*-nitroso-naphthol derivatives mentioned in Eng. Pat. 6035A of 1893 (this Journal, 1894, 383) are to be employed in this invention. The following example describes the application of the method:—23·1 kilos. of nitroso-*m*-hydroxydiethylaniline hydrochloride are dissolved in 500 litres of water and reduced by means of zinc-dust and hydrochloric acid. The solution, which contains 18 kilos. of *p*-amido-*m*-hydroxydiethylaniline, is filtered, a small quantity of aqueous sulphurous acid added, then mixed with 28 kilos. of 1.2.3′-dihydroxynaphthalene potassium sulphonate, and heated to 50°—80° C., together with 200 kilos. of soda-lye (25 per cent. NaOH), a current of air being passed through the liquid. The solution becomes greenish-blue and after some time, dark crystals of the dyestuff separate out. When no further separation takes place the precipitate is filtered off, redissolved in hot water, again filtered, and the filtrate made acid with acetic acid, after which the dyestuff is salted out, forming greenish lustrous crystals. The colouring matter is identical with that obtained by condensing nitroso-*m*-dihydroxydiethylaniline with 1.2.3′-dihydroxynaphthalene potassium sulphonate, and has the formula—



Compounds which are insoluble or only sparingly soluble may be sulphonated according to the usual methods.
—T. A. L.

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*The Manufacture or Production of Azo Colouring Matters, and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5148, March 12, 1894.

According to the present specification, two new 2.1′-amidonaphtholsulphonic acids can be obtained by sulphonating 2.1′-amidonaphthol. Hitherto, the only known 2.1′-amidonaphthol sulphonic acid was the so-called amidonaphthol sulphonic acid G ($NH_2 : OH : SO_3H = 2 : 1' : 3'$), which was obtained by fusing β-naphthylaminedisulphonic acid G with alkalis. The 2.1′-amidonaphthol is prepared by fusing 2.1′-naphthylamine sulphonic acid or its salts with alkalis at 260°—270° C. It is readily soluble in hot water, but sparingly in cold, and forms shining scales melting at 158° C. In order to sulphonate it, 10 kilos. of the compound and 20 kilos. of concentrated sulphuric acid are heated at 20°—30° C. until sulphonation is complete, when the melt is poured into 200 litres of water. The mixture of the two isomeric acids is filtered, and the acids are converted into their calcium salts. The solution of these in about 100 litres of water is mixed with an excess of hydrochloric acid, when the 2.1′-amidonaphthol sulphonic acid V separates out, whilst the 2.1′-amidonaphthol sulphonic acid Sch. is precipitated by adding salt to the filtrate. The two acids are formed in about equal proportions, and the specification contains a table giving some of their characteristic properties as compared with 2.1′-amidonaphthol sulphonic acid G. Both these acids are to be employed for the preparation of dyestuffs by combining them with tetrazo compounds. Of the two, the acid designated Sch. gives valuable colouring matters when combined with tetrazo compounds to form either symmetrical or mixed disazo dyestuffs. These colouring matters give very dark shades, fast to washing and fulling. They can be further diazotised and combined with other components, and this operation may be carried out on the fibre.—T. A. L.

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*Improvements in the Manufacture of Colouring Matters and Materials therefor.* H. H. Lake, London. From A. Leonhardt and Co., Mühlheim, near Frankfort-on-the-Main. Eng. Pat. 5159, March 12, 1894.

The new processes forming subject of this patent are based upon the observations—(1) that whilst unsubstituted meta-amidophenols cannot by the known methods be converted into nitroso compounds, this conversion can be readily achieved by employing their acid derivatives (preferably acetyl compounds); (2) that nitroso derivatives of mono-alkylated meta-amidophenols can be obtained, either by treating these bodies in an acid solution with nitrous acid, or by reacting with metallic nitrites on their acid salts in the absence of free mineral acid; (3) that the nitroso compounds thus obtained form colouring matters when heated with amines, meta-amidophenols, or their substitution products. In the process of converting meta-amidophenol into the nitroso compound by treating the acetyl compound with nitrous acid in the presence of mineral acid (preferably hydrochloric acid), the nitrosoacetylamidophenol is obtained, from which, by saponification, either with alkalis or mineral acids, the acetyl group can be split off. The practical methods employed for carrying out the processes alluded to, are essentially the same as those generally employed in the preparation of nitroso compounds.

For the production of colouring matters from nitrosomonomethylmeta-amido-*p*-cresol or nitrosomono-ethylmeta-amido-*p*-cresol, the following amido compounds were found useful: α-naphthylamine, ethyl-α-naphthylamine, meta-amidodimethyl-*p*-toluidine, benzyl-*m*-amidodimethyl-*o*-toluidine, tetramethylmetaphenylenediamine, *m*-amidomonomethyl-*o*-toluidine, *m*-amidomono-ethyl-*o*-toluidine, *m*-amido-*p*-cresol and its monomethyl and mono-ethyl derivatives. The dyes thus obtained proved to be identical with those from the corresponding azo-derivatives of the alkylamidocresols, in the manner described in Eng. Pat. 15,080, 1892. The following is an example of the methods by which these dyes are prepared. A mixture of 27 parts of nitrosomono-ethylamidocresol, 17 parts of ethyl-α-naphthylamine, 30 parts of 30 per cent. hydrochloric acid, and 80 parts of alcohol, is heated until the nitroso compound has disappeared. The solution is then diluted with 500 parts of hot water, and 30 parts of sodium acetate are added. After filtration, the colouring matter is precipitated from the cooled solution by means of zinc chloride and common salt.

The colouring matters from nitrosometa-amidophenol and *p*-cresol and aromatic amines, are obtained in the same manner as those just described, by using the hydrochlorides of the nitroso compounds and any of the amido compounds previously enumerated. Instead of converting the acetylnitroso compounds into the nitroso compounds proper, previous to their employment for the manufacture of dyes, the saponification necessary can be carried out after the formation of the latter, by heating with sulphuric or hydrochloric acid. For example, 6 parts nitrosoacetylmeta-amidocresol, 3 parts of α-naphthylamine, 3·5 parts of hydrochloric acid (30 per cent.), and 30 parts of alcohol, are heated together. The unstable acetylated colouring matter, which separates in crystals, is heated for a short time with 10 parts of concentrated sulphuric acid on the water-bath, until a sample taken, dissolves in water with a pure violet colour. The dyestuff is then separated, by pouring the mixture into ice-water and filtering off the precipitate formed. Or a mixture of 3 parts tetramethylmetaphenylenediamine, 6 parts nitrosoacetylmeta-amido-*p*-cresol, 3·5 parts of hydrochloric acid, and 40 parts of alcohol, is heated, 24 parts of strong hydrochloric acid being added as soon as the solution has assumed a red tint. Boiling is continued until the colour of the solution turns into violet. Hot water is then added, and the dyestuff, after removal of impurities by means of sodium acetate, precipitated from the cooled solution by the addition of common salt.—F. M.

*The Manufacture or Production of Azo Dyestuffs, and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5267, March 13, 1894.

By applying the method described in Eng. Pat. 5148 of 1894 (see above) to 2.4′-amidonaphthol, a mixture of two monosulphonic acids is obtained, the proportion of sparingly soluble to easily soluble acid being about 3:7. The two acids are distinguished by the letters S and L, but only the latter acid appears to give valuable dyestuffs by combination with tetrazo compounds to form either symmetrical or mixed disazo colouring matters. The colouring matters from tetrazodiphenyl, its analogues or homologues, and 2.4′-amidonaphthol sulphonic acid S, are brownish-violet, of no particular value, but are converted into valuable brown dyestuffs when further diazotised and combined on the fibre. The colouring matters obtained from the sulphonic acid L are violet, blue, or red, and these on rediazotisation and combination yield deep blue to bluish-black shades. The preparation of these dyestuffs is carried out in the usual manner, and several examples are given.—T. A. L.

*Improved Manufacture of Dry Alizarine.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 5444, March 15, 1894.

By mixing alizarin paste with starch in cold water, filtering, and drying first at a low and afterwards at a higher temperature, an alizarin in lump can be obtained, containing any desired percentage of alizarin in a form suitable for export to the tropics. About 1,000 kilos. of a 20 per cent. alizarin paste are mixed with 466 kilos. of starch and 3,000 litres of cold water, well stirred, filter-pressed, and dried, as mentioned above. This gives 666 kilos. of 30 per cent. alizarin in the form of lumps resembling starch.—T. A. L.

*The Manufacture or Production of Poly-azo Dyestuffs.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5636, March 17, 1894.

The dyestuffs referred to, which are distinguished by their fastness, are derived from those amidonaphthol sulphonic acids which contain the hydroxyl and the sulphonic group in the meta position. Acids containing the groups in these relative positions are the 2.1′.2′-amidonaphthol sulphonic acid and the 2.4′.1.2′-amidonaphthol disulphonic acid. The former of these compounds is obtained by fusing 2.4′.2′-naphthylamine disulphonic acid or its salts with alkalis, whilst the latter is produced by heating 2.4′-naphthylamine sulphonic acid, 2.1.4′- or 2.1′.2′-naphthylamine disulphonic acid with fuming sulphuric acid, and fusing the so-formed 2.1.4′.2′-naphthylamine trisulphonic acid with alkalis. For the production of dyestuffs 1 mol. of a tetrazo compound is combined with 1 mol. of an amido compound, giving a rediazotisable product, and after having been diazotised, this intermediate compound is combined with 2 mols. of one of the above-mentioned acids. These dyestuffs can then be further diazotised and combined on the fibre, giving deep and fast shades.—T. A. L.

*Manufacture of New Colouring Matters.* C. D. Abel, London. From "The Actiengesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 5709, March 19, 1894.

The amidonaphthol mono- and disulphonic acids of Eng. Pat. 15,175 of 1889 (this Journal, 1890, 854), the 1.8.4-amidonaphthol sulphonic acid and the 1.8-amidonaphthol disulphonic acid of Eng. Pat. 2984 of 1893 (this Journal, 1894, 32), when diazotised and combined with *m*-diamines, yield azo colouring matters which dye wool brownish-yellow to brownish-violet from an acid bath. They have the general formula—

$$C_{10}H_{(6-x)}OH(SO_3H)_xN:ND,$$

where D represents the nucleus of a *m*-diamine. These colouring matters, it is now found, will combine with tetrazo compounds, forming new colouring matters which dye unmordanted cotton. The combinations may be carried out according to the methods usually employed. For instance, one molecular proportion of a tetrazo compound may be combined with two molecular proportions of the same dyestuff or with different dyestuffs, or with one molecular proportion of one of the above-mentioned dyestuffs, and subsequently with some other component. Cotton dyestuffs are also obtained by combining the diazo compounds of dehydrothiotoluidine, its homologues and sulphonic acids, with the dyestuffs referred to. If simple diazo compounds be employed, such as those from aniline, its homologues and derivatives, the naphthylamines and their sulphonic acids, &c., the colouring matters resulting by employing these compounds for the combinations, are useful as wool dyestuffs, and give dark shades.—T. A. L.

*The Manufacture or Production of Colouring Matters and Materials therefor.* H. E. Newton, London, From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 5711, March 19, 1894.

This invention relates to colouring matters of the triphenylmethane series, and describes the production of dyestuffs containing in one nucleus an amido group ortho to the methane carbon, in which one of the hydrogens is substituted by an acid radicle. The colouring matters so produced are said to be of great technical value, on account of their solubility and clearness of shade. In general, the acetyl derivatives appear to have been prepared, and the following methods are employed, of which examples are given in the specification:—1. Alkylated diamidobenzhydrols are condensed with acidyl derivatives of dialkylated *m*-diamines, and the so-formed leuco compounds are oxidised. As a special example of this method, tetramethyldiamidobenzhydrol is condensed with acetyl-*m*-amidodiethylaniline, and the leuco compound obtained is oxidised with lead peroxide, the colouring matter being subsequently precipitated with zinc chloride and salt, forming a greenish-yellow mass, which is easily soluble in water, and gives brilliant blue shades on cotton mordanted with tannic acid. 2. In place of the hydrols, the corresponding ketones, such as tetramethyldiamidobenzophenone, may be employed. 3. Alkylated diamido benzhydrols are condensed with *m*-diamines dialkylated in one amido group, acetylated in the other amido group, and the leuco products oxidised. 4. Alkylated diamidobenzhydrols, containing an acetylated amido group in one nucleus ortho to the methane carbon, are condensed with tertiary aromatic amines or acidyl derivatives of *m*-diamines, dialkylated in one amido group, and the leuco compounds so formed are subsequently oxidised. 5. Alkylated leuco compounds of the triphenylmethane series are nitrated, when the nitro group enters one of the nuclei ortho to the methane carbon. The products, on reduction, acetylation, and oxidation, give colouring matters which can also be obtained by condensation according to the first method described above.—T. A. L.

*Improvements in the Manufacture of Colouring Matters of the Alkylated Induline Series.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 5722, March 19, 1894.

This is an extension of Eng. Pats. 10,138, 10,138A, 10,138B, and 10,138C of 1892 (this Journal, 1893, 593 *et seq.*) and 17,572, 18,374, and 18,925 of 1893 (this Journal, 1894, 878, 942, and 879). In the present specification, colouring matters are described which are obtained by condensing α-naphthylamine or alkylated or phenylated α-naphthylamines with mono-alkylated *o*-nitro-amines, of which the following is an example:—About 14 kilos. of α-naphthylamine, 10 kilos. of α-naphthylamine hydrochloride, 16 kilos. of nitromethyl-*o*-toluidine, $C_6H_3.CH_3.NO_2.NHCH_3(1.3.4)$, and 5 kilos. of zinc chloride, are heated to about 175° C. for four hours. The melt is then extracted with 1 per cent. hydrochloric acid, and filtered. The filtrate contains β-methyleurhodine, which is precipitated with salt and filtered off. In order to purify it, the press-cakes are dissolved in water, filtered, and a slight excess of ammonia added, and again filtered, when any non-alkylated eurhodine is separated, and the ammoniacal solution containing β-methyleurhodine is precipitated as hydrochloride by adding salt. In the case of the corresponding ethyl compound, it is recommended that only $\frac{1}{4}$ per cent. hydrochloric acid be used for extraction, the colouring matter, after purification, being precipitated finally by zinc chloride instead of salt.—T. A. L.

*A New Direct-dyeing Yellow Colour for Cotton, and the Process for its Manufacture.* Brooke, Simpson, and Spiller, Ltd., and A. G. Green, London. Eng. Pat. 5853, March 21, 1894.

The colouring matter described is obtained by the action of formaldehyde in aqueous solution on primuline in presence of hydrochloric acid, or by the action of an aqueous solution of formaldehyde on primuline in concentrated sulphuric acid. A solution of 100 lb. of the sodium salt of primuline in 300 galls. of water is mixed with 2 galls. of a 40 per cent. solution of formaldehyde, acidified with 2 galls. of 30 per cent. hydrochloric acid, and heated at 70°—80° C. for several hours until a test mixed with nitrite and an alkaline solution of β-naphthol no longer gives a red colour. Caustic soda or other suitable alkali is then slowly added until a clear solution is obtained, when the new colouring matter is precipitated with salt, filter-pressed, and dried. It dissolves easily in water, and dyes unmordanted cotton greenish-yellow from a neutral or alkaline bath.—T. A. L.

*The Manufacture and Production of New Azo Colouring Matters.* B. Willcox, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 6197, March 27, 1894.

Alkylated *m*-amidobenzene sulphonic acids have hitherto not been employed for the production of azo dyestuffs, since they will not combine with the diazo compounds from aniline, xylidine, naphthylamine, or *p*-amido-acetanilide. By using the diazo compounds of nitranilines and nitrotoluidines, and more particularly *p*-nitraniline and dinitro-aniline ($NH_2:(NO_2)_2 = 1:2:4$) combination takes place, giving, according to the components chosen, colouring matters ranging from yellow and orange, through red, to violet. The shades produced are fast to light, alkalis, and acetic acid. The alkylated *m*-amido-benzene sulphonic acids employed are the dimethyl- and diethyl- and the methyl- and ethylbenzyl-*m*-sulphanilic acids. About 138 kilos. of *p*-nitraniline are diazotised "in the usual way" with 70 kilos. of sodium nitrite, and the diazo solution is run into 5,000 litres of water containing 250 kilos. of sodium dimethyl-*m*-amidobenzene sulphonate and 500 kilos. of crystallised sodium acetate. After stirring for three hours, the colouring matter separates in red crystalline needles, and is filter-pressed and dried. It dyes wool red from an acid bath.—T. A. L.

*Manufacture of Colouring Matters of the Induline Series.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 7044, April 9, 1894.

By heating tetramidodiphenyl-*p*-azophenylene (Bandrowsky, Ber. **27**, 480) with aniline and aniline hydrochloride or with α-naphthylamine and its hydrochloride, dyestuffs of the induline series are obtained which are more or less soluble in water or dilute acids, and dye tannin-mordanted cotton violet to blue. The shades are bluer the higher the temperature, the greater the excess of aniline, and the longer the heating is continued. Those products insoluble in dilute acids, may be sulphonated by means of the usual sulphonating agents. About 20 kilos. of tetramido-diphenyl-*p*-azophenylene, 40 kilos. of aniline, and 8 kilos. of aniline hydrochloride are heated for 4—5 hours at about 175° C. After cooling, the melt is poured into water, made alkaline, and the excess of aniline blown off by steam. The base is soluble in dilute mineral acids, and being readily soluble in concentrated acetic acid, is especially applicable for printing, giving indigo shades on cotton mordanted with tannin. —T. A. L.

*Manufacture of* 1-*Naphthylamine* 3, 6, 8-*Trisulphonic Acid from* 1-*Nitronaphthalene* 3, 8-*Disulphonic Acid.* C. D. Abel, London. From A. Fischesser and Co., Lutterbach, near Mulhouse, Alsace. Eng. Pat. 7046, April 9, 1894.

This trisulphonic acid (identical with that of Ger. Pat. 56,058) is obtained by the treatment of 1-nitronaphthalene 3, 8-disulphonic acid with normal or hydric sulphites. Reduction of the nitro group to the amido group takes place, while simultaneously a sulpho group enters into the naphthalene nucleus.

The process of manufacture is carried out as follows: A concentrated solution of 75 kilos. of sodium bisulphite is added to 50 kilos. of sodium 1-nitronaphthalene 3, 8-disulphonate dissolved in 500 litres of hot water. The mixture is heated until the deep orange colour it at first assumes, is changed into a light yellow. It is then supersaturated with hydrochloric acid, and kept for some time at the boiling-point. The sparingly-soluble acid sodium salt of 1-naphthylamine 3, 6, 8-trisulphonic acid, $C_{10}H_4(NH_2)(SO_3H)(SO_3Na)_2$, crystallises from the liquor on cooling.—F. M.

*The Manufacture and Production of New Azo Colouring Matters.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 8564, April 30, 1894.

The colouring matters are obtained by the action of certain sulphonated tetrazo compounds, such as tetrazodiphenyl disulphonic acid, or of diazotised primuline on nitro-*m*-phenylene diamine or nitro-*m*-tolylenediamine (Ber. **3**, 9, and **7**, 1257). The shades produced on unmordanted cotton are yellow and orange, fast to acids, washing, and light. About 34·5 kilos. of benzidine disulphonic acid and the requisite quantity of alkali are dissolved in 200 litres of water, and 14 kilos. of sodium nitrite in 200 litres of water are mixed therewith. This solution is poured into 160 kilos. of 30 per cent. hydrochloric acid diluted with three times its weight of water, and there is then added, with constant agitation, 32 kilos. of nitro-*m*-phenylene diamine in 58 kilos. of hydrochloric acid and 200 litres of water, the latter solution being at about 55° C. A solution of 112 kilos. of sodium acetate in three times its weight of water is then run in, the mixture stirred for three hours, and 170 kilos. of calcined soda in 1,000 litres of water gradually added. After stirring about 24 hours, the colouring matter is filter-pressed and dried. It forms a dark reddish-brown powder readily soluble in water.—T. A. L.

*Manufacture of Colouring Matter from Logwood.* W. J. Matheson and Co., New York. Eng. Pat. 22,533, November 21, 1894.

The claim of novelty in this invention rests upon the use of borax either as an addition (from 1 to 3 per cent.) to ordinary syrupy logwood extract previous to complete evaporation, or as a medium employed in dilute aqueous solution for the extraction of the wood. The resulting product consists of a friable mass, which is scarcely affected by atmospheric heat and moisture, and produces tints of great purity.—F. M.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*Artificial Silk.* E. Herzog. Färber Zeit. **6**, 49—50.

Patents for the production of artificial silk have been granted to Chardonnet, de Vivier, and Lehner. The only process now worked on the commercial scale is that of Chardonnet, whose first patent was taken out in 1885, although the method was not generally known until the Paris Exhibition of 1889. According to this first patent, cotton is treated with nitric and sulphuric acids, and the nitrocellulose obtained is dissolved in a mixture of ether and alcohol, with the addition of a small amount (0·2 per cent.) of some metallic salt to lessen the danger of explosion. The solution is pressed through a system of fine capillary tubes, whose openings have the diameter of a natural silk fibre, into hot water, in which the ether and alcohol evaporate, leaving a fine thread capable of being spun. It possesses, however, great inflammability.

A company with a capital of 6 million francs was formed at Besançon to work Chardonnet's process, in which several improvements were made. For cotton, is substituted the cheaper wood-cellulose. The nitrocellulose, after its solution in ether and alcohol, is denitrated with acetic and sulphuric acids and its explosiveness thus removed.

The processes of de Vivier and of Lehner very closely resemble that of Chardonnet. De Vivier dissolves nitrocellulose in glacial acetic acid, with the addition of solutions of fish glue in glacial acetic acid, and gutta-percha in $CS_2$. Lehner dissolves a mixture of silk waste and nitrocellulose in ether and alcohol.

Chardonnet's artificial silk appears in commerce as a greyish-white, lustrous fibre, similar in appearance to boiled-off natural silk. It lacks the softness and the peculiar crackling feel of "boiled-off" silk. In tenacity and elasticity it compares unfavourably with the natural product. Experiments with fibres of similar thickness gave the following results:—

| — | Strength (Tenacity). | Elasticity (Amount of Stretch). |
|---|---|---|
| | Grms. | Mm. Metre. |
| Natural silk ................. | 214 | 189 in 1 |
| Artificial silk ................. | 69 | 155 „ 1 |

In a room of average dryness, dry artificial silk absorbed in two hours 16 per cent. of moisture: the legal amount for natural silk is 11 per cent. The specific gravity of artificial is about 13 per cent. higher than that of natural silk.

In dyeing properties the difference is very marked. On soaking with water the artificial silk fibre becomes very weak and must be handled with the greatest care. Soap solutions do not greatly injure the fibre, but free alkalis bring about an alteration which in concentrated alkaline liquids extends to complete solution of the fibre. Dilute acids are without injurious effect.

Dyeing is accomplished without addition of soap or acid to the bath, so that the number of dyestuffs applicable is somewhat limited; the most suitable are the basic dyes, with a few "direct cotton" colouring matters. Various shades may be obtained in the following ways:—

*White.*—Bleach for 10 hours with phosphate of soda, rinse, and tint slightly with Methyl Violet 5 B.
*Light Pink.*—Rhodamine.
*Light Blue.*—Methylene blue.
*Moss Green.*—Methylene blue and Thioflavin.
*Straw Yellow.*—Thioflavin.
*Gold.*—Chrysophenine.
*Navy.*—Methylene blue and Methyl violet.
*Scarlet.*—Safranine G and Phosphine.

There is no doubt that artificial silk can be produced more cheaply than natural silk, and can replace it in many branches of the silk industry.—R. B. B.

*The Removal of Aniline-Ink Spots from Textile Fabrics.* Helbig. Pharm. Central-Halle, N.F. 1894, **15**, 654.

To remove aniline-ink spots from linen, &c., they should be moistened with a strong solution of potassium permanganate. After a few minutes the brown stain produced by the latter may be destroyed by means of a few drops of aqueous sulphurous acid.—H. T. P.

*Boiled-off Liquor from the Stripping of Raw Silk.* H. Silbermann. Färber Zeit. **6**, 1894—1895, 81.

*See under* VI., *page* 270.

### PATENTS.

*Improved Process and Apparatus for the Treatment of Rhea Grass and Similar Fibres for Commercial Purposes.* H. H. Boyle, London. Eng. Pat. 21,313, November 9, 1893.

The fibres are passed through a series of tanks and squeezing-rollers in such a way that the whole operation is perfectly continuous. The grass is carried through the tanks between two rows of rods attached to endless chains, and so arranged that from each tank the material is passed on between rollers to the travelling rods of the next tank. The various operations take place in the following order:—The grass is boiled in caustic soda solution and subjected to the action of steam. It then passes through three sets of rollers, each travelling at a higher speed than the last, to break and loosen the bark and separate the fibres. Then follows a series of tanks containing, in the order mentioned, hydrochloric acid, caustic soda (here the fibre is boiled as in the first tank), permanganate of potash, hyposulphite of soda and hydrochloric acid, hydrochloric acid, hyposulphite of soda. From this last tank the material is delivered on to an endless apron and thoroughly washed by means of a douche, after which it passes through a softening bath containing a soapy liquid, and finally between three sets of rollers similar to those employed near the beginning of the operation. It is then ready for combing or other treatment to fit it for commercial uses.—R. B. B.

*Improvements in Treating Tissues, Fibres, Paper, and the like.* A. Zimmermann, London. From J. Holfert, Berlin, Germany. Eng. Pat. 4697, March 6, 1894.

*See under* XIII., *page* 285.

*Improvements in the Process of and Machinery or Apparatus for Decorticating, Preparing, Twisting, and Winding Peat Fibre or other Fibrous Material.* G. A. Cannot, London. Eng. Pat. 5272, March 13, 1894.

A special combination of revolving beaters, screens, and grooved cylinders is claimed for the purposes of decorticating, preparing, carding, twisting, and winding the fibrous material referred to.—W. S.

*Improvements in Furnaces for Extracting Potash from the Grease contained in Sheep's Wool.* Madame E. Richard-Lagerie, Roubaix, France. Eng. Pat. 13,677, July 16, 1894.

*See under* VII., *page* 271.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*The Dyeing of Cotton with Substantive Coal-Tar Dyes in Combination with Carmine Colours.* C. H. Steinbeck. Färber Zeit. 5, 382—384.

A number of dyes have recently been offered to cotton-dyers under the names "Carmine colours" and "Mode colours." These are made by mixing together dyewood extracts and metallic salts. They are soluble in water, and are acid metallic salts of the colour acid. Usually they also contain glycerol to increase the solubility. Light shades can be dyed on cotton without mordant, but the dye-bath is not exhausted and soon becomes so acid that no further amount of colour can be withdrawn from it. If the bath is neutralised, more complete exhaustion is possible, but there is great danger of superficial precipitation of the colour-lake on to the fibre. Darker shades can be dyed on tannin mordants, but these shades can in every case be more cheaply produced by coal-tar dyes.

The direct cotton (benzidine, &c.) dyes possess the property of acting as mordants for these colouring matters. For example, if cotton be dyed with chrysophenine and then topped with a blue "carmine" dye a myrtle shade results, which is in every way faster than either of the dyes mentioned would be if used alone.

The number of shades to be obtained with carmine colours is very limited; no light pure yellow, red, or blue is known, and these shades must be produced by direct cotton dyes. But a number of tertiary or "mode" colours, such as "Old rose," Light olive, &c., can be best obtained by such a combination as that described. The direct dye is first applied in a soap and soda bath at 80°—90° C., and then topped with carmine colour in a separate bath. Beautiful shades of brown, grey, drab, and olive are thus obtained. A further variety of shades results by bottoming as before with a direct dye and topping with a mixture of carmine colour and basic coal-tar dyestuff.—R. B. B.

*After-Treatment of Paranitraniline Red with Copper Sulphate.* C. M. Müller. Färber Zeit. 5, 384.

The effect of the presence of copper salts in the direct development of Paranitraniline red on the fibre has been described by Caberti and Peco (Färber Zeit. 5, 333; this Journal, 1894, 946). It may be added that copper salts exercise a similar influence when applied to the dyed fibre after development of the colour. When cotton dyed with Paranitraniline red is boiled for 15 minutes in a solution containing 1 grm. $CuSO_4$ per litre, a full chocolate-brown shade results.—R. B. B.

*After-Treatment of Paranitraniline Red with Copper Salts.* H. von Niederhäusern. Färber Zeit. 6, 3.

To the communication of C. M. Müller on this subject (see above) the author adds that the effect of the copper sulphate is to considerably increase the fastness of the dyed colour to light and air. A pattern so treated did not noticeably alter in shade during three weeks' exposure to bright light, and a pattern dyed with Nitrosamine red (B.A.S.F.), and similarly treated, was hardly affected by two months' exposure.—R. B. B.

*Dianisidine-naphthol Blue.* M. von Gallois. Färber Zeit. 5, 381—382.

The process of producing insoluble azo dyes directly on the cotton fibre is finding extended application in dyeing and printing, but up to the present it has been impossible to obtain by this means a really fast and useful blue colour. The dye produced from Tetrazosafranine and β-naphthol is a fine blue, but very fugitive, and so are the blues hitherto obtained by combining Tetrazodianisidine or diphenetidine with naphthol; they possess neither brilliancy nor fastness. Blues have also been made by combining tetrazodianisidine with certain naphthol sulphonic acids. These latter can be increased in fastness by subsequent treatment of the fibre with copper sulphate, but even with this the colours leave much to be desired in the way of fastness, nor do they combine well with other insoluble azo dyes.

The Farbwerke (vorm. Meister, Lucius, and Brüning) of Höchst a/Main, have applied for a patent for the production of a fast blue on a ground of naphthol, and this blue (of which Herr F. Storck, director of the Prague-Schmichower calico manufactory, is the inventor) appears to fulfil the required conditions.

The process consists in combining tetrazo compounds of dianisidine or diphenetidine with β-naphthol in the presence of a copper salt, and of suitable compounds of fatty acids. It has been previously noticed that copper salts have the important effect on combinations of diazo compounds with naphthol of increasing the fastness of the azo dye produced; but it has been impossible to make practical use of this fact, because most of the diazo compounds are decomposed in the presence of metallic salts. However, the tetrazo compounds of dianisidine and diphenetidine in acid solution withstand this decomposing influence, and the thickened printing colour mixed with a copper salt can be preserved without injury for a whole day, especially if light be excluded.

If the tetrazo compound mixed with a copper salt be allowed to act on fibre impregnated with β-naphthol in the presence of certain fatty acid compounds, there results a bright blue colour of great fastness. It is not affected by boiling soap solution, and in resistance to light, surpasses even indigo and alizarin blue. It is rather less fast to acids (therefore to perspiration) and to chlorine, being reddened by the latter; the original colour is, however, restored by a passage through a hot copper sulphate solution. Unlike the other insoluble azo dyes it is unaffected by a short steaming, and this fact may be made use of in combining it with other colouring matters. For example, by addition of Alizarin Yellow G G to the tetrazo compound containing copper, and steaming after printing, the tone of blue may be made more greenish. In printing, a resist for this blue may consist of stannous chloride or preferably of sodium or potassium sulphite.

An interesting fact is that, in printing, the steel "doctor" is neither attacked nor coated with copper by the printing colour, indicating that the copper is present in the tetrazo colour in organic combination.—R. B. B.

*Metallic Salts as Fixing Agents for Diamine Colours.* A. Kertész. Färber Zeit. 6, 1894—95, 65—66 and 82—84.

According to the author, colours fixed after dyeing on cotton by the method described in Eng. Pat. 15,326, 1893 (this Journal, 1894, 883—884), although improved in their fastness to soap and washing, yet bleed when washed. The author gives his experience with various diamine colours, using copper sulphate, "fluorchrom," and potassium bichromate as fixing agents.

*Copper Sulphate.*—The fibre, after dyeing in the usual way with the following colours, is worked in a bath containing 3·5 per cent. copper sulphate (of the weight of the material) according to the depth of shade, for $\frac{1}{4}$—$\frac{1}{2}$ hour at the boil or at 80° C.

In the case of pieces this treatment may be carried out in a Foulard machine. Cotton dyed with—

*Diamine Brilliant Blue G.*—A new colouring matter derived from dianisidine, gives, when treated in this way, a somewhat duller shade, but faster to washing and very fast to light.

*Diamine Deep Blacks S S and O O.* — The fastness to washing and soaping is excellent, the colours not bleeding on to white cotton even by repeated washing. The shade, however, becomes browner.

*Diamine Browns M and B.*—These two new colouring matters, said to be the fastest to light of all direct cotton dyestuffs (browns), become faster by treatment with copper sulphate, and the fastness to washing is also improved.

*Diamine Orange B, and Diamine Brown 3 G,* also become browner in shade, but are improved in fastness to light and washing.

*Diamine Bronze G and Diamine Yellow N.* — The fastness to light and washing is greatly improved; the shade with the former dyestuff becomes browner and with the latter duller and more orange in tone.

This treatment with copper sulphate differs from that in use with the benzoazurins, inasmuch as in the case of the brown and black colours the improvement in fastness is probably due to an oxidation of the colouring matter.

"*Fluorchrom*" *as a Fixing Agent.*—The material, after dyeing, is boiled in a bath containing "Fluorchrom" solution for $\frac{1}{4}$—$\frac{1}{2}$ hour. The quantity of this salt varies with the depth of shade. For deep colours 3 per cent., and for lighter shades the same weight of "Fluorchrom" as of dyestuff is used. The "after-chroming" of the following dyestuffs gave satisfactory results:—

*Diamine Fast Red F.*—The colour becomes faster to washing and does not bleed so much, but the fastness to light is decreased.

*Diamine Bronze G.*—The fastness to washing and soaping is greatly improved, and the colour bleeds only very little even in the darker shades.

*Diamine Browns M and B, and Diamine Yellow N.*— These colours also show increase in fastness to washing.

*Potassium Bichromate.* — Cotton is dyed with the addition of common salt or Glauber's salts, but not with sodium carbonate, to the dye bath. After washing it is boiled for 10—15 minutes with a 3—4 per cent. solution of potassium bichromate.

Favourable results were obtained by this treatment with—

*Diamine Deep Blacks S S and O O.*— Cotton dyed with 5—6 per cent. of colouring matter, after boiling 15 minutes with 4 per cent. of bichromate, yields a black very fast to washing and soaping, which bleeds very little and is fast to acid. The shades obtained from the mark O O are not so good as those from the other dyestuff.

*Diamine Browns M and B.* — The best results were obtained by a mixture of 2 per cent. of bichromate and 2 per cent. of copper sulphate.

The use of potassium bichromate as a fixing agent for these dyestuffs, permits of their use in conjunction with aniline black or catechu. For the former the use of 4 per cent. Diamine Deep Black S S as a bottom is recommended, while with catechu Diamine Brown M or B, with or without the addition of Diamine Deep Black S S or O O, may be added to the bath along with the requisite amount of catechu and 15 per cent. of Glauber's salts (see H. Falke, Färb. Zeit. 5, 1893-94, 349). The catechu and the diamine colour are then fixed with a mixture of copper sulphate and potassium bichromate in a separate bath.—H. I.

### *Substantive Cotton Dyestuffs and their Fastness to Soap.*

Luigi Caberti. Farber Zeit. 6, 1894-95, 68—69.

The author finds that the fastness to soap and washing, of dyestuffs containing the OH group is greatly increased if they be dyed on a chrome mordant.

This mordant is made by dissolving in $\frac{1}{2}$ litre of boiling water 255 grms. of potassium bichromate, and adding 350 grms. of sulphuric acid of 36° B. After cooling, 75 grms. of glycerin of 28° B. are gradually added, care being taken that the mixture does not become too hot. The liquid after again cooling is neutralised by the addition of 55 grms. of magnesium carbonate and filtered. The filtrate may be kept for some time without change. If the solution be diluted with water and a little sodium bicarbonate be added, then on boiling, a separation of flocks of chromium hydrate occurs. This is made use of as follows:—

The goods are boiled in a bath containing 50—75 cc. of the mordant solution of 20° B., per litre of water for $\frac{1}{2}$—$\frac{3}{4}$ hours, and after washing, are dyed in the usual way.

Very good results were obtained with Congo, Diamine fast red, Benzo brown NBX, Benzoazurine G, and others.
—H. I.

### *Improvement of Goods Damaged by Bleeding of the Dye.*

F. Giessler (Cottbus). Färber Zeit. 6, 1894-95, 145.

Mixed goods containing yarns dyed with Alizarin blue, Anthracene brown W, Alizarin red, and various azo-dyestuffs, &c., and white cotton silk or wool, are often injured by the "bleeding" of these colours. The discolored parts may again be rendered white by working the pieces in a dilute solution of sodium bisulphite (10 litres of commercial bisulphite in 1,000 litres of water) at 35° C., and then washing. An excess of sodium bisulphite must be avoided otherwise injury to the dyed yarns results.—H. I.

### *The Dyeing of Hair and its Vegetable Substitutes.*

M. Ganghofer. Färber Zeit. 6, 36—37.

A few large iron pans or wooden vats, pitchforks, rough willow crates, similar to those used for acid carboys, and several drying frames, complete the plant necessary for the dyeing of hair. The dyed goods may be allowed to dry in the open air, but if kept waiting to be dried by reason of unfavourable weather, they should be covered with cloths to protect the colour from light.

The great demand at present for stuffing materials cannot be met by the supply of horsehair, cattle-hair, and bristles. It is therefore necessary to seek a substitute for these. One of the best is the Pita fibre, also known as Mexican fibre, vegetable horsehair, &c., consisting of the leaf-fibres of various species of American Aloe. This fibre very closely resembles horsehair, but is yellowish-white in colour. It is imported from South America in bales of 90—250 kilos. No previous cleansing is required, as with horsehair, and the dyeing operation is therefore simpler. Coal-tar dyes are not used. The only colours dyed are black, grey, and brown. It is generally spun after dyeing, together with real horsehair, and twisted into cords 10—12 metres in length. These are subjected to the action of steam, at a pressure of half an atmosphere, and in this process if the dye be not fast it runs into the horsehair, giving to the mixture a soiled and uneven appearance. After steaming it is well dried.

It is most economical in dyeing the Pita fibre to use vats capable of holding 500—600 kilos. of material. Some methods of dyeing this fibre are as follows:—

*Black, First Method.*—The bath is filled with water which is heated to 60°—70° C. and the dyestuff added. For 100 lb. of material this would consist of $1\frac{3}{4}$ lb. solid logwood extract, and $\frac{1}{4}$ lb. solid fustic extract. When the dye is dissolved, enter the fibre, boil for $2\frac{1}{2}$ hours, and steep in the liquor overnight. The next day lift and dry.

*Black, Second Method.*—Work the fibre in small lots at a time, first in a bath containing lime, then in a weak solution of ferrous sulphate. The poor greyish-black thus obtained is topped with small amounts of logwood and fustic, and then saddened with ferrous sulphate. A full black which does not rub is thus produced.

*Grey, First Method.*—Heat the bath to 60°—70°, add 2 lb. sumach (for 100 lb. goods) and enter the material. Allow to steep overnight and then work the fibre, small portions at a time, in a very weak lukewarm ferrous sulphate bath for 10 minutes. Allow to lie for 2—3 hours and dry without washing.

*Grey, Second Method.*—Boil 2½ hours in a bath containing about 3 pints pyrolignite of iron for 100 lb. of goods. The dye-vessel is provided with a cover. As before, allow the goods to lie wet for a few hours before drying.

*Light Brown.*—Steep overnight in a bath containing 1½ lb. of catechu, ¼ lb. of logwood extract, ¼ lb. of fustic extract, and 3½ oz. of copper sulphate. The next day pass through a strong iron bath, and then through a hot bichromate bath, and rinse.

*Dark Brown.*—The dye-vessel is packed tightly with the material, and a solution containing logwood extract, fustic extract, and pyrolignite of iron is poured upon it. The bath is filled up with water, covered, and boiled for two hours. The material is taken out and allowed to lie for some time, passed through a bath of catechu and bichromate, washed, and dried.—R. B. B.

### *Boiled-off Liquor from the Stripping of Raw Silk.* Henri Silbermann. Färber Zeit. 6, 1894—95, 81—82.

The soapy liquor employed for removing the silk glue from raw silk (stripping) consists of undecomposed soap, ammonia, sericin, the sodium compounds of sericin and oxysericin, and finally free fatty acid. It is used in silk dyeing as a levelling agent for acid coal-tar colours, and according to the author it acts by forming an emulsion in the bath, and thus by hindering the motion of the molecules of the colouring matter, prevents the too rapid dyeing of the goods, the free fatty acid causing the shades to be bright and fresh. The dyer can, by the use of boiled-off liquor, enter the silk into the boiling bath, and still obtain level shades.

Various substitutes for boiled-off liquor have been proposed, such as:—Glue, starch paste, gum tragacanth, &c. The following mixture has been used with advantage:—1 kilo. of Marseilles soap dissolved in 40 litres of boiling water are added to 250—300 grms. of glue dissolved in 10 litres of water, and the whole heated to boiling, 130—150 cc. of Provence oil are gradually run in, and the boiling continued for a short time.

In order to recover the fatty acids from the waste dye-bath liquors, they are treated with calcium chloride or with lime water, the fatty acids and the sericins being precipitated as calcium salts. The cake which separates is decomposed with hydrochloric acid, and the fatty acids again converted into soap.

Drevon precipitates the fatty acids and sericins in the waste liquor with hydrochloric acid, and collects the former, which are afterwards purified.

Gianolli uses an acid solution of ferrous sulphate, and treats the mixture of fatty acids and iron salts in a lead autoclave with sulphuric acid (15 per cent. of acid at 15° B. of the weight of the air dried mass) under ½—¾ atmosphere pressure. The fatty acids are thus obtained in a state of purity, and may be directly made into soap. (For Taylor's process, see this Journal, 1886, 378, Eng. Pat. 6331.)

—H. I.

## PATENTS.

### *Improvements in or relating to Bleaching, Mordanting, Dyeing, Steaming, and Analogous Processes, and Apparatus therefor.* H. Lange, Crefeld, and R. Hömberg, Falkenburg, Germany. Eng. Pat. 6054, March 22, 1894.

The improvement consists in a method of bleaching, dyeing, &c., the warp threads while on the warp-beam. The beam consists of a hollow metal tube with perforated sides, tapering at both ends. The lower end can be fixed in an aperture provided in the vessel in which the warps are to be treated. The top is closed by a screw-plug or cap. To prevent immediate contact of the warps with the metal beam, and also to obviate the precipitation of any sediment or deposit on the warp, the perforated beam is covered with layers of calico, linen, or flannel; over this the warp is beamed, and is wrapped round with a similar outer covering.

The warp beam is placed vertically in the vessel destined to receive the dye or other liquid, and this liquid is forced from a reservoir by means of a pump into the warp beam, and flows through the perforations and the warps into the surrounding vessel. When the level of liquid in this vessel reaches a certain height the pump is reversed, and the liquid withdrawn by suction through the warp and perforations into the reservoir. These two operations are repeated as often as required.

Steaming is effected by passing steam through the warps, or by placing the warp-beams in a suitable steaming apparatus.

After drying by drawing or forcing hot air through the warp, the warp-beam is laid directly in the weaving loom.

—R. B. B.

### *Improvements in Printing Cotton Goods.* W. E. Kay, Thornliebank, and The Thornliebank Company, Lim., Glasgow. Eng. Pat. 6450, March 31, 1894.

The object of the improvements is the production of printed fabrics bearing heads, flowers, &c., at intervals, on a groundwork of imitation moiré antique, watered, or shot fabric, an imitation of brocaded or embroidered work being thus obtained. The moiré effect, as is well known, is produced by printing in two different colours with two rollers engraved with lines crossing one another at angles. Two methods may be employed for printing the flowers, &c. on such a groundwork, so that the design is quite free from the lines forming the ground effect.

*First Method.*—One roller prints its share of the ground lines all over the piece in undeveloped aniline black. On this ground are printed the flowers in resist or resist and colour. The ground effect is completed by printing the remainder of the necessary lines, which are discontinued at those places where the flowers, &c. are printed; the black is then developed.

*Second Method.*—The fabric is prepared with undeveloped aniline black mixture, the flowers and the lines fitting in with them are printed in coloured resists, and then lines are printed all over in white resists. These lines do not show where they pass over the coloured portions, but in conjunction with the coloured lines and the aniline black, when developed they produce the moiré or other special ground effect. The white lines correspond to the unprinted portions of the fabric in the former case.—R. B. B.

### *Improvements in Dyeing Machines.* L. Weldon, Montgomery, U.S.A. Eng. Pat. 25,128, December 24, 1894.

The invention is one applied to yarn-dyeing or drying-machines of the class provided with a "revoluble frame" for supporting the skeins of yarn, the object being to provide more simple and efficient means of turning the cross-bars supporting the skeins, and adjusting the bars to the length of the skeins. The invention consists in the combination with the "revoluble frame" of a shaft, a gear-wheel keyed thereto, a gear-wheel loose thereon, a gear-wheel operating with the first two gear-wheels, a cam carried by the loose gear-wheel, a pawl operated by the cam, and a ratchet-wheel engaging the pawl and secured to a "revoluble" cross-bar supporting the skeins. Other minor combinations are also specified.—W. S.

## VII.—ACIDS, ALKALIS, AND SALTS.

*A Method for Determining Calcium Oxide in Quicklime.* W. E. Stone and F. C. Scheuch. Amer. Chem. J. **16**, 721.

*See under* XXIII., *page* 304.

### PATENTS.

*A New Double Salt of Sodium.* G. S. Johnson, London. Eng. Pat. 1442, January 23, 1894.

This salt, containing two molecules of sodium sulphite to one of sodium carbonate, and twenty-one of water of crystallisation, is obtained by dissolving 7 parts of crystallised sodium sulphite and 4 parts of crystallised sodium carbonate in 12 parts of water, and evaporating the solution by boiling until a film appears. On adding a crystal of the previously prepared double salt to the cooled liquid, the new salt crystallises out. The same salt may be obtained by evaporating the solution of the constituent salts in a vacuum over sulphuric acid. Instead of using specially prepared sodium sulphite in forming the double salt, sulphur dioxide gas may be passed into solution of sodium carbonate in the proportion indicated by the equation—

$$3Na_2CO_3 + 2SO_2 + 21H_2O = (2Na_2SO_3Na_2CO_321H_2O) + 2CO_2.$$

Crystals of the double salt are not oxidised on exposure to air at the ordinary temperature, but gradually become opaque from loss of water; but acicular crystals, obtained by evaporating the solution of the salt at 60° C., are permanent in the air. The crystals lose all their water at 100°, and if heated in air at that temperature undergo slight oxidation.—E. S.

*Improved Process for Effecting the Desulphurisation of Sodic Sulphate.* J. Pedder, Widnes. Eng. Pat. 2373, February 3, 1894.

A mixture of 55 parts of sodium sulphate, in combination with 100 parts of water, and 48 parts of carbon, is calcined in a suitable furnace. The product, stated to consist of sodium sulphide and carbon, is treated for recovery of the sulphur, as for instance, with carbonic acid, according to the equation, $H_2CO_3 + Na_2S = Na_2CO_3 + H_2S$. The residue is ground up with carbon and water, and heated in a Thwaite or other type of revolving furnace, so as either to volatilise or oxidise the sulphur. When the combustion is of an oxidising character, the reaction is represented by—

$$2Na_2S + 2H_2O + 2C + 5O_2 = 2Na_2CO_3 + 2SO_2 + 2H_2O.$$

—E. S.

*Improvements in the Manufacture of Ferrocyanide of Potassium, or of Sodium, from Sulpho Cyanide.* A. E. Hetherington, Widnes, and E. K. Muspratt, Liverpool. Eng. Pat. 5830, March 20, 1894.

Iron in a divided state, such as filings, borings, scrap, or spongy iron, is strongly heated with pitch to reduce any oxide that may be present. About 70 to 80 parts of iron thus treated are heated with from 20 to 40 parts of pitch, and 100 parts of potassium sulphocyanide added in a state of fusion. The mixture is heated to from 700 to 800 F. in a closed retort or vessel admitting a stirrer, and which may be connected by a pipe to a scrubber for recovery of any sulphocyanide that may be volatilised; or instead of a vessel with a stirrer, a revolving cylinder may be employed. When the reaction is complete, the mass, containing potassium ferrocyanide and sulphide, ferrous sulphide, and a little sulphocyanide, besides remains of the pitch, is lixiviated with hot water. The filtered solution is treated with carbonic acid gas, and the ferrocyanide is separated from the carbonate thus formed, by crystallisation. But when the process is used to obtain sodium ferrocyanide, it is preferred to separate that from the sulphide, and to decompose the sulphide afterwards by carbonic acid. The potassium or sodium carbonate occurring as a by-product in the process, containing some sulpho- and ferrocyanide, may be usefully applied in the manufacture of a sulphocyanide, by double decomposition with calcium sulphocyanide.—E. S.

*Improvements in the Manufacture of Cyanide of Sodium or of Potassium from their Ferrocyanides.* A. E. Hetherington and F. Hurter, Widnes, and E. K. Muspratt, Liverpool. Eng. Pat. 5832, March 20, 1894.

A sodium-lead alloy is fused in an iron pot under a small quantity of previously formed cyanide, and anhydrous ferrocyanide (of sodium or potassium) is added in small portions. "For every 100 parts of anhydrous ferrocyanide to be converted into cyanide there should be employed, so much of the alloy as corresponds to at least 13 parts of metallic sodium." When the reaction is complete, the mixture consists of three distinct layers, fused lead, reduced iron, and above, the fused alkaline cyanide, which latter is easily separated. Sodium-lead alloy is preferably used in the process; but may be replaced by potassium-lead alloy.—E. S.

*An Improved Compound or Mixture for Freezing or Chilling.* K. C. Edmonds, London. Eng. Pat. 6462, March 31, 1894.

The cooling mixture is constituted of sodium sulphate, 4 lb.; ammonium nitrate, 3 lb.; sodium phosphate and ammonium sulphate, 1 lb. each; and 2 oz. of nitric acid diluted with 4 lb. of water, or approximately these proportions. The compound is stated to be well suited for use in the apparatus described in Eng. Pat. 16,782, 1893, by the same inventor, besides having more general application.

—E. S.

*Improvements in Furnaces for Extracting Potash from the Grease contained in Sheep's Wool.* Madame E. Richard-Lagerie, Roubaix, France. Eng. Pat. 13,677, July 16, 1894.

The furnace may have one, two, or more storeys. Each storey is provided with one or more revolving stirrers, to prevent losses by priming. The stirrers, mounted on transverse shafts, have each cross arms supporting four sheets of wire gauze, which during revolution in a direction opposite to the draught, periodically dip into the incoming sheep's wool grease, which is thus distributed over the gauze and exposed to the heat of the escaping gases. The arch of the furnace consists of ribbed cast-iron panels, filled with clay between the ribs, to retain heat and obstruct outward radiation. Ammoniacal and offensive products are condensed and collected by the use of nozzles fitted into the chimney or into vertical chambers in which the gases circulate, through which a condensing liquid is injected. Or, alternatively, the combustion gases may be collected by a fan, and forced through a coke column, provided with an upper injector through which a liquid is sprayed. The beds or pans on the same level or storey, communicate by a special channel, and the incinerated product flows from the lowest chamber down a tier of firebrick or asbestos steps, which may be duplicated. A sloping channel or culvert runs around the furnace, communicating with small cisterns in the ,walls, to receive any escaping liquid, and take it to a larger cistern in front of the furnace, to be thence returned. The level of the grease in the concentrating chambers is kept constant, so that the stirrers may dip about $\frac{5}{8}$ths of an inch below the surface; this is accomplished by means of an automatic feeder operated by a float and valve of described construction. The lower furnace is fed from the upper one by means of a tube fitted with an inverted valve, the tube being provided with a rod and spring arrangement, whereby the valve is closed when the grease in the lower furnace is sufficiently concentrated. A three-storied furnace is preferably employed, fired with gas or liquid hydrocarbon.—E. S.

*A Process of and Apparatus for Distilling and Condensing Nitric Acid, Tar, and other Liquids.* W. B. Maxfield, Leicester. From W. Dieterle, Feuerbach, near Stuttgart, and L. Rohrmann, Krauschwitz, near Muskau, Germany. Eng. Pat. 14,520, July 28, 1894.

When a mixture of saltpetre with sulphuric acid, in suitable proportions, is heated, even at so low a temperature as 50° to 60° C., the hydro-acids of the halogens (particularly noticeable when the nitre contains much sodium chloride) are oxidised with liberation of the halogens and production of oxides of nitrogen. To remove these by action of a continuous current of air or of an inert gas, passed into the mixture from the beginning of the heating to the termination of the process, admits of obtaining a distillate of nitric acid of high purity, the apparatus shown and described below being used.

Fig. 1.

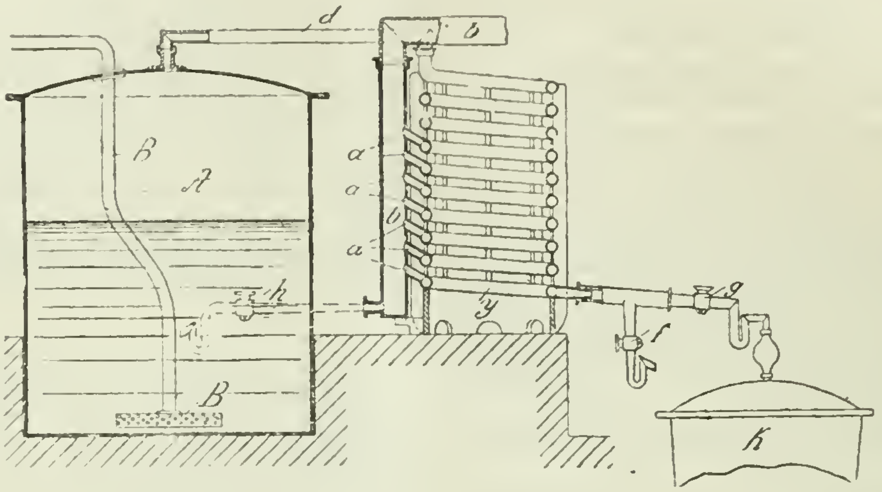
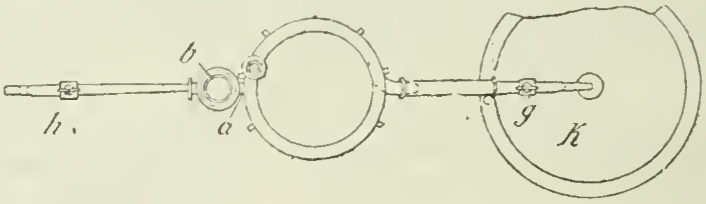


Fig. 2.



Air or inert gas is forced through the tube B into the mixture of sulphuric acid and nitre contained in the heated receptacle A. The tube *d* passes into the cooler, from the lower coils of which small branch inclined pipes, *a*, pass into the large tube *b*, shown in plan in Fig. 2. This tube, receiving the less condensable products of the distillation, terminates in a suitable reservoir, provided with a siphon cock *h*; the upper part of the tube *b* may be connected to an absorption apparatus. The air first separated is returned to the still. The first portions of the distillate are liable to be coloured and have a chlorine reaction: to obtain these portions separately, the cock *g* is at first kept closed, while the cock *f* in the branch pipe is open. The action of these cocks is reversed when the pure acid comes over, which then enters the receiver K. The acid condensed in the pipe *b* is stronger than that entering the cooler, and it may be allowed to drip continuously from the siphon valve *h*, or that valve may be closed so that the acid may pass through the lowest pipe *a* of the last coil *y* into the receiver. A modified form of the apparatus is also shown in the original drawing. The cooler may be made of glass or metal, and "is suitable for all kinds of distillation in which corroding gases are produced, such as, for instance, in the distillation of tar or the like."—E. S.

*Production of Hydrochloric Acid from Chlorine, and of Hydrobromic Acid from Bromine.* R. O. Lorenz, Göttingen, Germany. Eng. Pat. 25,073, December 24, 1894.

Chlorine, produced in electrolytic and other processes as a by-product not readily made commercially available, is collected in suitable gas-holders, to be taken through clay retorts, charged with coke, charcoal, or anthracite, heated to low redness, while steam is simultaneously forced in The reactions are represented by the two equations:

I.

$$C + H_2O + Cl_2 = 2HCl + CO.$$

II.

$$C + 2H_2O + 2Cl_2 = 4HCl + CO_2.$$

The gaseous mixture of hydrochloric acid, carbonic oxide, and carbonic acid, is passed into suitable apparatus for condensing the hydrochloric acid gas in water, the product being described as pure. Hydrobromic acid is obtained from bromine in like manner.—E. S.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*Enamel Glazing on Cooking Utensils with Antimony as a Constituent.* Paul Kaszper. Dingler's Polyt. J. **294**, 187—188.

For some time past, iron cooking utensils with an enamel glazing of especial brightness have been in the market. The author has investigated the composition of this enamel and also the action of vinegar upon it. The analysis gave the following results :—

$SiO_2$, 39·80 ; $Al_2O_3$, 10·04 ; $SnO_2$, 1·19 ; $Sb_2O_3$, 14·32 ; $P_2O_5$, 2·73 ; CaO, 0·36 ; $K_2O$, 7·72 ; $Na_2O$, 8·92 ; $B_2O_3$ (by difference), 14·92 ; 100·00.

On boiling 8·9041 grms. of the enamel in small pieces with 250 cc. of strong vinegar, 1·61 per cent. was dissolved, and on adding HCl and $H_2S$ to the solution, an unmistakeable precipitate of antimony sulphide was obtained.

For the purpose of comparison, 400 cc. of the same vinegar were boiled in two new pots of equal size, one of which was glazed with the ordinary tin oxide enamel, and the other with the antimony enamel. In the case of the former, 0·3147 grm. was dissolved ; in the latter, 0·5036 grm. The greater amount of corrosion in the antimony glazed pot was also perceptible, and as in the first experiment the antimony dissolved could be readily precipitated as sulphide. These results show that from a hygienic point of view the presence of such large quantities of antimony in enamel glazing requires the most serious attention.

—C. A. M.

## PATENTS.

*New or Improved Apparatus for stirring Enamel Mixtures used in the Manufacture of Enamelled Metallic Name Plates, Wall Plates, and other like Metallic Plates, and other Enamelled Metallic Articles.* B. Baugh, Birmingham. Eng. Pat. 7218, April 11, 1894.

THE apparatus described, consists of a bowl to contain the enamel mixture carried at the upper end of a vertical shaft, the lower end of which is driven by a bevel gearing from a horizontal shaft, motion being cut off and communicated by the aid of a clutch. Stirrers or brushes of various design depend from radial fixed arms projecting from the working bench into the rotating bowl, the liquid contents of which are thus churned up by its motion relative to these brushes. The advantages claimed are that the mixture is kept uniform by this method of agitation and that on account of the brushes themselves being fixed, relative to the working bench, access to the contents of the bowl is not impeded by the process of agitation.—B. B.

*The Manufacture of a New Vitrified Material.* La Société Anonyme des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny et Cirey Paris, France. Eng. Pat. 22,834, June 13, 1894. Under International Convention.

A VITRIFIED material to which the name "*opaline laminée*," has been given, is made from silica 54 per cent., baryta 39 per cent., and soda 7 per cent. It is stated that the material can be made into plates of any required dimensions, and can be used for all purposes to which glazed tiles are commonly applied.—B. B.

# IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Notes on the Hardening of Mortar.* J. A. McPherson. J. Amer. Chem. Soc. **16**, 733—735.

IT is a common belief among builders that it is better to mix lime-mortar some days previous to use rather than use it directly after mixing. To test this belief, samples of mortar were taken on successive days from two separate heaps of large size ; briquettes were made therefrom, and, after an interval of some weeks, were broken for estimation of tensile strength with the following results :—

| — | Days in Heap after Mixing. | Days exposed to Air as a Briquette. | Average Breaking Stress in Lb. per Sq. In. |
|---|---|---|---|
| Mortar No. 1 | 3 | 50 | 34·6 |
| " | 4 | 49 | 38·6 |
| " | 6 | 48 | 33·1 |
| " | 7 | 46 | 39·3 |
| Mortar No. 2 | 4 | 48 | 36·0 |
| " | 5 | 47 | 38·0 |
| " | 6 | 46 | 41·2 |
| " | 7 | 45 | 41·5 |

The amount of calcium silicate formed was found to be exceedingly small, even after long intervals of time. Thus, mortar taken from the Van Reusselaer mansion at Albany, built about 1760, and some from a very ancient tower in the Lahn valley, only contained 0·34 per cent. of calcium silicate.

Hydraulic mortar tempered with sugar solution (half a pound of sugar to one gallon of water) was found to be stronger than the same mortar tempered with water, for use in air ; but if used for sub-aqueous work no advantage resulted. The same mortar was tempered with bullock's blood diluted with one-third its volume of water. The resulting briquettes set somewhat more quickly, and showed a considerable increase in strength both in air and water. The following results were obtained :—

Average strength of the same sample of hydraulic mortar :—

| | Pounds per Sq. In. |
|---|---|
| 1. Tempered with water alone ...................... | 63·00 |
| 2. Tempered with sugar solution, and exposed to water during 38 days. | 62·75 |
| 3. Tempered with sugar solution, and exposed to air during 38 days. | 65·4 |
| 4. Tempered with diluted blood, and exposed to water during 37 days. | 68·3 |
| 5. Tempered with diluted blood, and exposed to air during 37 days. | 69·8 |

—L. A.

*Test for Portland Cement.* Eng. and Min. J. 1895, **59**, 32.

MICHELE's test for Portland cement for 1895 (U.S. America) is as follows :—Pats one-eighth of an inch thick in water, absolutely sound at seven days ; tensile strength, 400 lb. per sq. in. at seven days ; fineness, 5 per cent. residue on a 50 sieve. The pats to be gauged on glass immersed in water immediately, and left there for the whole period. One pat to each three bricks. The test bricks to be gauged by a skilled man, with a minimum quantity of water, and well rammed into moulds. The average of three to be taken, which shall represent about 100 tons or less. The strain to be applied as quickly as possible. The sieve to have 2,500 holes per square inch, and to be of wire of not less than 0·007 of an inch—34 B.W.G.—in diameter. Shaking to be continued for five minutes.—A. W.

## PATENTS.

*Manufacture of Asbestos, Cements, and of Coverings or Moulded Objects made therefrom.* A. Kublewein, Berlin, Germany. Eng. Pat. 4632, March 5, 1894.

THIRTY to thirty-five parts of asbestos, half of which is "asbestine," 60 to 75 parts of gypsum, 25 of lime powder, 20 of chalk, 20 of crucible or fire-clay powder, 30 of graphite, 20 of coke ashes, may be used as the constituents of a cement said to be weather-proof and fireproof and capable of application to general structural purposes. A similar mixture, having the gypsum replaced by cement, may be employed where the load to be carried is greater than can be supported by the composition already quoted. The "asbestine" appearing in the prescription given above is said to be "a known product belonging to the same class as asbestos and resembling talc in appearance." The composition may be stiffened by the introduction of layers of wire netting or of jute.—B. B.

*An Improved Material for Paving and like Purposes.* C. B. Potter, Newcastle-on-Tyne. Eng. Pat. 5160, March 12, 1894.

The material patented consists of concrete made of small lumps of emery stone set in Portland cement. The emery may be in pieces varying from half an inch in diameter down to a powder, and is mixed with Portland cement in the proportion of three parts of emery to two of cement. The composition prepared in this way is used to face ordinary concrete slabs, constituting a wearing surface for paving flags, steps, man-hole covers, &c.—B. B.

## X.—METALLURGY.

*Some Recent Contributions to our Knowledge of Metallic Reducing Agents.* H. F. Keller. J. Amer. Chem. Soc. **16**, 833—844.

An account, chiefly of the researches of C. Winkler on the reduction of oxides by magnesium, and of Seubert and Schmidt on the action of magnesium on chlorides. (See this Journal, 1890, 737—738; 1892, 39 and 849.) That part of Winkler's work referred to, which is not to be found in the above references, concerns the metals of the 4th group.

*Carbon.*—Magnesium ribbon, when *moderately* heated in a current of carbon dioxide, does not take fire, but is slowly converted at its surface into a carbide, carbon monoxide being formed at the same time. On raising the temperature to full redness, the metal inflames, and continues to burn with a dazzling light, the products being magnesia and carbon. With magnesium powder, carbon monoxide is formed much below a red heat.

Burning magnesium wire is extinguished if plunged into carbon monoxide; but, when strongly heated in a current of the gas, the metal emits light, and a grey coating of a carbide appears on the surface.

*Silicon.*—Silica is very easily reduced by magnesium, and, as L. Gattermann has shown, either silicon or silicon-magnesium can be obtained by varying the proportion of magnesium. Silicon monoxide could not be obtained by the reduction of silica, either by magnesium or silicon. Many silicates are reduced quite as easily as the dioxide.

*Titanium.*—Titanium dioxide was not reduced to metal; a mixture of monoxide and a titanium spinel were the products of the reaction.

*Zirconium.*—This element is obtained by heating zirconia with magnesium to a high temperature.

*Cerium.*—According to the proportion of magnesium employed, either cerium or $Ce_2O_3$ was obtained from cerium dioxide. The reduction begins at a moderate red heat and is accompanied by a vivid glow. In the nascent state cerium absorbs hydrogen in large quantities. This remarkable fact was demonstrated by the following experiment:—

A mixture of 1 molecular proportion of $CeO_2$ and 2 of Mg was prepared, and 20 grms. of it were placed in a combustion tube, through which a current of dry hydrogen was passed, at a gentle heat, to expel moisture. The further end of the tube was then closed, stopping the current of hydrogen, and the temperature quickly raised to bright redness; a rapid current of hydrogen was seen to enter the tube through the washing bottles. The hydride is brownish-red in colour, without action on water at ordinary temperatures, but liberates hydrogen upon heating. Hydrochloric acid dissolves it to $CeCl_3$, with evolution of hydrogen. It is very inflammable, and detonates with $KClO_3$, $KNO_3$, &c. Analysis points to the formula $CeH_2$. Carbon and silicon could not be made to unite with hydrogen under similar circumstances, but zirconium and thorium yielded hydrides similar to $CeH_2$. The same was observed with lanthanum, and this led Winkler to believe that this element belongs to the cerium group; but he showed subsequently that yttrium and other trivalent elements, as well as barium, strontium, and calcium, can unite with hydrogen (this Journal, 1892, 39).—L. A.

*Changes in Iron and Carbon during Tempering.* M. G. Charpy. Eng. and Min. J. 1894, **58**, 512.

A series of experiments has led the author to the conclusion that the change produced in iron after tempering is an allotropic one which is readily characterised by the presence or the absence of a rectilinear level in the curve of tension. Furthermore a transformation of the carbon is produced, indicated by the diminished colour in the Eggertz colorimetric test with tempered steel, as compared with the same metal before being tempered. This failure to indicate all the carbon in tempered steel is persistent in character, and it is now demonstrated that the quantity shown by the Eggertz method is smaller in proportion to the degree of hardness of the steel. There are thus two clearly defined transformations, both of which in hard steels are produced at almost identical temperatures. In soft steel the Eggertz method is uncertain, but an indication might be obtained by comparing the results of various processes of tempering on the same steel.

The results of a series of experiments on a Martin steel containing 0·71 per cent. of carbon showed that the carbon suffered no change, in bars heated above 750° C. The iron was partially transformed in some, but there appeared to be no connection between this transformation and the variation of the breaking strain. The differences in the resistance of the bar are probably owing to the modification of the mechanical structure in the grain of the metal which appeared in the fracture. In these steels, tempered after heating at a temperature above 740°, the iron and the carbon are simultaneously transformed, but the iron is completely transformed in all those bars which have a breaking strain higher than 82 kilogs. The proportion of carbon transformed, diminishes continuously, while the breaking strain rises and the lengthening decreases. Hard tempering only appears for very heavy strains, and the sole difference between these and the light strains consists in a diminution in the apparent quantity of carbon contained. The tempering products are therefore a transformation of the iron indicated by the traction test and a transformation of the carbon shown by the Eggertz test. The former appears to have only a very slight influence on the breaking strain, whilst the latter seems to be correlative to the increase of hardness.—A. W.

*Crystallised Hard Compounds in Cement Steel, and in Alloys of Iron with Chromium, Tungsten, and Manganese.* H. Behrens and A. R. van Linge. Zeits. Anal. Chem. 1894, **33**, 513—533.

1. *Raw Cement Steel.*—The steel had been made by cementation from Dannemora iron, and contained about 0·74 per cent. of carbon. It broke easily and the fracture was hackly, with here and there a bright white cubical formation. Polishing gave evidence of the presence of a harder substance distributed in crooked lines, which were intensified by etching or on colouring by heat. On treating with fuming hydrochloric acid, or better with diluted (1:4) sulphuric acid, hydrocarbons were evolved during the first two hours, and then the gas acquired a garlic-like (phosphoretic) odour. An insoluble granular residue, after treatment with a 10 per cent. solution of sulphuric acid to extract free iron, and after washing away a little graphite,

was dried; it was found to consist of coarse clear-grey lustrous particles, resembling powdered spiegeleisen; they were a little harder than apatite, but softer than window glass (hardness therefore = 5·2 – 5·3), were easily powdered in an agate mortar, were strongly magnetic, and under the microscope appeared as bright spangles and rods of very irregular (non-crystalline) form. The yield of the purified powder was 5 per cent. of the original sample. Analysis showed it to contain 6·6 per cent. of carbon (= $Fe_3C$) and a little phosphorus. The dissolved portion of the metal must therefore have contained 0·4 per cent. of carbon; but this was not evenly distributed. Careful etching to 1 mm. depth, showed minute cubical boundary lines within the larger meshes, which vanished on prolonged treatment with acid; and the inner portions of the cubes had a hardness of 3·5—3·7, about equal to that of a steel containing 0·1—0·2 per cent. of carbon.

These results do not accord with the migration theory of the carbon atoms, which supposes carbon to be passed inwards from one atom of iron to another; as this would lead to the formation of an outer hard sheath with a soft core, whereas the carbon is regularly distributed in a network of hard material running throughout the mass and enclosing soft cubes of unaltered iron. Rather acceptable is Laurent's carbon monoxide dissociation theory; for the microscopic structure points to the diffusion of carbon monoxide into minute cracks, due perhaps to incomplete welding, and between the surfaces of the crystals; here the formation of high-carbon iron compounds may lead to local fusion at the copper-melting temperature of the cementation furnace, which would favour the absorption of carbon by the mass. Thus carbon penetrates to the centre of the bar, and the channels by which it was introduced are more or less filled by the irregular plates and rods of the once fused hard iron compound, whilst the original crystals of soft iron remain embedded within the cells thus formed. The puddling cinder left in the iron would also fuse, and favour the action. A little graphitic carbon is found, and there are indications that phosphorus concentrates in the hard carbide. The hard compound appears, but is not yet proved, to be crystalline, as by analogy with manganiferous and phosphuretic white iron, and with Osmond's Siemens-Martin (0·14 per cent. C.) steel (Comptes. rend., April 1894), it should be.

2. *Ferro-Tungsten and Tungsten Steel.*—The fracture of ferro-tungsten is granular or made up of small plates. Polished surfaces which have been heated or etched recall the appearance of spiegeleisen. Prolonged attack with fuming hydrochloric acid gave different results with different samples. A granular specimen from Biermann's works gave a turbid, almost black, solution which deposited much carbon on standing, and a fine grained nickel-like metallic powder; whilst a 50 per cent. alloy from List's works gave an almost clear, light brown solution containing much tungsten, together with plates and threads of a hard yellowish metal. The most suitable acid was found to be dilute (1:4) sulphuric acid, applied cold until brisk action ceased, and then at 50°—60° C., with frequent stirring. Much tungsten passed into solution, but the iron in the dissolved portion ranged from 82 to 85 per cent. The resulting crystals were separated from soluble iron alloys by a 5 per cent. sulphuric acid solution, and from carbon by washing. They were found to be very lustrous, whitish, non-magnetic crystals, many of them being most perfect octahedra. They were just hard enough to scratch felspar, but were much softer than quartz; the hardness is therefore 6—6·3, whilst that of the dissolved grey portion was 4·2—4·5. Yet they could be easily crushed to a bright grey powder. The carbon in a specially well-crystallised specimen was only 0·56 per cent. (in another sample 0·68 per cent.), whilst the ratio of iron to tungsten agreed with the formula $Fe_2W$. A silky fractured tungsten steel (= 7 per cent W), when polished and heated, showed small granules (20 $\mu$) in a fine network. The coarser fracture of a hammered 1·7 per cent. tungsten steel hammered bar displayed small octahedra, whilst the same steel polished and etched exhibited a confused network of bruised squares and rhombs, the crystals appearing for the most part to have been powdered by the hammering and rolling.

3. *Ferro-Chrome.*—The fracture of ferro-chrome with 12—20 per cent. of chromium resembles white iron, and the brilliant white radial needles may attain a length of 15 mm. and a thickness of 1 mm.; but with increasing chromium they become shorter and thinner, and with 50 per cent. alloys the fracture is felt-like or granular. Heating polished surfaces to a blue heat developed a yellowish skeleton of hard chromium alloy (hardness far above 6) enclosing a blue softer material with a hardness of 4·2. Sharp angles of a 13 per cent. alloy scratched felspar easily, whilst those of the 50 per cent. compound scratched quartz. The microscope shows that the soft enclosed material is caught into and interlaced with the hard crystals in such a manner that it quite accounts for the great strength of the alloy.

The richer ferro-chromes offer much resistance to acids, and the best solution for rapid etching is aqua regia (or strong hydrochloric acid) mixed with a little potassium chlorate. But where rapidity may be subordinated to excellence of results, fuming hydrochloric acid alone should be used to isolate the harder crystals. It is applied cold, and is later warmed to 50°—60° C. Much chromium passes into solution, imparting a green colour to the liquid. The residue, after digestion with acid until all visible action has ceased, is boiled with water, then stirred well in a solution of sodium boro-tungstate (sp. gr. = 2·8) to separate carbon, and then washed many times with boiling water. On drying, it is found as a coarsish, brownish-grey, lustrous powder, made of small bars, of which many are 3—4 mm., and a few 8—10 mm. in length, with a hardness of 7·5. The larger fragments show many notches and furrows, through which they break easily. The powder, unlike the raw material (even the 50 per cent. sample), is not attracted by a powerful steel magnet. The composition of the powder which separated from a ferro-chrome containing 13·8 per cent. Cr, 81 per cent. Fe, and 5·5 per cent. C, corresponded to the formula $Cr_2Fe_7C_3$, and may be regarded as $Fe_3C$, in which iron is replaced by chromium; the yield was 65·4 per cent. of the original sample. A 50 per cent. ferro-chrome gave a residue containing 65 per cent. Cr and 10·4 per cent. C, agreeing with the formula $Cr_3FeC_2$, in which the increased carbon percentage may be correlated with the high temperature necessary to the production of the ferro chrome. The intense hardness of the material is owing rather to carbon than to chromium, for there is much chromium in the part that still remains soft; but chromium appears to facilitate the formation of the carbide, whose characteristics, even in pure carbon steels, are great hardness and chemical stability. Chromium thus acts as a precipitating agent, and is able in this way to increase the proportion of carbide to an extent unequalled, probably, by any other element.

4. *Chrome Steel.*—The fractures of chrome steel are almost identical with those of carbon steel. The etching of polished surfaces brings out markings similar to those in ferro-chrome, but on a smaller scale. The magnetic properties, composition, and hardness of the powder separated by acids agree well with that ($Cr_2Fe_7C_3$) obtained from a 13 per cent. ferro-chrome, but the grains are finer, and appear to consist of particles of the original rods broken down by mechanical working. The result of this destructive action constitutes the chief, or only, class distinction between chromium steel and the lower ferro-chromes. The hardening of low-chrome steels doubtless takes place throughout, but with steels containing more than 7 per cent. Cr, the hardness and stiffness of the mass is due to the separated carbide, which is protected from fracture by encasement in a softer material; the behaviour of the remainder of the steel is immaterial.

Finally, the authors give a short account of the methods of analysis adopted; and two pages are devoted to protests: first, against the growing misapplication of the word *steel* to alloys (such as the so-called manganese steel), the properties of which are quite distinct from those of true carbon steel; and secondly, against the $\beta$-iron hypothesis.—W. G. M.

### *Magnesia and Sulphur in Blast-Furnace Slag.* A. D. Elbers. Eng. and Mining J. 1895, **59**, 52.

The author points out the occasional failure of certain rules laid down in respect to the behaviour of one substance in relation to another in their action in the blast furnace. Hence the necessity of tracing the origin of the various reactions from a common starting point, which he does by accounting for the ultimate results on thermochemical principles. He has previously shown that the higher the specific heat of the slag, the hotter is the furnace, due to the greater proportion of fuel used. Consequently, the iron becomes more highly carburetted, and the ferrous and ferric silicates in the slag more thoroughly reduced. In order to explain the effect which the relative proportion of the magnesia has on the absorption of sulphur a similar line of argument has to be pursued, but with this difference,—the elimination of remnants of combined iron depends on the ultimate reactions between slag and metal, whereas the sulphur-absorbing capacity of the slag depends chiefly on the primary reactions of the flux.

From the following thermal data it is seen that the sulphur absorbing capacity of a slag depends chiefly on the sulphide-producing capacity of the lime:—

| | | |
|---|---|---|
| Heat required for the decomposition of..... | $CaO$ = 132 cal., of | $MgO$ = 146 cal. |
| Heat set free by the formation of.......... | $CaS$ = 92 „ | $MgS$ = 79·6 „ |
| Difference.......... | 40 cal. | 66·4 cal |

It is also known, that calcium sulphide is much more easily produced than magnesium sulphide by corresponding reactions; that ferrous sulphide and lime react at a lower temperature than ferrous sulphide and magnesia; and that lime takes up more sulphur from the furnace gases when the temperature is high. Consequently, if a highly magnesian slag absorbs so much, or more, of sulphur as a slag of the same silicate constitution does which is low in magnesia, the reasons must be (1) that the quantity of lime contained in the burden is sufficient to absorb nearly all of the sulphur, and (2) that the sulphur-absorbing or -combining capacity of the lime is brought to its highest pitch by the high furnace temperature, which the high specific heat of the highly magnesian slag renders necessary. To express it in another way:—The furnace works hotter with the same amount of fuel when the burden is rich in magnesia, and correspondingly poor in lime, than when these conditions are reversed, because a smaller quantity of flux is required for making the same grade of silicate when the proportion of magnesia is high.

As the specific heat of alumina is lower than that of magnesia and higher than that of lime, it might be inferred that it takes an intermediate position with regard to its effect on the absorption of sulphur; this it does so far as the influence of its specific heat has any bearing on the point. But the alumina of the slag comes from the ore, and is not therefore a constituent of the flux added to the charge. A slag containing high percentages of alumina and magnesia is inefficient in absorbing sulphur, as it is deficient in the sulphur-absorbing constituent lime, and this last-named substance therefore should be added in sufficient quantity to form a sub-silicate slag of an oxygen ratio of $\frac{3}{4}$ to 1. Hence the rule to keep the alumina of sub-silicate slags low when the flux is high in magnesia. As regards the influence of magnesia on the absorption of sulphur, it would be correct to say that it assists the action under all conditions, provided always that the quantity of lime that goes with the magnesia is sufficient to take up the greater portion of the sulphur.—A. W.

### *Use of Aluminium in Refining Metals.* M. J. Faucan. Eng. and Mining J. 1895, **59**, 57.

In concluding a communication on the above subject to the Liège section of the Association des Ingenieurs de Liège, the author states that:—The use of aluminium as a refining agent does not dispense with the usual precautions, it being still necessary to allow the metal to cool properly and give off its gas before casting; and while pouring, the stream should be kept continuous and central, care being taken to avoid its falling too quickly so as to make large runners. If the metal be subject to considerable contraction, the ingot mould must be protected from too rapid cooling; and if depressions be produced by suction, hot metal must be immediately poured in to fill them. If these precautions be observed, the following results may reasonably be expected, viz.:—Suppression of the use of silico-carburetted iron and a diminution in that of ferro-manganese, aluminium playing the same part as the former under better conditions, and restricting that of the latter to the elimination of sulphur; in making nickel steel, great homogeneity of the product, aluminium acting violently on the steel and nickel bath, and greatly facilitating a union which is not otherwise easy; in making iron and steel castings generally, leaving out of the question "red shear iron" (fer metis), in which aluminium plays an important part, the obtainment of castings very clean, very compact, and standing as well hot as cold; dense brass castings, easy to work with the hammer and having an electric conductivity more than double that of ordinary castings; and lastly, in working nickel, all the advantages of refining with magnesium, but obtained more economically.—A. W.

### *Chemical Behaviour and Use of Aluminium.* E. Donath. Dingler's Polyt. J. 1895, **295**, 18—21.

The action of distilled, of filtered river, and of spring water, upon carefully cleaned strips of aluminium sheet, are first described. The strips were boiled for 48 hours in beakers in contact with the water under test. In the case of distilled water, the surface of the metal remained bright excepting where it had been more or less exposed to the air, and here it was covered with a faint veil of white deposit, and was slightly deadened; but the strip had only lost 6 mgrms. on 8·3832 grms. The addition of merely a few cc. of pure but weak hydrogen peroxide solution to the distilled water, caused an immediate deadening and darkening of the metal, and the water became visibly turbid from the presence of a light precipitate of alumina. The production of hydrogen peroxide by the combined action of air and water upon aluminium, described by Mylius and Rose (as by their analogous joint action upon zinc, quoted by Traube in this Journal, 1890, 213), would account for the slight attack above described; so that the action of pure water upon dense aluminium may be regarded as *nil*. But the filtered river water, and less markedly the spring water, soon caused a visible corrosion, accompanied by the production of rough dark grey, black, or brown patches, with here and there a white deposit, and of whitish flocks in the water; the plates immersed in the waters lost, respectively, 0·0667 grm. on 7·2531 grms. and 0·0361 grm. on 7·5415 grms. Experiments with the filtered water, repeated at different seasons of the year, always gave similar results; but the intensity of action varied, the brown and grey patches predominating in spring, when the water contained most nitrates, and the white being most in evidence in summer, when nitrates and nitrites were practically absent. Experiments were next made to determine which ingredients of the water produced the corrosive action. Alkaline chlorides and sulphates are generally said to have no action, and the same has been proved by Neumann-Wenden for carbonic acid and bicarbonates. A nearly saturated solution of calcium sulphate showed no corrosion, but of solutions containing 0·3 grm. of magnesium sulphate, and 0·26 grm. of the chloride per litre, respectively, the former showed a just perceptible alteration, the latter a distinct and uniform corrosion of the aluminium surface, but without brown or grey patches, and without the formation of a precipitate in the solution. But solutions containing as little as 0·01 grm. per litre respectively of potassium and ammonium nitrate, and of potassium nitrite, produced a strong alteration analogous to that given by the natural waters. The influence of the organic constituents of the water could not well be observed, because they could not be separated from the accompanying metallic elements, and being of very variable (and largely of unknown) constitution, they could not be imitated artificially. But excluding the action of organic matter, it would seem from the above experiment that the effect upon similar aluminium plates of boiling with various samples of water for equal periods, may give a fair general indication of the comparative hygienic characters of the waters examined. There would seem to be no objection to the use of aluminium for cooking utensils, for even when the highest degree of corrosion has been attained, but little alumina and iron pass into the solution; the dark-coloured patches being due to the formation of insoluble compounds of carbon, silicon, and iron, which are always present in commercial aluminium.

Aluminium is also recommended for use in the packing or treatment of fats or fatty acids. Experiments similar to those made with water showed that exposure for three days at 60° C. in contact with either rancid butter, palm oil, or raw oleic or stearic acid produced no effect upon the aluminium strips, even where they were exposed to the air. The immunity of so electro-positive a metal may be ascribed to the feebly basic character of its oxide.

Lastly, melted anhydrous phenol failed to produce any perceptible corrosion of the aluminium, even after a 60 hours' contact, whilst a 10 per cent. aqueous solution of carbolic acid, after a like period of action at a boiling temperature, produced yellowish patches upon the metal, and caused a loss of 0·0051 grm. on 7·9501 grms., which was doubtless due to the combined action of air and water, afterwards assisted by the acid-like action of the phenol. Aluminium is therefore especially suited to the manufacture of condenser worms and packing vessels for pure carbolic acid.

—W. G. M.

*Condensation of Gases, and the Direct Extraction of Zinc in the Blast Furnace.* W. Hempel. Berg. u. Hüttenm. Zeit. 1893, Nos. 41 and 42.

The direct smelting of merchantable zinc in the blast furnace has never been practically successful, and the author's experiments serve to confirm past experience. But the blast furnace may yet be usefully applied in the treatment of zinc-bearing ores. Zinc condensed from the gases of such a furnace is always in the form of dust, probably from two causes: first, a part of the zinc vapour is oxidised by the carbon dioxide which must always be present in the gas; and secondly, a vapour which is mixed with more than a certain proportion of diluent gas will only condense into finely-divided particles, which are with difficulty united into one continuous mass. It is for this latter reason that the first portion that comes over in the ordinary zinc-distillation process, is always in the form of zinc dust. It was found possible, however, to ensure the production of a dust containing 80 per cent. of zinc and of waste gases, after condensation, free from metal; the separation was assisted by centrifugal action. Blast-furnace experiments with zinc-bearing lead and silver ores, and on ore consisting of zinc blende and pyrites (after a careful roasting in which the waste gases of the blast furnace could be utilised) showed that the iron could be obtained fluid, as a white iron, and the zinc, carrying most of the silver and lead, could be condensed from the furnace gases in the form of dust. This dust, after consolidation by pressure, is distilled in the usual way, but without admixture of coal, a further quantity of the furnace gases being used as the heating agent. The absence of reduction reactions and of their resulting gases in the distillation muffle, permits the use of a lower temperature, and leads to a higher yield of zinc. It is found that two thirds of the zinc is recovered in a state of sufficient purity for the market without further refining, and a mixture is left in the muffle containing zinc oxide, lead, and silver. Electrolytic refining of the compressed dust may be economically practised, the use of a soluble anode minimising the electro-motive force required.

—W. G. M.

*The Varied Behaviour and Structure of Metallic Tin precipitated from different Solutions; and the Production of Pure Tin Powder.* G. Buchner. Chem. Zeit. 1894, **18**, 1904—1905.

The chemical and physical properties of precipitated tin vary with the mode of production, a fact which is of considerable importance in the arts, as, for example, in the manufacture of so-called silver paper. From a 1 per cent. aqueous solution of stannous or stannic chloride, with or without the addition of hydrochloric acid, sheet zinc throws down a fine grey-black precipitate of tin, which, after washing and drying, forms a powder that gives no coherent film when rubbed on paper with the aid of a glass rod. It is in a readily oxidisable condition whether wet or dry, and is mixed with black stannous oxide (Villon, Chem. Zeit. Rep. 1888, **12**, 319); under the microscope it appears to consist for the most part of minute comma-shaped grains, which precipitated from acidified solutions, are somewhat larger, brighter, and denser than from normal solutions. But the properties of the precipitates obtained from alkaline liquids are quite different. Potassium hydroxide throws down a white precipitate, becoming first grey and then black as the reagent is added in excess, from strong solutions of stannous chloride, and the precipitate finally consists for the most part of black stannous oxide. But with a dilute (1 : 20) solution of the stannous chloride, an excess of potash (or, less satisfactorily, of soda) gives a colourless solution, becoming slightly brown on warming; but as the liquid becomes concentrated, a grey mass of intermixed potassium stannate, stannous hydroxide, and finely-divided metallic tin separates out. The tin may be separated from this by washing as a very finely-divided bright grey powder, which does not oxidise either in moist or dry air; but the yield is very small. The size of the grains is in inverse proportion to the rapidity of precipitation; and the addition of potassium cyanide hastens the precipitation of a denser form of tin. The crystals are always needle- or comb-shaped. But the process cannot be used for the commercial preparation of tin powder. Coarser non-oxidisable crystals are obtained by treating the potash solution, containing a slight excess of alkali, with zinc dust (not with zinc sheet), but they always contain some zinc. Exceedingly minute clear-grey, unoxidisable crystals of needle, comma, or fern shape, are obtained by immersing aluminium plate in a similar solution (19 grms. $SnCl_2$, 400 cc. $H_2O$, and 100 grm. KOH solution of 1·33 sp. gr.). By increasing the proportion of caustic potash to at least 50 per cent. above that which is present in the alkaline solution of stannous oxide, zinc sheet will precipitate the tin, which at first coats the zinc and prevents further action, but increases in rate of deposition and decreases in size of grain, as the proportion of alkali is increased. Thus, a solution of 10 grms. of tin salt in 100 grms. of water, mixed with 20 grms. of potassium hydroxide, gives no deposit on sheet zinc; with 23 grms. it coats the zinc: and with 25 grms. or more of alkali the tin forms a dark-grey slime, which is brighter when 30 grms. of potash are present. The tin is always non-oxidisable in dry or moist air, but the crystals are in plates when deposited from strong solutions, or in needles, feathers, or combs, if from dilute solutions. With the addition of potassium cyanide the crystals are equally good, but very finely divided; but in either case they break up to a very fine powder on washing with water. Potassium or sodium stannate in alkaline solution gives dark grey granules with zinc, slowly with sheet and rapidly with dust. To prepare the finest white unoxidised and non-oxidisable tin powder, 400 grms. of stannous chloride may be dissolved in 6 litres of water, and poured slowly, with stirring, into a mixture of 6 litres of water with 4 litres of caustic potash or soda solution (1·33 sp. gr.) containing 60 grms. of pure potassium cyanide. Zinc plate is placed in the mixture for 5 to 10 minutes, the slime washed off with water, and the precipitation continued until tin ceases to come down, when more tin-salt and alkali may be added. The tin is washed well, dried, and sifted.—W. G. M.

*A Possible Explanation of Kernel-Roasting ("Copper Ores").* H. M. Howe. Eng. and Mining J. 1895, **59**, 104.

The concentration of the copper in the centre of a piece of cupriferous pyrites during the process of kernel-roasting is explained by the author as follows:—As the temperature reaches the point of ignition of the pyrites the iron and sulphur of the outer layer are first oxidised. The iron with its stronger affinity for oxygen, oxidises in preference to the copper, in accordance with the well-known preferential oxidation of iron in the smelting of the mixed sulphides, with the production of iron oxide and copper sulphide. Each particle of iron sulphide in oxidising forms a solid infusible porous particle of iron oxide in its place, and thus the outer envelope of the lump is transformed into an incipient "forest" of this substance with layers of sulphide enriched in copper within it. This enriched sulphide becomes at the existing temperature, sufficiently fluid er plastic to obey the laws of surface tension or capillarity, which cause it to adhere by preference to the solid mass of the undecomposed pyrites within, and consequently to retreat from the porous envelope of infusible oxide. This is the first step of progress of the copper towards the centre, and its further retreat is simply a continuation of the process. The surface adhesion which causes the layer of plastic sulphide to retreat ever so little, would continue to cause it to further retreat as layer after layer of the ore became oxidised, the kernel of sulphide becoming continuously richer in copper.

The conditions for kernel-roasting must be favourable, and the most important seem to be the proper temperature and the freedom of the ore from gangue. That the latter should prevent the travelling of the copper is mechanically obvious, whilst the necessity of a suitable temperature would agree with the foregoing explanation, inasmuch as it must be sufficiently high to render the supposed layer of sulphide plastic, and yet not high enough to cause the whole to melt and matt together, and thus to stop the roasting.—A. W.

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*How to Use Plumbago Crucibles.* J. A. Walker. Eng. and Mining J. 1895, **59**, 127.

Crucibles now receive greater punishment than heretofore on account of the improved furnaces, with better draughts and higher temperatures, which are used, as a result of the necessity for quick working. The author suggests that new pots, after annealing in the usual way, should always be used when the fires are started in the morning for the first heat, and never used for the first time when the furnace is in full work and at its highest temperature. A new pot in a hot fire is almost sure to "fly" or "scalp," whereas an old pot, that has had its second, third, or fourth heat, rarely suffers in this way. Consequently, a supply of both new and old pots should always be kept in readiness. A plumbago crucible contains ingredients which, on gradual heating, ooze out and melt on the sides of the crucible, forming a vitreous protecting coat. Once this action has taken place the crucible will never "fly" or "scalp" if placed in the hottest fire.—A. W.

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*Volumetric Determination of Phosphorus in Steel.* W. A. Noyes and E. D. Frohman. J. Amer. Chem. Soc. 1894, **16**, 553.

*See under* XXIII., *page* 302.

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*Accuracy of the Commercial Assay for Silver.* F. P. Dewey. J. Amer. Chem. Soc. 1894, **16**, 505.

*See under* XXIII., *page* 301.

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*Analysis of Lead Glance and Argentiferous Lead with the Aid of Hydriodic Acid.* W. Hampe. Chem. Zeit. 1894, **18**, 1899.

*See under* XXIII., *page* 304.

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*Determination of Copper; and the Determination of Antimony in Antimonial Pyrites.* T. C. Cloud and G. J. Rogers. Australasian Assoc. for the Advancement of Science, 1893.

*See under* XXIII., *page* 303.

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*The Analysis of American Refined Copper.* H. F. Keller. J. Amer. Chem. Soc. **16**, 785.

*See under* XXIII., *page* 303.

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*Iodide Assay for Copper.* E. D. Peters. Eng. and Mining J. 1895, **59**, 124.

*See under* XXIII., *page* 304.

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*The Action of Fatty Lubricating Oils on Metals.* E. Donath. Dingler's Polyt. J. **294**, 186.

*See under* XII., *page* 283.

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## PATENTS.

*An Improved Furnace for Treating Ingots, Blooms, or Billets of Iron or Steel.* W. D. Allen, Sheffield. Eng. Pat. 5379, March 14, 1894.

The improved furnace is for the purpose of keeping hot and equalising the temperature of ingots, blooms, or billets. The latter are supported on pipes or hollow bars, through which water is caused to flow, these hollow supports being arranged longitudinally in the furnace, so that the ingots, &c., as they slide or travel along upon the pipes or bars, will be caused to present continually fresh portions of their surfaces to them.—W. S.

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*An Improved Composition of Metals.* P. Inch, Washington, U.S.A. Eng. Pat. 22,415, November 20, 1894.

One pound of zinc is melted, into it is poured "2·2143 lb." of melted tin, and to the mixture is added half an ounce of sal ammoniac. If aluminium is to be added, one pennyweight of this metal is then mixed in. The alloy can be cast, drawn, or rolled, with facility, and is recommended principally for ship-sheathing either as sheets or by coating the metal plates of the ship by dipping them into the molten composition before they are put into position. Water, and especially salt water, is said to cause a slight exfoliation or decomposition which prevents fouling of any sort. The alloy also possesses the property of taking ink like the limestone used in photolithography, and is recommended for this purpose. It likewise can be used as a solder. —A. W.

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*Improvements relating to the Manufacture of Ferro-Zinc Alloys with or without other Metals.* M. M. Marcus and G. Buffier, both of Brunoy, and E. Marcellot and G. Dardespinne, both of Paris. Eng. Pat, 24,535, December 17, 1894.

The object of this patent is a new alloy which is termed "Ferro-zinc." Iron chips, shavings, &c., are first cleaned by submersion for 24 hours in a cold alkaline bath consisting of a mixture of ammonium carbonate, caustic soda, and potash. They are afterwards drained and mixed with sawdust or other carbonaceous material and heated to a white heat in any suitable furnace or crucible. The zinc is then added in the solid state and the temperature maintained with the exclusion of air until it melts and alloys with the iron. The quantities to be taken are equal, but the two metals "seem to combine in different proportions."

Ferro-zinc can be alloyed with other metals forming alloys, to which is given the general name "bronzium." Thus "yellow bronzium" is 50 per cent. of copper and 50 per cent. of ferro-zinc, and "white bronzium" is 50 per cent. of ferro-zinc, 35 per cent. of copper, and 15 per cent. of nickel. Ferro-zinc is stated to be also useful in deoxidising molten steel, and as a substitute for zinc alone in the manufacture of terne plate.—A. W.

# XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*The Electrolytic Reduction of Copper by Höpfner's Process.* E. Jensch. Chem. Zeit. 1894, **18**, 1906—1907.

The Höpfner process was used at Schwarzenberg from August 1891 to March 1892, and in the Giessen and Weidenau works. It was applied both to rich ores and mattes, and to the cupriferous pyrites from the Sulitjelma mines in Northern Norway, in which the copper percentage ranged from 9·5 to 12·25, and that of iron from 34·5 to 32·6. The ore was very finely crushed, so that 85 per cent. of the sample passed through a No. 200, and 96 per cent. passed a No. 100 sieve; but some little trouble was caused by the blocking of the meshes by the fine powder. The leaching was effected by means of a solution of cupric chloride in calcium chloride, which latter (instead of brine) becomes the solvent of the resulting cuprous chloride, the mixture being placed in revolving wooden drums of 900 to 6,600 litres capacity. The drums caused considerable difficulty by leakage, which began when the temperature of the liquid was raised by the admission of steam to hasten the reaction, and increased with the rise of temperature and the growing percentage of cuprous chloride; yet for obvious reasons lead and iron vessels could not be used. With the rich materials three or four extractions sufficed, but with the Sulitjelma ore, although the first extraction removed half of the copper, even 10 or 12 leachings failed to extract the whole of the remainder, partly on account of the large percentage of iron present, partly owing to the increasing dilution of the liquid. At the temperature of the reaction, magnetic pyrites reacts with cupric chloride, giving equivalents of ferrous chloride, cuprous chloride, iron bisulphide, and sulphur, while the resulting ferrous chloride reacts with another quantity of cupric chloride to give ferric and cuprous chlorides; and iron pyrites reacts directly with cupric chloride to give ferrous and cuprous chlorides and sulphur. For this reason an excess of cupric chloride must be used in the leaching solution. The slimes were filter-pressed at a temperature of 40° to 50° C. in order to avoid the retention of copper by them. The anodes were of paraffined carbon, the cathodes thin copper plates, experiments with coppered carbon cathodes having proved unsuccessful. The well-known difficulties with the parchment paper, and short-circuiting by detached copper fragments, were met with. (Compare this Journal, 1891, 817.)—W. G. M.

## PATENTS.

*Improvements in or relating to Electrodes for Secondary Batteries.* M. Wuillot, Brussels, Belgium. Eng. Pat. 1903, January 29, 1894.

The inventor sets forth the advantages of "forming" lead electrodes "in an alkaline bath (*e.g.*, ammoniacal solution)" by electrolysis, instead of in acids. By this means he gets rid of salts, sulphates, and the like, of lead. "This substitution having the effect of greatly accelerating the formation of the Planté electrodes, and of entirely preventing their rapid disintegration when they are made after the Faure type." The specific chemical constitution of this alkaline bath is not given. It appears to be simply ammonia in solution, but no proportions are indicated. Certain by-products, as sulphate of ammonia, are formed in the process. —J. C. R.

*Improvements relating to the Manufacture of Lead Salts.* H. H. Lake, London. From J. B. Tibbits, Hoosac, U.S.A. Eng. Pat. 2060, January 30, 1894.

*See under* XIII., *page* 285.

*Improvements in Electrolytical Decomposing Apparatus.* C. Kellner, Vienna, Austria. Eng. Pat. 2806, February 8, 1894.

According to this improvement, the electrodes are embedded in molten asphalt or any other suitable insulating substance, and are arranged horizontally so as to form the bottom of the electrolytic vessel, space being left between them in which may be inserted, if necessary, a partition of porous or non-porous conducting material. They are so arranged that only the first and last plates have metallic connection with the source of electricity, the current entering the first electrode, passing thence through the electrolyte, over the insulating partition into the next plate, through it, under the next partition into the electrolyte again, and so on, alternately under and over the insulating partitions to the other electrode. The electrodes are preferably carbon, and to obviate excessive wear, are surrounded with a layer of finely-powdered and coarsely-powdered carbon according to Eng. Pat. 9346 of 1892 (this Journal, 1892, 755). Bleaching liquor may be prepared in a tank made as above if the chlorine evolved in the decomposition of sodic chloride is compelled, by means of an inclined plate of glass, to become dissolved in the sodic hydrate formed at the cathode, or the gas evolved may be collected by suitable means.—G. H. R.

*Dry or Semi-Dry Galvanic Element.* T. Blackhurst, London. Eng. Pat. 3725, February 21, 1894.

The battery is of the Leclanché type, the excitant being a saturated solution of ammonium chloride and sea-salt. This solution is divided into two parts; to one portion is added starch and china clay, and to the other gelatin and wood pulp, the whole being then mixed together to form a putty-like mass.—G. H. R.

*Improvements in and relating to Secondary Batteries.* O. March, London. Eng. Pat. 4724, March 6, 1894.

The improvement consists in a plate having for its basis a perforated sheet of lead, corrugated in such a manner that perforations occur at the crests and troughs of the corrugations, with or without perforations in the sides of the corrugations. This sheet is secured in a frame of lead or lead alloy, preferably by fusion, and the frame is then filled with lead oxide or other suitable material, so as to entirely enclose the plate. The frames of the negative plates are provided with feet pierced with holes, and the lugs for both plates are pierced also. They are further provided with tenons which fit mortice-holes in the connecting straps. The plates are held together by ebonite bolts and nuts in such a manner that the positive plates pass through the lugs of the negative ones.—G. H. R.

*Improvements in the Production of Ozone, and in Apparatus therefor.* A. Schneller, Leyden, and W. J. Wisse, Haarlem, Holland. Eng. Pat. 5656, March 17, 1894.

According to this invention, the discharge is kept silent by means of a resistance inserted between the transformers and one or both of the discharge surfaces, which latter are perforated sheets of metal, or woven wire or wires placed parallel or crosswise, without the intervention of any glass or dielectric between them.—G. H. R.

*New or Improved Process and Apparatus for the Electrolytic Decomposition of Common Salt.* C. Smith, London. From G. Jorgensen, Bergen, Norway. Eng. Pat. 5721, March 19, 1894.

Apparatus of U shape is shown in which to decompose sodium chloride solution. The electrodes are placed in the limbs, extending to the bottom. A porous pot or partition separates the anode. It is proposed to purify the soda solution resulting from the first operation by subsequent electrolytic treatment according to the following methods, the object being to free it from original electrolyte and other products:—

1. By filling the anode room of the second or subsequent vat with a strong solution of common salt, and the cathode room of the same vat with the electrolysed solution from the cathode room of the first vat.

2. By filling the anode room of the second or subsequent vat with the electrolysed solution from the cathode room of the first vat, and the cathode room of the second vat with water, to which, in order to further the process, a little caustic soda may be added and the water kept warm.

3. By filling the whole of the second or subsequent vat with the electrolysed solution from the cathode room of the first vat.

4. By using in any of the anode rooms strong solution of common salt and in the cathode rooms pure water, to which, as in process 2, a little caustic soda may be added and the water kept boiling; the solutions are then electrolysed in the ordinary way.—J. C. R.

### *Improvements in and Apparatus for the Production of Alloys of Sodium or Potassium with Lead.* A. E. Hetherington and F. Hurter, Widnes, and E. K. Muspratt, Liverpool. Eng. Pat. 5831, March 20, 1894.

Fused sodium or potassium hydrate is electrolysed, using molten lead as a cathode and iron as an anode.

The electrolytic pot is made in two parts, of cast iron, the lower portion being insulated from the upper electrolyte-containing portion by asbestos, and caustic lime introduced as a packing between a flanged joint. The anode is suspended from an insulated lid, and made to move up and down in the electrolyte by a screw attached. An overflow-pipe for the lead alloy produced, is so arranged that as the alloy increases, it shall not reach to the upper insulated portions of the pot. The pot or pots is or are set in brickwork above gas-burners or a grate, that the requisite temperature may be maintained. The following is of interest:—

"The current may be considerably more than 500 ampères per square foot of anode surface. The alkali-hydrate should be kept at a comparatively low temperature, only high enough to keep the lead alloy and the alkali-hydrate fluid. When the lead alloy has been so far enriched as to contain 10 per cent. of the alkali metal, it will be found to have nearly doubled its volume, and when it contains 30 per cent. of the alkali metal, the volume will be trebled.

"We find it advantageous not to enrich the alloy to more than 10 to 15 per cent. of its weight of alkali metal, as, when this limit is reached or surpassed, a considerable amount of the electric current is wasted, and slight explosions occur. Also the alloy, if too rich in alkali metal, inflames readily when in contact with atmospheric air; hence, a covered receptacle for its storage is needed. When it is desired to produce an alloy of from 20 to 30 per cent. of alkali metal, it is advisable not to place a cover over the apparatus, in order that any occasional explosions may not be confined, and thus damage the apparatus."—J. C. R.

### *An Improvement in the Coating of Metals with a Metallic Alloy.* W. A. Thoms and W. H. Burgum, London. Eng. Pat. 7854, April 20, 1894.

The object of this invention is to provide a durable and homogeneous protective coating, the colour of which can be regulated according to the metals that compose the electrolytic bath. Such colours can be white, yellow, bronze, red, blue, black, or any intermediate tints. As an example of this process, an electrolytic bath can be made as follows:—

1 oz. tin converted into chloride in the ordinary manner.
½ oz. zinc ,, ,, ,,
1 oz. phosphate of soda.
1 oz. tartrate of potash.
Water added to make one gallon of solution.

Or half the quantity of zinc may be replaced by an equal quantity of cadmium, or the amount of zinc may be doubled. The solution must be used at a temperature of 75°—80° F., and the anodes should be composed of an alloy of the same, or approximately the same, proportions as are desired in the deposit.—G. H. R.

### *Improvements in Electrolysis.* H. Blumenberg, New York, U.S.A. Eng. Pat. 9129, May 8, 1894.

The improvement consists in the electrolysis of a haloid solution in an electrolytic tank having the positive compartment closed, and the top of which is connected by a pipe with the bottom of the negative compartment, so that the gas liberated during electrolysis forms a certain proportion of bromate or chlorate as the case may be. These separate out in a settling tank, which is connected with the negative compartment by means of a valved pipe, and also with a residue vat, whence the spent electrolyte is transferred by means of a pump to a resaturator, and thence back to the positive compartment. The temperature of the bath is preferably kept at 120° F. in order to prevent the formation of hypochlorites.—G. H. R.

### *Improvements in or relating to the Electro-Chemical Decomposition of Solutions of Salts.* J. C. Richardson, London. Eng. Pat. 22,613, November 22, 1894.

These improvements relate to electrolytic processes wherein mercury is employed as a moving cathode in electrolysing solutions, such as sodium or potassium chloride, to obtain the cations (sodium, potassium) separate from the electrolyte under treatment, but subsequently to give them up to a solvent, such as water. To remove the cations, which become alloyed with the mercury, in a more regular manner, and to keep the mercury free from hydrogen, it is joined up, in a separate chamber through which it circulates, by a conductor, with an additional cathode, in the presence of the cation solvent. In contact with this additional cathode is placed cupric oxide, by which the hydrogen is got rid of chemically. The cations being more readily dissolved out by this arrangement, the mercury acts regularly and efficiently as a cation carrier, and the ultimate element displaced in the operation being copper, instead of hydrogen as hitherto, gas resistance and back electromotive force are reduced to a minimum, with a corresponding saving in energy necessary to decomposition on a manufacturing scale.—J. C. R.

### *Improvements in Apparatus for the Electrical Treatment of Beer or other Liquid or Material.* L. Wagner and J. Marr, Baltimore, U.S.A. Eng. Pat. 23,553, December 4, 1894.

According to this improvement, the fluid coming from the shavings-cask passes through an elbow to the bottom of a vertical and cylindrical vessel, preferably composed of glass, so that the process of electrolysis may be observed. The electrodes fit close to the walls of the tube and have flat opposing faces, which may be transversely ribbed or corrugated, and the bottom of the faces are inclined so as to direct the liquid into the narrow interspace. Secured in, or to, or burned with, the electrode, is a conductor which passes through the tube, and is clamped in place by a washer and nut, thus securing the electrode. A tube leads from the top of the electrolytic vessel to a bend, where is situated a cock, whence any gas may be allowed to escape, or samples of the liquid under treatment may be taken. The current employed is preferably alternating. The apparatus may be placed at any suitable point in a beer-making plant, and may be the means of finally drawing off the finished beer.
—G. H. R.

### *Process of and Apparatus for Dissociating Soluble Salts by Electrolysis.* H. S. Blackmore, Mount Vernon, State of New York, U.S.A. Eng. Pat. 24,630, December 18, 1894.

This process has to do with methods of effecting electrolysis of salts, fused and in solution. To collect the products set free around the electrodes, which are separated by "partitions or porous diaphragms," a layer of a denser conducting solution or fused electrolyte is placed at the bottom of the electrolytic tank or electrolytic pot. The partitions dip into this denser solution, so that it forms part of the path through which the current travels. The electrolyte to be decomposed is supplied at, and the products drawn off from, above the level of this "tranquil" layer, which is a saturated solution of caustic soda, for example, when common salt solution is to be decomposed. As an example of dealing with fused electrolytes, the separating layer is molten lead, into which the dividing partition dips. Common salt is fed into the anode chamber, and fused caustic soda, to commence the operation, is added to the cathode chamber, into which, also, is fed live steam to prevent the reduction of the hydrate to oxide. Details are given along with diagrammatic drawings. The addition of certain acids and salts to the various electrolytes is suggested as aiding their decomposition.—J. C. R.

*Improvements in or relating to the Separation of Metals by Electric Action.* T. T. Oliver, Chicago, U.S.A. Eng. Pat. 25,080, December 24, 1894.

In furnaces described, metalliferous ores are fused by an electric arc, and the metals contained therein precipitated electrolytically upon a revolving drum or cone-shaped cathode, over which the fused mass flows. This cathode may be cooled by water circulating through it. The temperature produced by the arc may be varied, so that different metals may be separated by the differences in their fusion points.—J. C. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Degras.* C. S. Bush. J. Amer. Chem. Soc. 1894, **16**, 535—537.

In America this term is only used to designate the fatty matter recovered from water in which wool has been scoured, and not, as in some parts of Europe, also that similarly obtained at chamois-leather factories. The greasy and soapy residuals are treated with sulphuric acid to remove the alkali, and the fatty acids filtered hot through cloths. The individual character of this fat is due to the presence of cholesterin, $C_{26}H_{44}O$. Cholesterin is soluble in boiling alcohol, but separates out on cooling in tabular crystals. It never crystallises from the degras, and is probably present combined with the fatty acid and not in the free state. Cholesterin is not saponifiable, but takes up 120 per cent. of water to form a perfect emulsion, which remains in the emulsive state for years. Degras is sometimes used in finishing leather, as it is cheaper than tallow and is exceedingly penetrating and emollient. Trials have been made to use it for soap-making, but not with much success, as the cholesterin is non-saponifiable, is not detergent, and deteriorates the soap. Degras is of the consistency of soft tallow, is yellowish-brown, and has a disagreeable odour, due to the presence of dung and urine products and of volatile fatty acids present in the wool as potash salts.
—L. T. T.

*Composition and Manufacture of some Candle Material; also Determination of Melting Points.* W. E. Garrigues. J. Amer. Chem. Soc. **16**, 825—832.

A method of determining melting points which will quickly give, with all kinds of candle material, concordant results in the hands of different manipulators, is a much felt want. Dalican's method is frequently used for stearic acid candles, but is valueless for paraffin wax and for many mixtures of the two. In American oil refineries, the melting point of paraffin wax is determined by immersing the bulb of the thermometer to two-thirds of its length in the molten wax, which is then permitted to cool slowly until the first signs of incipient solidification appear on the surface; the height of the mercury is then read off. Some operators draw the point of a pin across the surface of the melted wax, until a "string" of the latter can be picked up; this is regarded as the melting point. The method which the author recommends is a modification of Dalican's method, due to Mr. Gladding:—30—50 cc. of the dry, melted sample is placed in a small beaker, the bulb of the thermometer is completely immersed therein, and the beaker is twirled continuously in one direction until the mercury ceases to fall or rise. At first it falls rapidly and regularly, but its subsequent behaviour varies. With fatty acids there is a rise of 0·1° to 1·0°, averaging about 0·3° for commercial stearic acid; here it remains stationary for about 1 minute. With paraffin wax, no rise takes place, but the mercury remains stationary about ½ minute, and then continues to steadily fall at the rate of about 0·1° to 0·2° per minute, the fall prior to reaching this point being much swifter. With mixtures of stearic acid and wax the behaviour varies, according to the relative proportions of the mixture, from no rise to a rise of 3°—4°. The "melting point" is the highest temperature to which the mercury rises, or that at which it remains stationary. It is claimed for this method that it gives concordant results in different hands.

It is well known that a mixture of fatty acids, subjected to distillation with superheated steam, undergoes change. Liquid hydrocarbons are formed, together with a black pitch; there is also a slight rise in the melting point. The author has made a partial investigation of the changes which occur. The following is an outline of the process studied:—The fats, exclusively tallow and bone fat, are saponified in an autoclave under 150 lb. steam pressure, without any base present. All that is of good colour is pressed at once to obtain the solid acids; the dark-coloured portion is first distilled, in copper, with superheated steam. The distillate is caught in three fractions. The white "first-run oil" comprises about four-fifths of the whole. When the colour of the distillate changes to a decided green, the receiver is changed, and the "second-run oil" is collected. As soon as the distillate again changes colour and becomes more viscid, the contents of the still are allowed to cool, and transferred to a smaller iron still. From this still another fraction, called "green oil," is obtained, and there remains in the retort a black pitch called "candle tar." The "second-run oil" and "green oil" are returned to the storage tank for redistillation with the next lot of fatty acids.

To determine quantitatively the changes which occur during distillation, the temperature being about 260°, a run of 16,075 lb. was traced through. The oil had a melting point of 43·2°, and contained—

| — | Before Distillation. | After Distillation. |
|---|---|---|
| | Per Cent. | Per Cent. |
| Solid acids | 49·52 | 50·47 |
| Oleic acid* | 42·86 | 33·05 |
| Hydrocarbons (liquid) | 6·94 | 13·14 |
| Glycerol | 1·37 | .. |
| Tar | .. | 2·00 |
| Loss | .. | 1·34 |
| | 100·69 | 100·00 |

* Calculated from the iodine number.

The percentage yield of the different grades of oil, and the composition of each, was—

| | Per Cent. | | | Per Cent. |
|---|---|---|---|---|
| First run oil........ (Melting point 44·8°) | 80·31 | Containing | Hydrocarbons<br>Fatty acids... | 6·29<br>93·71 |
| Second-run oil ..... | 12·13 | Containing | Hydrocarbons<br>Fatty acids... | 35·90<br>64·10 |
| Green oil........... | 4·22 | Containing | Hydrocarbons<br>Fatty acids... | 98·74<br>1·26 |
| Tar................ | 2·00 | | | |
| Loss............... | 1·34 | | | |
| | 100·00 | | | |

Making corrections for the hydrocarbons present before distillation, and the glycerol which forms a large part of the 1·34 per cent. loss, we have, as a result of distilling 100 parts of pure fatty acids—

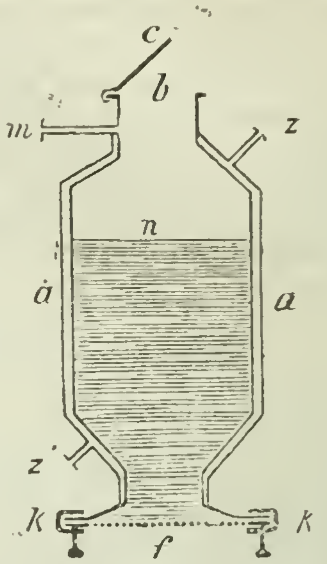
| —— | Before. | After. |
|---|---|---|
| Solid acids...................... | 53·61 | 54·63 |
| Oleic acid*...................... | 46·39 | 35·77 |
| Hydrocarbons (liquid).......... | .. | 6·71 |
| Tar ............................ | .. | 2·15 |
| Loss ........................... | .. | 0·74 |
| | 100·00 | 100·00 |

* Calculated from the iodine number.

It seems from these figures that the stearic and palmitic acids distil without change, while the oleic acid partly splits up into liquid hydrocarbons, tar, and a saturated or non-iodine consuming fatty acid. Press-cake made from distilled stock invariably has a lower melting point than that from the autoclave; the author also shows that the mean molecular weight of the solid acids is lower, viz., 267—268·5 instead of 271—272, but he has not isolated the particular acid or acids, formed by the decomposition of oleic acid, to which these changes are due. He concludes, as a result of his investigation, that the process of manufacture might be improved by taking the fatty acids directly from the autoclave to the presses—as is done with the light-coloured stock—and obtaining a press-cake melting at 55°—56°, which latter is then subjected to distillation. By these means, the candle stock would not deteriorate in the still as it now does, and the formation of valueless—and even for most purposes harmful—hydrocarbons would be avoided, giving the red oils a greater value.—L. A.

### *Progress in the Ceresin (Cerasin) Industry.* B. Lach. Chem. Zeit. 1894, **18**, 1889–90.

Important progress has been recently made in the ceresin (ozokerite) industry, relating chiefly to details of manipulation and plant. On the chemical side, it must be noted that concentrated sulphuric acid, 66° B., has almost superseded the fuming acid for refining purposes; whilst it has been possible to greatly diminish the percentage of acid required. Concerning improvements in plant, the tendency has been to do away with hydraulic hot-presses—for which, as is well known, the original outlay and labour required are large, and the manipulation costly and tedious—and replace them by pressure-filters or filter-presses. A pressure-filter is shown in the accompanying drawing. It consists of a cylindrical double-walled vessel, 1½ m. high and 1 m. in diameter, which is charged with the hot waxy mass through the aperture at the top. The bottom of the cylinder is perforated with holes and covered with a canvas filter-cloth. In operation, the lid is clamped down and steam admitted to the jacket and to the upper part of the cylinder. Filtration takes place rapidly and is allowed to proceed until dry steam emerges through the filter-bottom. The latter is then screwed off, when the residue falls out of the cylinder in a perfectly dry and pulverulent condition. As regards efficiency, it is stated that one filter will do the work of three hydraulic presses, whilst their respective prime costs are 1,200 and 20,000 marks. A drawback to the apparatus is that only wax in a relatively advanced state of refinement can be filtered by its means. Filter-presses are, however, most commonly employed. The wax is pumped direct from the vessel in which it has been treated with acid and forced through the press, canvas or jute being used as filtering medium. The operation proceeds rapidly, and residues are quite dry and readily extracted by solvents. The final bright filtration is also effected in filter-presses charged with cotton-cloth or flannel. The intermixture of wax and acid during refining is effected almost exclusively by means of mechanical agitators; and the use of compressed air or hand-stirrers has become practically obsolete. For dyeing the wax, fat-soluble aniline preparations are alone used, the colouring matter being added directly to the fused wax. Regarding the recovery of wax from residues, reference is made to Dombrain and Trumper's extracting apparatus—hitherto not practically introduced—which is stated to be very efficient. Attempts to refine ozokerite with agents other than sulphuric acid have failed; nor has it been possible to replace the "decolorising powder" (ferrocyanide residues) by ignited calcareous earth. The variety of uses to which ceresin is put has increased considerably. It is employed, for example, in vaselin manufactories, spinning and weaving mills, cartridge and torpedo factories, &c. The demand—by far the largest—for candle and wax-light making has diminished, owing to the competition of paraffin. The sole source of commercial ozokerite is Galicia. Deposits of excellent quality have been discovered in the Caucasus and near the Caspian Sea, but owing to difficulties of transport, &c., have not, so far, been made available.—H. T. P.



### *The Susceptibility to Resinification and the so-called "Resin-Content" of Mineral Oils.* S. Aisinman. Dingler's polyt. J. 1894, **294**, 65—68.

As it is only within the last few years that the examination of the physical and chemical properties of mineral lubricating oils has been conducted on a scientific basis, it is not surprising that there are still a few faulty and unreliable methods practised. On account of the difficulties unnecessarily imposed on the producers of these oils through some of the stipulations insisted on by consumers, owing to the erroneous impressions produced in their minds by these defective methods as to the nature of mineral lubricating oils, a critical examination of methods and conditions will be of interest to all concerned.

In addition to the ordinary requirements for these oils as to viscosity, flashing and burning points, resistance to cold, and content of acid, others are formulated, particularly by the German State Railways, respecting the drying properties of the oil, the stipulation being that "the oil shall not possess any drying properties; *i.e.*, when exposed for a considerable time in thin layers to the action of the air it should neither resinify nor dry to a film resembling varnish." A further condition to the effect that "no resin oil nor tar oil of any kind," should be present in the oil. The reasons for this are obvious, since the presence of such bodies would lead to the formation of a crust whereby the friction of the revolving surfaces would be increased, resulting in greater wear and tear to the machinery.

The drying properties of oils (and all oils are oxidisable to some extent, differing only in degree) can be measured by oxygen absorption or by means of the iodine test, but whilst the iodine number of linseed oil is 158 and that of rape oil 100, for rosin oil it lies between 43 and 48, and in the case of pure mineral oils it seldoms exceeds 14.

The absorption of oxygen is on somewhat similar lines. Bach obtained by Fox's method (Zeits. anal. Chem. **23**, 434) the following figures, expressing in cc. the oxygen taken up by 1 grm. of oil:—

| | Cc. |
|---|---|
| Valve oil | 0·10 |
| "Valvoline" oil | 0·45 |
| Refined cylinder oil | 0·34 |
| Mineral oil (Baku) | 0·74 |
| Lubricating oil 0·877 | 0·70 |
| „ „ 0·865 | 4·80 |
| 90 parts lubricating oil and 10 parts cod-liver oil | 9·40 |
| 90 parts oleonaphtha and 10 parts cod-liver oil | 8·60 |
| Tovotes' lubricating grease | 21·80 |
| Rosin oil | 181·0 |
| Rape oil | 166·0 |
| Cotton-seed oil | 111·0 |

This low degree of oxidation of pure mineral oils is due to their consisting chiefly of hydrocarbons of the fatty series and having but a slight content of the more readily oxidisable aromatic hydrocarbons, and in view of the exceptionally favourable opportunity for oxidation afforded in the operation of the method employed, may be taken as being almost *nil* under normal conditions. In support of this, and of the opinion that the testing of mineral lubricants for resinifiable bodies is unnecessary, Schaedler, Künkler, and the experience of the Experimental Institute at Charlottenburg, are cited, and mechanical tests, similar to Nasmith and Albrecht's, are considered as only for preliminary work, polarisation, iodine absorption, colour reaction, specific gravity, &c., being recommended for the exact determination of rosin- and tar oils. The asphalt determination, as a means of explaining the oxidation ("verpechen") of the oil, should not be under-valued.

Our knowledge of the resinous or asphaltic oxidation products of mineral oils is still in a backward state, even Zaloziecki's discovery of terpenes in these oils (this Journal, 1894, 1187), and his supposition that polymerisation and oxidation of the oil is the simplest explanation of the formation of such resins, not affording much more than hypothetical conclusions.

Meanwhile one method of quantitatively determining the presence of so-called resinous substances in mineral oils, as practised even by such institutions as that of Charlottenburg—viz., the action of concentrated sulphuric acid on a solution of mineral oil in petroleum ether—is altogether unreliable, for the author, having tested a number of good lubricating oils of Russian, American, and German origin by this process, found that the pale Russian oils contained of so-called "resins" from 0 to 15 per cent., the darker kinds showing from 30 to 50 per cent.; the pale American oils contained none at all, and the darker grades from 0 to 25 per cent.; while the pale German oil from Pechelbronn showed 10 per cent., and the dark oils from Pechelbronn, Alsace, 20 per cent. and 59 per cent. respectively; whereas, according to such authorities as Veith, J. Grossmann, and Benedikt, the "resin content" varies from 6 to 25 per cent., the permissible limit for locomotive oils being given as 10 per cent.

The solution of the question is to be found in the composition of the oils. Those from Baku consist chiefly of naphthenes and olefines, which are soluble in sulphuric acid, the former completely so in fuming acid, forming aromatic sulpho-compounds and pitchy bodies partially volatilisable by steam. On the other hand, the American oils are mainly composed of paraffins, with a very slight proportion of bodies poor in hydrogen. It thus appears that the so-called "resin content" is rather the proportion of bodies soluble in sulphuric acid, but that the latter is no criterion of the amount of resins is shown by the process prescribed for the preparation of vaseline in the German Pharmacopœia, wherein 75 per cent. of the oil (lubricating oil distillate) is removed as so-called "brandharze" by treatment with fuming sulphuric acid. If, however, this large percentage really consisted of resins, the lubricating oils, having been treated with a much smaller proportion of acid, must still contain a large quantity of the resin, and be therefore unfit for use, a hypothesis which needs no refutation. The constantly increasing use of mineral oil for lubricating proves its value, and the stipulation respecting the permissible limit therein of bodies soluble in sulphuric acid, being shown incorrect, should be expunged.

Furthermore, the opinion expressed by the Charlottenburg officials that "resin-content" of an oil is in direct relation to its degree of acidity, cannot be acquiesced in, the method of testing (extracting with alcohol, evaporating the extract, and testing the residue for resin by feel and smell) being so defective that no resin could be detected in a sample containing the prohibitive amount of 0·4 per cent. of acid (reckoned as $SO_3$).

The actual amount of resins in mineral oils can, in correspondence with the quantity of oxygen therein, only be very small, and testing for impurities may therefore be confined to the estimation of such bodies as tar oils, resin oils, drying oils, and asphalt.—C. S.

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### *The Action of Fatty Lubricating Oils on Metals.* E. Donath. Dingler's polyt. J. **294**, 186—187.

Notwithstanding many statements to the contrary, the author is of opinion that the neutral fats and fatty acids have in themselves no direct chemical action on metals. His conclusion is based on the following experiment:—Bright strips of iron, copper, brass, and zinc, were accurately weighed and placed in large test tubes, some of which contained strongly rancid olive oil, and others crude oleic acid. After being completely immersed for three weeks, the strips were removed, washed with a mixture of ether and spirit, dried, and weighed. In each case, the surface was almost as bright as at first, and there was scarcely any perceptible loss in weight. Even after the tubes had been warmed on the water-bath at from 70° C. to 80° C. for several days, the strips remained unattacked, which proved that the moderately high temperatures which occur in practice are not the cause of the corrosion of the metals, this being due in the first place to the access of atmospheric oxygen. Thus, in the above experiment, if, before inserting the metal strips, the tubes containing the rancid oils and oleic acid were well shaken so as to incorporate air bubbles, the strips lost considerably in weight and were changed in appearance.

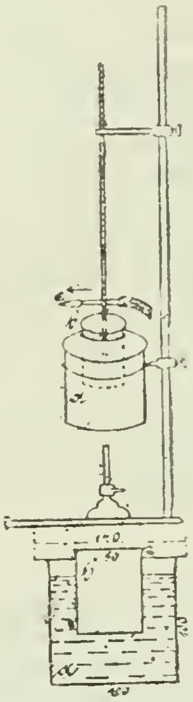
Free fatty acids naturally exert a predisposing influence, promoting more rapid and energetic oxidation. The oxides of the metals form soaps with them which are partly soluble and partly insoluble in the excess of oil and fatty acids.

The presence of moisture is also very probably another favouring circumstance, for where a small amount of water was introduced by vigorous shaking into rancid rape oil and oleic acid in which strips of zinc were completely immersed, the latter became coated with a white deposit, and showed considerable loss in weight after being washed and dried.

The general conclusion arrived at is that the corroding influence of lubricating oils on metals depends to a great extent on whether the oiled surface comes in contact with atmospheric oxygen, and whether by condensation or other means water gets into the oil. It is thus not so much a question of the nature of the oil itself as of the conditions under which it is applied.—C. A. M.

*The Determination of the Flashing-Point of Mineral Lubricating Oils.* S. Aisinman. Dingler's polyt. J. 1894, **294**, 68—70.

The Prussian State Railways employ the Treumann (an open cup) apparatus (J. Grossmann : "Die Schmiermittel," 1894, 71) for testing the flashing-point of mineral lubricating oils, although defective and a frequent cause of dispute between seller and consumer, and have not adopted the more accurate Pensky-Martens' close cup, chiefly because the lower flashing-point (15°—25° C.) indicated by the latter would necessitate alterations in their contract stipulations.



In the laboratory of Messrs. Albrecht and Co., mineral oil refiners, of Hamburg, the following modification of the Treumann cup is employed :—*a* is a copper bath containing paraffin, in which is immersed the copper oil-cup *b*, filled with oil up to a mark 1 cm. below the rim. The dimensions are as given in the adjacent figure. Heat is applied to bring the oil quickly up to 120° C., from which point the temperature is raised at a rate not exceeding 3° C. per minute. A gas test-flame of not more than 10 cm. in length is employed, and is moved horizontally in such a manner as not to touch the rim of the oil-cup.

Its advantages as compared with the Treumann cup are : the use of paraffin in the outer vessel permits the attainment of the highest temperatures (up to 350° C.) required —which cannot be done with the Treumann instrument— and the oil, being surrounded by the paraffin, is more regularly heated than if simply placed on a sand-bath, where it is exposed to cooling air-currents.

In a series of comparative tests made with the Treumann, Pensky-Martens', and Albrecht apparatus, the results given by the latter approximated more nearly to those of the close cup than did those given by the Treumann cup, and this in greater degree as the flashing-point rises. In the case of mixed oils, the difference between the results recorded by the Albrecht and the Pensky-Martens' instrument was greater than in the case of the component oils of the mixture. The following examples will serve as typical :—

| | Average Flashing-Point. | | |
|---|---|---|---|
| | Treumann. | Albrecht. | Pensky-Martens. |
| | ° C. | ° C. | ° C. |
| Russian spindle oil.... | 171·5 | 164·5 | 151·3 |
| „ machine oil .. | 211·0 | 199·6 | 193·3 |
| Mixture of the above.. | 180·5 | 180·0 | 159·0 |
| Heavy machine oil.... | 236·0 | 207·3 | 202·0 |

Attention is directed to a likely source of error in the estimation of flashing-points, especially those of high temperature. This consists in the practice of always filling the oil-cup up to the mark, without making any allowance for the expansion of the oil on heating and the consequent variation in the distance between the surface of the oil and the test-flame. It has been found in the case of an oil flashing at 174° C. (Pensky-Martens), that raising the oil-surface 1 cm. above the mark altered the flashing-point by 2·5° C., and a rise of 2 cm. affected the flashing-point to the extent of 7·5° C. with an oil flashing at 158° C. The effect must therefore be much greater when dealing with flashing-points of about 300° C., and the author made experiments with a view to ascertain the correction allowance to be made for this expansion. The result confirmed the co-efficient of expansion (0·00068) determined for Russian lubricating oils by the Charlottenburg Institution, the total expansion per 75 c.c. of oil (the quantity used in the Pensky-Martens' cup) being 0·5 c.c. per 10° C.

Given these figures, the quantity of oil to be used in order to ascertain the *true* flashing point of an oil flashing, say, at about 200° C., would be, not 75 c.c., but (at an initial temperature of 20° C.)—

$$75 - \left(\frac{200 - 20}{10}\right) . 0 \cdot 5 = 66 \text{ c.c.}$$

Check experiments gave the subjoined results :—

| Flashing-point. | | | | Difference in ° C. | Correction for Filling. c.c. |
|---|---|---|---|---|---|
| Usual Filling. | Corrected Filling. | | | | |
| 151 | 153 | 154 | .. | 2·5° | 6·55 |
| 193 | 200 | 200 | .. | 7·0° | 8·65 |
| 157 | 266 | 268 | 268 | 10·3° | 11·85 |

thus demonstrating the importance of making due allowance for expansion, particularly for the high test oils.—C. S.

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*Rapid Examination of Vaselin for Fatty Oils.* Crauzel. Union Pharm. per Rep. de Pharm. 1894, **50**, 453.

*See under* XXIII., *page* 316.

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## PATENTS.

*Improvements in Making Elastic or Semi-Elastic Compositions for Insulating and other Purposes.* R. Hutchison, Cowlairs. Eng. Pat. 6389, March 30, 1894.

*See under* XIII., *page* 285.

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*Improvements in or relating to the Production of Compounds applicable for such Uses as for Paints, for Electric Insulating and Waterproofing, as Substitutes for Vulcanisable Rubber and Gum Compounds, and for other Purposes.* W. P. Thompson, Liverpool. From W. Griscom, Bound Brook, New Jersey, U.S.A. Eng. Pat. 22,966, November 27, 1894.

*See under* XIII. C., *page* 285.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

### PATENTS.

*Improvements relating to the Manufacture of Lead Salts.* H. H. Lake, London. From J. B. Tibbits, Hoosac, U.S.A. Eng. Pat. 2060, January 30, 1894.

This patent refers to the preparation of shaded or coloured white lead by a modification of the electrolytic process described in Eng. Pat. 18,076, 1889 (this Journal, 1890, 398). The original simple lead anode is replaced by one consisting of an amalgam, alloy, or mixture of lead with another metal, with the result that the deposited lead carbonate is mixed with another substance, modifying its colour. To produce a light blue shade, the anode consists of 90 per cent. of lead and 10 per cent. of copper; for a brown shade a small amount of tin is mixed with the lead, picric acid being dissolved in the electrolyte to obtain a purple; a composite anode of lead and iron may be employed with cochineal mixed in an alkaline electrolyte. The process is also available for colouring the sulphate and sulphite of lead.—F. H. L.

*An Improvement in Decorative Printing on Prepared Paper.* F. A. Degroote and A. A. Durant des Aulnois. Paris, France. Eng. Pat. 6268, March 28, 1894.

The necessary colour is made into a paste with half-boiled linseed oil, and thinned down with raw (*i.e.*, ordinary) linseed oil. It is afterwards thickened with strong oil and a siccative added if required. Thus prepared, the colour is employed for printing in the usual way, and the impression produced cannot be distinguished from a painting by hand. In certain cases when the pigment is to be applied to non-porous materials, such as glass, further additions are made of caoutchouc, and gums (Almacia, Sierra Leone, &c.) dissolved in suitable solvents.—R. B. B.

*An Improved Anti-Fouling Paint.* J. Holliday, Wellington, and A. Cameron, Dunedin, New Zealand. Eng. Pat. 23,849, December 7, 1894.

Fifty-six pounds of zinc white, one gallon of kerosene, and one half pound of (Hubbock's) "patent" driers are mixed together, and form the paint. The surface to be protected is given one coat of ordinary red lead, a second of zinc white in boiled oil, and finally the above mixture is applied. —F. H. L.

### (*B.*)—RESINS, VARNISHES.

*Technical Analysis of Asphaltum.* L. A. Lynton. J. Amer. Chem. Soc. **16**, 809.

*See under* XXIII., *page* 315.

### (*C.*)—INDIA-RUBBER, &c.

### PATENTS.

*Improvements in Treating Tissues, Fibres, Paper, and the Like.* A. Zimmermann, London. From J. Holfert, Berlin, Germany. Eng. Pat. 4697, March 6, 1894.

Tissues, fibres, or paper are covered or impregnated with a solution of gelatinous matter of animal origin, such as glue and gelatin, and exposed to the action of formalin (aqueous solution of formaldehyde) by immersion therein. After this treatment the material becomes insoluble in water, useful as a substitute for india-rubber or gutta-percha, and as a waterproofing substance.—A. G. B.

*Improvements in Making Elastic or Semi-Elastic Compositions for Insulating and other Purposes.* R. Hutchison, Cowlairs. Eng. Pat. 6389, March 30, 1894.

This invention is a further amplification of the process described in Eng. Pat. 17,739, 1892 (this Journal 1893, 936), consisting in the addition of balata with or without india-rubber and gutta-percha to the "lanichol" or wool cholesterin. (See also Eng. Pat. 12,266, 1893; this Journal, 1894, 649).—F. H. L.

*Improvements in or relating to the Production of Compounds applicable for such uses as for Paints, for Electric Insulating and Waterproofing, as Substitutes for Vulcanizable Rubber and Gum Compounds, and for other Purposes.* W. P. Thompson, Liverpool. From W. Griscom, Bound Brook, New Jersey, U.S.A. Eng. Pat. 22,966, November 27, 1894.

The substances which are included in the title "candle tar," and more especially those resulting from the distillation of animal fats may be "vulcanised" by heating with from 6 to 18 per cent. of sulphur to 300°—325° F. for half-an-hour or more. Such a product either alone or mixed with 10—50 per cent. of a petroleum residue, melting at about 250° F. may be dissolved in a suitable solvent, such as light coal-tar naphtha, to form a paint, or it may be used to coat fabrics or wires for waterproofing or insulating purposes. The vulcanisation may take place before or after the admixture of the petroleum product, and by variation in the hardness of the original candle tar, in the proportion of the petroleum residue added, and in the amount of sulphur employed, the finished material may be made of any desired degree of softness.—F. H. L.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

*Analysis of Acid Tan Liquors.* J. Pässler. Dingler's polyt. J. 1895, **295**, 141.

*See under* XXIII., *page* 316.

### PATENTS.

*Improvements in the Treatment and Testing of Gelatinous Matter.* A. Zimmermann, London. From The Chemische Fabrik auf Actien vormals E. Schering, Berlin. Eng. Pat. 4696, March 6, 1894.

It has been already published that the addition of formic aldehyde to a liquid gelatin solution, for instance, 0·25 cc. formalin (36 per cent. formic aldehyde solution) to 50 cc. of a 5 per cent. gelatin solution, the gelatin is converted into a jelly insoluble in water and infusible. When a smaller proportion of formalin is added, the resulting jelly remains fusible but possesses an increased tenacity and power of resistance, and, if it be allowed to dry, it will become insoluble in warm water. A still smaller proportion of formic aldehyde, added to the jelly before drying, will not prevent the dried gelatin from redissolving in warm water; the jelly obtained from such treated gelatin, however, is very tenacious. The following figures illustrate the foregoing remarks. A 5 per cent. solution of gelatin was used.

| Formalin added to 50 Grs. Gelatin Solution. | Proportion of Formalin to Dry Gelatin. | Load Borne in Grs. | Behaviour of Product on Warming in Test-Tube. | Solubility of Gelatin Dried on a Glass Plate. |
|---|---|---|---|---|
| | Per Cent. | | | |
| 0 | 0 | 117 + *a** | Liquefied on warming. | Soluble. |
| 0·0025 | 0·1 | 148 + *a* | „ | „ |
| 0·005 | 0·2 | 163 + *a* | „ | „ |
| 0·01 | 0·4 | 173 + *a* | „ | „ |
| 0·025 | 1·0 | 192 + *a* | „ | Insoluble. |
| 0·05 | 2·0 | 184 + *a* | „ | „ |
| 0·10 | 4·0 | 553 + *a* | Remains a jelly on warming. | „ |
| 0·25 | 10·0 | 3090 + *a* | „ | „ |
| 0·35 | 14·0 | 3890 + *a* | „ | „ |
| 0·50 | 20·0 | 4950 + *a* | „ | „ |
| 0·75 | 30·0 | 1520 + *a* | „ | „ |
| 1·00 | 40·0 | 1655 + *a* | „ | „ |
| 2·00 | 80·0 | 710 + *a* | „ | „ |
| 3·00 | 120·0 | 770 + *a* | „ | „ |
| 4·00 | 160·0 | 360 + *a* | „ | „ |
| 5·00 | 200·0 | 795 + *a* | „ | „ |
| 6·00 | 240·0 | 65 + *a* | „ | „ |

* *a* = 140 grs., the weight of the disc used for weighting.

A 10 per cent. gelatin solution received the undermentioned additions of formalin and was dried on a glass. All the gelatin dissolved easily in water. 5 per cent. solutions were made and the firmness of the jelly determined after 24 hours.

| Formalin added to 50 Grs. Gelatin Solution. | Proportion of Formalin to Dry Gelatin. | Firmness of Jelly. |
|---|---|---|
| Cc. | Per Cent. | |
| 0·0 | 0·0 | 391 + *a** |
| 0·0025 | 0·1 | 542 + *a* |
| 0·005 | 0·2 | 574 + *a* |
| 0·01 | 0·4 | 587 + *a* |

* *a* = 140 grs., the weight of the disc used for weighting.

The claims in the patent, are for the addition of formalin (formic aldehyde) during the manufacture of size and glue, in such proportion that the product shall liquefy in warm water.—A. G. B.

## XV.—MANURES, Etc.

*Note on the Decomposition of Phosphates containing Fluorine.* Dr. S. Feitler. Dingler's polyt. J. **294**, 188—189.

In a Hungarian phosphate factory, where South American phosphorite was largely used, the channels and chambers of the apparatus became coated with a light white powder to such an extent that within a year two or three waggon loads were removed. This powder, when analysed, attacked glass with evolution of pungent acid vapours, smelling of halogen acids, especially hydrofluoric acid. It consisted for the most part of $SiO_2$, the other constituents being $Al_2O_3$, $Fe_2O_3$, CaO, $K_2O$ with $P_2O_5$, $H_2SO_4$, HF, $H_2SiF_6$, and a small amount of HCl. The quantitative analysis gave :—Loss on ignition, 20·38 per cent.; $SiO_2$, 74·27 per cent.; $P_2O_5 + Al_2O_3 + Fe_2O_3$, 4·35 per cent.; CaO, 0·83 per cent.; total, 98·83 per cent. Water boiled with it became strongly acid and on titration with normal KOH the solution showed 7·6 per cent. of acid reckoned as $SO_3$. But the qualitative analysis showed that HF and $H_2SiF_6$ were also present. The latter must have been formed during the decomposition of the phosphorite by $H_2SO_4$ in the stages represented by the equations.

$$(1.)\ 2CaF_2 + 2H_2SO_4 + SiO_2 = SiF_4 + 2CaSO_4 + 2H_2O \text{ and}$$

$$(2.)\ 3SiF_4 + 4H_2O = 2H_2SiF_6 + Si(OH)_4.$$

Both would then be decomposed by the heat, the $Si(OH)_4$ yielding the anhydride, and the $H_2SiF_6$ forming, at least in part, $2HF + SiF_4$. These gaseous products acting on the substance undergoing decomposition would cause small quantities of the latter to be taken up by the porous $SiO_2$.
—C. A. M.

*The Gunning Method for Total Nitrogen in Fertilisers.* W. E. Carrigues. J. Amer. Chem. Soc. **16**, 798.

*See under* XXIII., *page* 305.

PATENT.

*Treating Brewer's Spent Hops, Wet and Dry, for the Production of Manure, Fire-Lighters, and Fuel, and a Powder for use in Dry-Earth Closets.* J. J. Adkins, London. Eng. Pat. 21,658, November 10, 1894.

*See under* XVII., *page* 292.

## XVI.—SUGAR, STARCH, GUM, Etc.

*The Manufacture of Cane Sugar in Cuba.* Saillard. J. des fabr. de Sucre, 1894, **35**, 46.

The author has obtained excellent results as regards yield of sugar (10·56 per cent.) and amount of syrup to be reworked, by carefully treating with lime and precipitating the slight excess of the latter by means of acid calcium phosphate or magnesium sulphite.—H. T. P.

*Manufacture of a New Colouring Matter.* R. E. Evans, Stratford-on-Avon. Eng. Pat. 4542, March 3, 1894.

A saccharine body, such as cane or invert sugar or glucose, is heated as for obtaining caramel, with alkaline material such as potassium or sodium hydrate or carbonate, "and the melt is dissolved in water," yielding a solution which contains "the alkali salt of a deeply-coloured body with an acid character." By adding sulphuric acid to the solution the colour is precipitated. It is washed to remove all acid and dried at a gentle heat. If the colour be desired of greater purity, it may be dissolved in an alkaline solution and again precipitated by acid. The colour may also be dissolved in spirit and used in the form of a solution. The colour is applied for colouring liquids, especially wines, spirits, &c.—F. M.

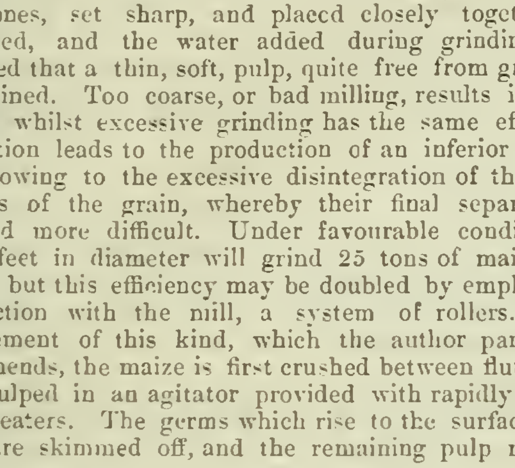
*The Manufacture of Starch from Maize in the United States of America.* J. Kriegner, Dingler's Polyt. J. 1895, **295**, 39—42.

The first stage in the manufacture of starch—the liberation of the starch-cells from the substances in which they are embedded—is effected in four operations.

1. Softening of the maize in water.
2. Crushing and grinding of the softened maize.
3. Mechanical separation of husks and germs.
4. Solution and separation of the gluten.

The softening process is conducted in wooden tanks of about 25,000 kilos. capacity, in which the unground maize is treated with water as hot as possible (60°—66° C.), consistent with non-gelatinisation of the starch. After 12—24 hours the steep-liquor is removed and renewed daily during 3—4 days, the temperature being lowered each time, so that it finally stands at 32°—38° C. The softened mass is subsequently ground between rotating stones or rolls, or a combination of the two. In the first case, ordinary flat mill-stones, set sharp, and placed closely together are employed, and the water added during grinding is so regulated that a thin, soft, pulp, quite free from grits, may be obtained. Too coarse, or bad milling, results in loss of starch; whilst excessive grinding has the same effect, and in addition leads to the production of an inferior grade of starch, owing to the excessive disintegration of the fibrous portions of the grain, whereby their final separation is rendered more difficult. Under favourable conditions, a mill 3 feet in diameter will grind 25 tons of maize in 24 hours; but this efficiency may be doubled by employing in conjunction with the mill, a system of rollers. In an arrangement of this kind, which the author particularly recommends, the maize is first crushed between fluted rolls, then pulped in an agitator provided with rapidly rotating blunt beaters. The germs which rise to the surface at this stage are skimmed off, and the remaining pulp milled as usual.

After milling, the starchy portion of the pulp is separated from the coarser impurities (husks, &c.) by washing the mass on rapidly-vibrating, obliquely mounted sieves (3 ft. wide, 6 ft. long) covered with fine silk-gauze (120—160 threads per inch). The manner in which the washing water is supplied to the sieves is a matter of some importance. The usual plan, as shown in the accompanying drawing, in which A A represents the sieve surface, B B and D, gutters for conveying starch-pulp and water respectively is regarded by the author as unsatisfactory. Much of the water falling on the sieve at *d* passes right through the gauze instead of flowing over its surface. This may be partly obviated by placing a lath immediately below the point where the water falls; but the best results are obtained by supplying water to the under-surface of the sieve by means of shallow troughs, *h* and *g*. Although the above form of sieve possesses certain advantages over the rotatory cylindrical form, there is no doubt that in the latter a far more uniform application of the wash-water, and more perfect washing are possible. In one form, which has been largely adopted, the inner periphery of the cylinder is fitted with a continuous spiral diaphragm, which compels the starch mass, during the rotation of the apparatus, to travel over every portion of its surface.



For the purpose of regulating the flow of the pulp to the sieves, the inclusion of taps or valves in the pipe system is not advisable on account of the stoppages likely to occur. A plan that has been found to work well, is to pump the pulp into a small tank through the bottom of which slide a number of open pipes, one to each sieve. By sliding these pipes up or down, the flow may be adjusted to a nicety. The starch-milk from the sieve is preferably divided into two parts, the richer (sp. gr. 6° B.) and poorer portions (2° B.) being collected and worked up separately.

The remaining operation, the solution of the gluten which cements together the starch cells, is exclusively effected by chemical means, either caustic soda or sulphurous acid being used. In the first instance, about 0·1 per cent. of alkali is added directly to the starch milk, which is then ready for *immediate* further treatment. In the acid process, the acid is employed at the very outset, about 0·4 per cent. of $SO_2$ being added to the steep liquor. It serves not only to dissolve the gluten, but plays the part of a disintegrating, preservative, and bleaching agent.

The final purification of the starch by washing, deposition, &c., and the drying process are carried out in much the same manner as in Europe. About 85 per cent. of the crude starch is recovered by these processes, the remainder being carried away with the gluten. Starch produced by the acid process is usually of a fine white colour, and yields a thin, elastic paste. On this account it is preferred for glazing, loading textile fabrics, &c. On the other hand, alkaline starch is inferior as regards appearance, but gives a much stiffer paste, which fact renders it more suitable for use in laundries, paper bag and box making, &c. These peculiarities may be referred to the presence of traces of acid or alkali in the respective starches.

The gluten (precipitated by the addition of an acid when the alkaline process has been used) in the waste liquors is recovered by filtration, dried, and coarsely ground. In this state it forms a valuable cattle-food, containing as it does, albuminoids, 30—35 per cent., the same amount of starch; fat, 8 per cent.; water, 10 per cent. Another by-product, known as "slop," consists of the coarser portions of the grain (husk, &c.), and is usually disposed of in the moist state to farmers, &c. Or, if this is not possible, the slop may be dried. 100 parts of maize yield on the average—anhydrous starch, 46·5 to 52; gluten meal, 18; dried slops, 18. In the selection of the raw material for starch manufacture, special stress is laid on thinness of husk, smallness of germ, and a high percentage of starch.

*The Recovery of Oil from Maize Germs.*—Maize-germs contain about 50 per cent. of oil, which may be readily extracted by grinding and hot pressing the dried germs. It is, however, worth while doing this only in larger installations (consuming 25,000 bushels of maize and upwards). In such cases it is usual to separate the germs during the crushing process in the manner already indicated. Crude maize-oil has a specific gravity of 0·917, is yellowish-red in colour, and possesses a characteristic odour of maize. On standing it deposits a small amount of granular fatty matter.

—H. T. P.

*Resistance of Molasses to Fermentation.* A. Bau. Zeits. f. Spiritusind. **17**, 366.

*See under* XVII., *page* 290.

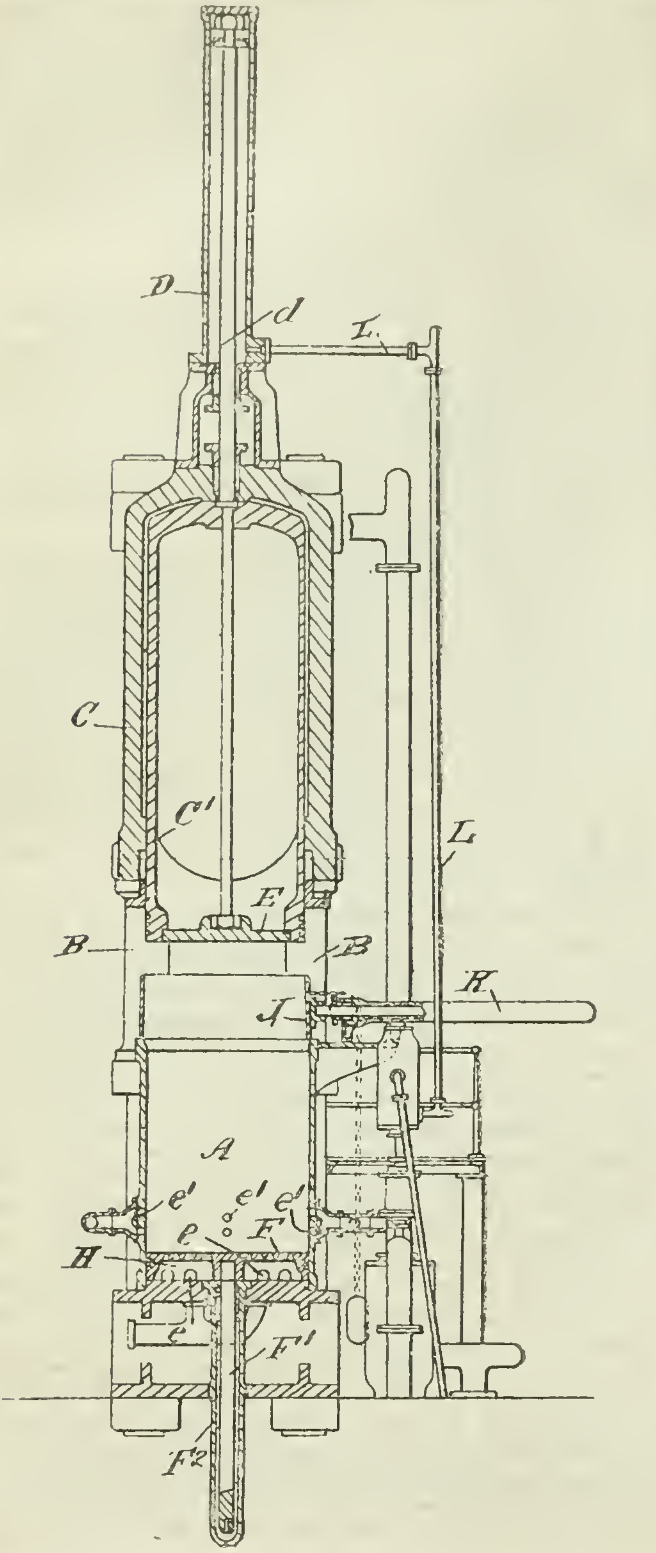
*A Comparison of Methods for the Determination of Starch.* W. E. Stone. J. Amer. Chem. Soc. **16**, 726.

*See under* XXIII., *page* 317.

## PATENTS.

*Improvements in Apparatus for Expressing Sap or Juice from Fibrous Canes and other Materials.* D. Drummond, Glasgow. Eng. Pat. 5119, March 12, 1894.

The figure is a sectional elevation of the apparatus, consisting of a cylinder A for the reception of the scutched cane, over which is the ram E of an hydraulic cylinder C and a steam cylinder D arranged tandem fashion, so that a light pressure can be put on the cane by the steam cylinder or a heavy one by the hydraulic cylinder. The cane in the crushing cylinder A is first beaten down by the ram E and cylinder D with a series of light blows, and when it becomes consolidated, the full force of the hydraulic cylinder is exerted and the sap or juice is forced through the orifices of the false bottom F and away by the outlets e, while to ensure the whole of the sap being carried away, jets of steam are forced in the side perforations $e^1$ to assist the squeezing action. At the close of the operation, the compressed fibre remaining, is raised by the ram $F^1$ and false bottom F up to the level of the section J, where the megasse is discharged at the mouth of cylinder A by the piston head at J, operated by the horizontal cylinder K. Thus it is swept clear of the false bottom F, ready for the next charge.—E. G. C.



Sugar Cane Crusher.

*The Manufacture and Production of a New Crystallised Compound of Anhydro-ortho-sulphamine Benzoic Acid.* J. Y. Johnson, London. From F. von Heyden Nachfolger, Dresden, Germany. Eng. Pat. 22,726, November 23, 1894.

*See under* XX., *page* 297.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Consumption of Steam in Steam Installations in Breweries.* Schneider. Wochenschr. f. Brauerei, 1894, **11**, 997—999.

Experiments were made with mashes of 3·44 tons each. The results are given in the following table :—

| —— | Mash Tun. | Wort Copper. |
|---|---|---|
| Time of boiling ................ | 4 hours 10 min. | 4 hours 30 min. |
| Mean steam pressure ............ | 11·7 lb. | 22·8 lb. |
| Consumption of steam :— | | |
| *a.* During total boil............ | 3·55 tons | 6·0 tons |
| *b.* Mean per hour .............. | 0·9 „ | 1·36 „ |
| *c.* Mean per hour per 1 sq. ft. of heated surface of vessel. | 26·2 lb. | 19·9 lb. |
| *d.* Mean per hour per cwt. malt | 28·7 „ | 43·5 „ |
| *e.* Total per cwt. malt.......... | 115·4 „ | 195·3 „ |
| Consumption of coal :— | | |
| *a.* Mean per hour.............. | 196·0 „ | 296·8 „ |
| *b.* Mean per hour per cwt. malt | 2·85 „ | 4·3 „ |

According to these results the total consumption of steam per cwt. of malt was 310 lb. The total time occupied was 5·75 hours, so that the average hourly consumption of steam was 54 lb. per cwt. malt and the necessary heated boiler surface 10 to 13 ft. per cwt. of malt. These figures are much higher than the Schöneberg ones given by the Wochenschrift (this Journal, 1894, 1080) which the author considers to be much too low.—L. T. T.

*Reply to Preceding by the Editor of the* Wochenschr. f. Brauerei, 1894, **11**, 999—1000.

It is pointed out that Schneider's figures are based on simultaneous mashing of one lot of malt, and boiling of wort from a previous mash, and consequently his hourly figures refer to 2 × 3·44 tons and not to 3·44 tons. This accounts for the very high hourly consumption of steam, and very large boiler surface, which must be halved if they are to be compared with the Wochenschrift's figures relating to a mash and subsequent boiling of the same liquor. The total consumptions of steam are comparable, and Schneider's figures show an excess of 37 per cent. over those given in the Wochenschrift. The editor maintains the correctness of the Schöneberg figures, viz., for 1 cwt. malt a total of 222 lb. steam; an average hourly consumption of 15 lb. of steam; and a requisite heated boiler surface of 5 square ft. —L. T. T.

*Note on the Action of Diastase on Cold Starch-paste.* H. T. Brown and G. H. Morris. Proc. Chem. Soc. 1895 [148], 35.

The authors draw attention to the generalisation which they claim to have established in previous communications, namely, that the products of a starch transformation, or any part of them separated by any method of fractionation, can always be expressed, in the terms of maltose, having an optical activity of $[\alpha]_{j3\cdot 86} = 150°$, and a cupric-reducing power of $\kappa_{3\cdot 86} = 61°$, and of dextrin, having an optical activity of $[\alpha]_{j3\cdot 86} = 216°$, and no reducing power; in other words, knowing the cupric-reducing power of any starch product, the optical activity can be predicted with accuracy, and *vice versâ*. This fact is quite independent of any consideration of the true nature of the intermediate products between starch and maltose, and has been ignored by certain recent workers.

In a paper by Brown and Heron (Trans., 1879, p. 627) it is mentioned that during the early stages of the action of diastase upon starch-paste in the cold, there is an apparent exception to this rule, the optical activity being *lower* than it should be on the assumption that only maltose and dextrin are present. After standing some hours, or on boiling, this discrepancy disappears, and the optical cupric-reducing powers show the same relationship that they do in conversions made at higher temperatures. An observation made by O'Sullivan and Tompson in another direction suggested an explanation of these abnormal results, and in the present paper the authors show that the lower angle of rotation observed during the earlier stages is due to the maltose being liberated in the state of "half rotation," a condition which freshly prepared solutions of pure maltose always show. When freshly dissolved the optical power of maltose bears the relation to that of a boiled or old solution of about 133° — 150°, and the authors show that this relationship holds good in the case of freshly-prepared products from cold starch-paste.

### *The Advantages of Steam Boiling.* Wochenschr. f. Brauerei, **11**, 1894, 1475—1476.

THE opinions, founded upon practical experience, of a number of continental brewers are recorded, with reference to the vexed question of boiling worts by means of steam or by fire direct.

Unanimity seems to prevail to the effect that little or no difference can be detected in flavour of the beers from the two systems of boiling.

As to the amount of wear and tear and the relative cost of erecting and maintaining the plant, the views expressed naturally differ, although it appears recognised that brewers generally over-estimate the saving of fuel effected by steam-boiling. Direct experiment made for the comparison of pressure and ordinary boiling showed no advantage to be effected through the employment of pressure, in respect of flavour in the beers produced.—T. A. G.

### *The Study of a Beer Sarcina.* Woehenschr. f. Brauerei, **11**, 1894, 1471—1475.

A SARCINA which causes disease in beer has been recently investigated by A. Reichard and a full account of the work published in the Zeits. f. d. gesam. Brauwesen, 1894, Nos. 30—36. The following are the chief characteristics of the organism which has been named Pediococcus Sarcinaeformis :—

The best culture medium for the sarcina is unhopped wort, and the most favourable temperature for growth 20°—25° C. The growth shows itself after about 3 days, the liquid gradually acquiring a peculiar characteristic smell which is dissipated on exposing the liquid in open beakers. At the same time a gradual increase of acidity takes place due to the formation of lactic acid, and alcohol is also formed as a fermentation product. No formation of gas was observed. Colonies of bacteria form on the sides of the vessel, and at the end of 14—15 days during which turbidity lasted, the liquid gradually clarified. A sediment, which was at first brown and later on white, was gradually formed in the flasks. The pediococcus failed to grow in pasteurised beer, but in sterilised beer free from alcohol and carbonic acid, a strong growth was obtained, whilst in maltose and dextrin solutions a slight growth occurred. In cane sugar solution the organism refused to grow, even when asparagin was present, but in both cane-sugar and maltose solutions containing 3 per cent. of meat-peptone, it grew well, forming packet-shaped bacteria. Growths were also obtained in hay and barley infusions. In a 3 per cent. alkaline peptone solution a sediment was obtained after six weeks, consisting of masses of tetrads, and on allowing a shallow layer of the infected peptone solution to stand in a beaker for some time, irregular-shaped packet colonies of a pale yellow colour were formed. On sterilised potato-slices involution forms resulted, similar to those of Lindner's Pediococcus crevisiæ.

The activity of the sarcina is weakened or destroyed by age or by heating, the resistance to heat being less in hopped than in unhopped wort. Cold has also a retarding influence on its activity, and it will not grow in wort if deprived of air. Pasteurised bottles of beer were inoculated and, after standing three or four days at 4°—5° C. were placed at a temperature of 17°—20° C. After 10 days the beer became rather cloudy and gave the well-known taste of sarcina infected beer.

Reichard finds also that the virulence of Pediococcus towards beer varies; it may cause disease or it may not according to prevailing conditions. A low primary attenuation followed by a slow after-fermentation with but little formation of carbonic acid hinders the virulence but not the vegetation of Pediococcus, whilst a high primary attenuation with a vigorous after-fermentation and consequent copious formation of carbonic acid will, if continued long enough, gradually increase its virulence. The degree of unsoundness produced depends also upon the original activity of the organism. Saturation of the wort with air and the use of a strongly attenuative yeast will almost entirely suppress the sarcina, and at the same time the resultant beer is rendered more stable. Light hopping encourages sarcina growth. Primary fermentation proceeds too quickly for the development of sarcina, but during after-fermentation at a temperature of 2°—3° C. lower the cells vegetate at the bottom of the vessel.—T. A. G.

### *The Detection of Bottom-Fermentation Yeast in Top-Fermentation Pressed Yeast.* A. Bau. Zeits. f. Spiritusind. **17**, 1894, 374.

THE author divides the group Saccharomyces cerevisiæ into the types represented by top and bottom Frohberg and top and bottom Saaz yeasts (Wochenschr. f. Brauerei, 1894, 1366). Of these, only the top Frohberg types should be present in good pressed yeast, and for the detection of the bottom types advantage is taken of the fact that the former split up the sugar melitriose into fructose and melibiose, but only ferment the fructose, leaving melibiose in solution. On the other hand, the bottom yeasts ferment melibiose and can consequently ferment melitriose completely. A 4 or 5 per cent. raffinose or melitriose solution (to which yeast-water has been added as nutriment) is sterilised and inoculated, by means of a platinum needle, with the pressed yeast to be examined. When fermentation is completely at an end, the solution is examined for unfermented sugar by means of its cupric-reducing power, optical activity, and osazone reaction. Should melibiosazone (m.p. 177°—178° F.) be obtained, it is proof that only top yeasts were present. If the tests employed include the cupric-reducing power and opticity, but not the osazone reaction, the greatest care is requisite to insure completed fermentation, since the validity of the test will then depend upon this point.

Since several other organisms occur in pressed yeast it will be necessary to further examine this method with a view to ascertaining their action on melitriose, because any bacteria which are present may ferment this sugar themselves or by acting in symbiosis with yeast. So far the behaviour is only known in this respect with regard to top and bottom fermentation Frohberg and Saaz, Ellipsoïdeus II., Hansen, and Monilia candida, Hansen. Ellipsoïdeus acts like the top-fermentation yeasts in that it splits up melitriose into fructose and melibiose, leaving the latter unfermented, whilst Monilia candida is unable to ferment either melitriose or melibiose, and bottom-fermentation yeasts can ferment both completely. Similar results to the above have also been obtained by Berthelot, Loiseau, and Scheibler.—T. A. G.

### *Alcoholic Fermentation.* R. von Chudiakow. Annales de l'Inst. Pasteur. February 1894.

This investigator has carried out a number of experiments, the results of which may be grouped under five heads :—

I. *Fermentation in Pure Sugar-Water.*—In air, fermentation only occurs after the composition of the medium has been altered by the dying-off of some of the yeast cells. By taking smaller initial quantities of yeast it is found that after a certain time the cells have gradually died away, so that the restoration of normal conditions no longer results in the production of fermentation, and this peculiarity is intensified by increased temperatures.

II. *The Influence of Oxygen on Fermentation.*—Oxygen was found to retard fermentation in pure sugar-water, but the general results obtained by Chudiakow tend to indicate that the influence of oxygen varies according to the nutrient media employed, and is in fact in an inverse ratio to their suitability.

III. *The Reproduction of the Yeast in the Presence and Absence of Oxygen.*—Oxygen is necessary to the performance of this function, but its influence is the converse of that mentioned under II., *i.e.*, it is less essential where the nutrient medium is more valuable. It would also seem that the necessity for oxygen is intimately connected with the transference of nitrogen in the yeast cell.

IV. *The Influence of Temperature on Fermentation.*—Hitherto the effect of temperature has only been studied under conditions among which the multiplication of the yeast cells was a prominent factor, whereas the author considers this should either be excluded or its influence on the result ascertained. From his researches the existence of a most favourable temperature for fermentation appears to be negatived, but owing to experimental difficulties no accurate curve for the various temperatures could be obtained.

V. *Intermolecular Respiration of Yeast.*—While in the higher plants the dependence of respiration on the plant constituents cannot be detected, in moulds, on the other hand, an alteration is observed when the nutrient medium is changed, Diakonow found that only when glycose is used does more or less effective respiration occur during exclusion of oxygen. In all other cases the evolution of $CO_2$ ceases with the withdrawal of oxygen.

Chudiakow finds, in contradiction to previous observers, that intermolecular respiration or the so-called self-fermentation of yeast does not actually occur, and only apparently so when the cell plasma contains sugar, or as a result of bacterial impurities.—C. S.

### *Resistance of Molasses to Fermentation.* A. Bau. Zeits. f. Spiritusind. **17**, 366.

Several attempted explanations have been given of the cause of the difficulties experienced in completely fermenting molasses; the presence of volatile fatty acids, nitrous acid, fission fungi (*Spaltpilzen*), and of sugars only fermentable with difficulty, each having its advocates. The latter deserves more attention than it has hitherto received, as the raffinose or melitriose found in molasses is itself unfermentable. It is, however, split up by both top- and bottom-fermentation Frohberg and Saaz yeasts into fructose and melitriose, and of these the former is completely fermented by all four yeasts, whereas the latter is only so by the bottom-fermentation varieties, the top-fermentation yeasts merely fermenting about one-third of it.

The volatile acids and the fission-fungi (Spaltpilzen) can be removed or destroyed by boiling well with dilute sulphuric acid, a process which also inverts more or less of the melitriose. When the inversion is energetic, fructose, glucose, and galactose are formed, whereby though the latter (according to E. Fischer) is only attacked with difficulty by top-fermentation yeasts, two-thirds of the melitriose becomes susceptible of fermentation, and the whole may be fermented by adding "bottom" yeast to the "top" yeast usually employed. On the other hand, prolonged exposure to a comparatively large amount of sulphuric acid results in the destruction of some of the fructose of the molasses, and thereby in a diminished yield of alcohol. In view of the high fermentative energy of bottom Saaz yeast under certain conditions experiments with this variety on molasses would not be without value.—C. S.

### *Fermentation of Glucose Syrups.* H. E. Horton. J. Amer. Chem. Soc. **16**, 808—809.

Contrary to the general opinion, glucose syrup of 41° B. is fermentable. During the summer of 1893, large quantities of the so-called "mixing-glucose" sold in southern cities was found to be in a state of active fermentation. Moisture determinations showed 21·1 per cent., the normal quantity for 41° B. syrup. In order to try and prevent fermentation the following antiseptics were added to separate barrels of 52 gallons, viz. :—1·46 lb. of sodium bisulphite, 40° B.; ½ oz. boric acid and ¼ oz. benzoic acid; a mixture of all three. In neither case was there any effect.—L. A.

### *Sterilisation of Cellars, Floors, Vats, &c. by Means of Formaldehyde Vapour, and its Behaviour towards Yeasts and Bacteria.* W. Windisch. Wochenschr. f. Brauerei, **11**, 1894, 1531—1532.

The antiseptic properties of formaldehyde, both in the solid, liquid, and gaseous state, were recognised by Trillat in 1891. Its general use has been restricted however, owing to the difficulty of preparation, but Trillat has since that time constructed a modified burner, which will convert 5 kilos. of methyl alcohol per diem into formaldehyde, of which the yield is 25 per cent. of the methyl alcohol used. The bacteria of a sick room of 45 cub. m. capacity were destroyed by generating aldehyde for four hours by means of this apparatus (Comptes rend. **119**, 563).

Cambier and Brochet (Comptes rend. **119**, 607) have also constructed a burner for the generation of aldehyde by incomplete combustion of methyl alcohol. Formaldehyde offers certain advantages to brewers as a disinfectant for cellars, refrigerator rooms, vats, &c. Its action towards bacteria is known, but its behaviour to yeasts is yet to be investigated. The author has observed that in solutions of tri-formaldehyde, yeast cells will remain alive long after the bacteria are quite killed. A yeast which was very much contaminated by bacteria was freed from them by this means. Further, the addition of a dilute aqueous solution of tri-formaldehyde prevented butyric and lactic fermentation setting in, in an infusion of ground malt and water, when kept at an elevated temperature. A very small amount of aldehyde sufficed to prevent bacterial fermentation, although fermentation was set up by the yeasts present. Evidently then formaldehyde resembles hydrofluoric acid, in that bacteria are much more susceptible to its action than are yeasts.—T. A. G.

### *Composition and Analysis of Malt.* T. Crossman. J. Amer. Chem. Soc. 1894, **16**, 559—565.

Miller (this Journal, 1895, 80), states the important points for the brewer in the analysis of malts, as: 1. Moisture; 2. Extract; 3. Diastatic Power; 4. Acidity. The author contends that these determinations are not of much use to the brewer unless accompanied by—5. Ready-formed sugars soluble in cold water; 6. Percentage of uncoagulable albuminoids soluble in cold water; 7. The quantity of free maltose, malto-dextrins, and free dextrin, when the malt is mashed under standard conditions, and; 8. The amount of unmodified starch or steeliness. The *extract* is best determined by Heron's method (this Journal, 1888, 259—276), which gives valuable information to the practical brewer. Contrary to Miller's statement, the author believes that most brewers are guided, when purchasing malt, more by the quality than the quantity of the extract. The *diastatic power* is best determined by Lintner's method which gives the amount of curing the malt has been subjected to. The behaviour of the malt is not alone dependent on the diastatic power, but largely also on the state of the starch present. If the starch be free and friable the diastase will convert more than if it be vitreous or steely. The determination of *ready-formed* *sugars* is important to the brewer. If the percentage is very low, the barley has been insufficiently germinated, if it is above 17 per cent. calculated on the malt, it is probable that the malt has been forced and that the beer produced from it will not be sound. The amount of *uncoagulable albuminoids* appears to bear a relation to that of the ready-formed sugars (Moritz, Technical Brewing, a Report on the Chief Features in the year 1893), and by dividing the soluble albuminoids into the ready-formed sugars, a factor closely approximating 6·3 appears generally to be obtained. The author considers the determination of free maltose and malto-dextrins, if the malt is always mashed under the standard conditions of Heron's test, very valuable as helping the brewer to decide as to the way his malt is to be handled in the mash tun, since on the amount of free maltose and malto-dextrins in a wort depends to a large extent the condition, flavour, and attenuation of the resultant beer. The estimation of the amount of *unmodified starch or steeliness* is often neglected, but is most important. If there is much unmodified starch it shows that the malting has been inefficient, the cellulose surrounding the starch has not been properly broken down and the latter is, to a great extent, "locked up," and will not get converted by the diastase in the first mash. Part of it will, however, become "semi-dissolved" and be washed out by the subsequent higher temperature sparging, and, not being converted, is likely to cause grey or hazy beer. This incomplete breaking-down of the cellulose appears also to be accompanied by the incomplete modification of the glutens and this would cause want of brilliancy in the beer. The author recommends the following method for the determination of this unmodified starch. 50 grms. of malt are mashed, as in Heron's extract estimation, the mash is boiled vigorously for an hour and allowed to cool to 150° F., 50 cc. of cold water extract (Heron, *loc. cit.*) are now added, and the mash kept at 150° F. for another hour. The whole is now cooled to 60° F., made up to 515° cc. and the gravity taken, allowance being made for the gravity added, *i.e.*, 50 cc. cold water extract. The difference in solid matter between the boiled mash and the mash for extract gives the amount of unmodified starch. If the unmodified starch is much over 7 per cent., the malt should be looked upon with suspicion.

The author considers that the results of an analysis of malt should be stated as follows:—

*Composition of Wort Mashed under Standard Conditions.*

| | |
|---|---|
| Free maltose, fermentable | 33·30 |
| Ready-formed sugars, fermentable | 14·00 |
| Malto-dextrins, unfermentable {maltose 3·0<br>dextrin 1·9} | 4·90 |
| Free dextrin, unfermentable | 13·40 |
| Albuminoids | 2·21 |
| Ash | 1·60 |
| Acid as lactic acid | 0·51 |
| Dry extract | 70·00 |
| Unmodified starch | 7·60 |
| Moisture | 1·90 |
| Grains | 21·10 |
| Total | 100·00 |
| Diastatic capacity | 30 |
| Colour of wort | pale |
| Flavour | good |

—L. T. T.

### *Sulphurous Acid in Wine.* F. Schaffer and A. Bertschinger. Chem. Zeit. Rep. 1894, 18, 284,

(From the Authors' original pamphlet.)

Some uncertainty of opinion still exists as to the precise limit beyond which the presence of sulphurous acid in wine must be considered injurious to the consumer. The authors have therefore made numerous experiments to decide the matter, special attention being paid to the above question. Other points investigated related to the variations in the amounts of free and combined sulphurous acid during storage of wine, and the antiseptic action of the same; the stability of aldehyde sulphurous acid in presence of dilute hydrochloric acid (representative of gastric juice); the physiological action of sulphurous acid; variations in the proportion of acid produced by sterilisation of wine, &c. The following conclusions are arrived at:—In the examination of white wines both free and aldehyde sulphurous acid must be determined. In forming an opinion on sulphured wines from a hygienic point of view, the amount of free sulphurous acid is the chief determining factor. This should not exceed 20 mgms. per litre. The total sulphurous acid should not exceed 200 mgms. per litre. These figures also apply to cider, perry, &c. On the other hand medicinal wines must not contain more than 20 mgms. per litre of total sulphurous acid, and it is advisable to determine the amount in such cases gravimetrically.—H. T. P.

### *Estimation of Cane Sugar in Malt.* Wochenschr. f. Brauerei, 11, 1894, 1536.

*See under* XXIII., *page* 316.

## PATENTS.

### *Improvements in the Manufacture of Ale and Stout.* S. H. Sheldrake, Gipsy Hill, Surrey. Eng. Pat. 25,052, December 30, 1893.

The inventor proposes to increase the nourishing properties of ale and stout by introducing into them during the course of manufacture, calves' head or feet, bullocks' heads, and shins of beef, and a small quantity of quinine. He further proposes to raise the temperature in the mash-tun after the lapse of two hours to 190° F., and to boil in the copper for four hours.—J. G. W.

### *Improvements Relating to the Charging and Combining of Liquids with Carbonic Acid Gas and to Apparatus therefor.* H. H. Lake, London. From E. Adam, Philadelphia, U.S.A. Eng. Pat. 2054, January 30, 1894.

Fermented or unfermented wort, cordials, distilled and other liquids, are charged with carbonic acid gas by means of apparatus, including a high pressure combining and regulating tank, which is operated entirely full of liquid; another, expanding and releasing tank, with external gauge, in which space is left for air and gas; and a low pressure combining vat or vessel. The high-pressure tank has a liquid-pressure gauge, safety-valve, and valved pipes leading from the top and bottom to other parts of the apparatus. The expanding and releasing tank has a gas pressure-gauge, safety, blow-off, and other valves, a valved pipe connecting to the gas space above, and by an injector, to the lower part of the vessel, besides pipes at the bottom connecting the general system. The low-pressure vat has also suitable connections. Strainers are interposed in three places. An important part of the system is the charging apparatus, connected to a pump, to cylinders containing compressed carbonic acid gas, and by suitable valved pipes, to the tanks. It consists of a shell containing pipes or plugs, with intervening chambers communicating with branches leading to the different tanks, and has a tubular plug connected with the shell at the discharge end of the pipes, and a chamber between this end and the discharge nozzle of the shell, and a plug passing through the shell, operating as a valve with seat against the nozzle, all the parts being adjustable. By means of this apparatus, a liquid, or two liquids, may whilst under pressure, be brought into contact with carbonic acid, and also while under relief of pressure, while issuing as a spray from the nozzle.

In carrying out the process, the vat and high-pressure tank are quite filled with liquid, and the other tank is partially filled. By means of liquid drawn from the unfilled tank, hydraulic pressure is brought to bear by this pump on the two full vessels; but by regulation of the valves, a pressure of 20 lb., for instance, is exerted in one tank, and about half that in the other. The carbonic acid

gas is then turned on, and the liquid arriving in different chambers of the charging vessel meets the gas, with which it is sprayed. The charged liquid then, under high pressure, forces some of the liquid from the full tank into the low-pressure tank, "where it combines with its carbonic acid gas with the low compressed liquid," part of which then passes through a regulating cylinder into the incompletely filled tank. The process is continued until the liquid in the low-pressure vat is completely charged with the gas. Another process is described, in which highly-charged liquid and gas from the high-pressure tank is mixed as spray in the charging vessel, with a released and expanded stream of liquid from the partially-filled tank, the mixed liquid being then forced into the high-pressure vessel, the process being continued until the liquid is saturated under successively increased and diminished pressure. In this process, the low-pressure vat is not used. It is stated that the "expanded liquid may be charged with carbonic acid gas more freely than when the same is compressed," while the subsequent compression effects thorough combination. The processes admit of various subordinate modifications.
—E. S.

*Apparatus for Brewing.* Dr. C. Rach, Chicago. Eng. Pat. 3998, February 24, 1894.

The apparatus consists of a cylindrical vessel with a domed top and bottom, the latter being provided with a steam jacket. Into the top opens a wide vertical tube, which can be closed by a valve; passing through it is also a vertical charge or discharge pipe, which can be raised or lowered from the outside so as to bring its orifice to any required level within the interior of the vessel. The vessel is provided with a very complete stirring apparatus, consisting of a series of horizontally revolving arms towards the bottom, and of a set of vertically revolving ones in the centre. A series of nozzles above the horizontal arms, serves to introduce steam into the contents of the vessel, while the above-mentioned steam jacket serves for heating purposes. It is claimed that the apparatus can be used as a mash-tun, steam cooking apparatus, a pressure copper or a sterilising vessel by slight alterations of the valves and inlet pipes.
—J. G. W.

*Manufacture of a New Colouring Matter.* R. E. Evans, Stratford-on-Avon. Eng. Pat. 4542, March 3, 1894.

*See under* XVI., *page* 286.

*An Improved Filter for Wines and other Liquids.* T. F. Seitz, Kreuznach, Germany, Eng. Pat. 5221, March 13, 1894.

*See under* I., *page* 259.

*Improvements in or relating to the Treatment of Brewers' and Distillers' Mash and the Saccharine Liquid or Wort obtained therefrom.* R. W. Preston, Liverpool, and J. M. Hogarth, Bootle. Eng. Pat. 10,667, June 1, 1894.

The mash is made in a tub with the ordinary perforated bottom, and the wort run off, which process is repeated until the saccharine and amylaceous substances of the malt are completely extracted. The wort so obtained is filtered through an ordinary filter-press and fermented with yeast in the presence of pure air, which pure air is obtained by passing air successively through a couple of wooden vats, partly filled with commercial sulphuric acid, either half-dilute or undiluted. For the purpose of passing the air through the acid, the inventors propose a central downward tube, bearing six perforated arms, which arms, by the revolution of the central tube, circulate within the acid liquor.—J. G. W.

*Apparatus for Cooling Beer.* J. Y. Poplawsky, Bremerhafen Am Hafen. Eng. Pat. 20,988, November 1, 1894.

In order to cool beer or similar liquids, these are introduced into a closed vessel of rectangular, circular, or other form, surrounded by an ice jacket. The liquid is allowed to flow through a series of zigzag passages, the length of which may be varied, in order to regulate the cooling effect, and is afterwards drawn off in a cooled state. Various forms of apparatus are described and illustrated for dealing with large or small quantities of liquid.—E. G. C.

*Treating Brewers' Spent Hops, Wet and Dry, for the Production of Manure, Firelighters and Fuel, and a Powder for use in Dry Earth Closets.* J. J. Adkins, London. Eng. Pat. 21,658, November 10, 1894.

For use as a manure for flower, fruit, and vegetable gardens, the spent hops are mixed with nitrate of soda or sulphate of ammonia and salt. For very tender plants, the spent hops are used alone.

For use as fuel, the hops are dried and treated with tar, pitch, or rosin, and coal slack, and moulded into blocks. Or, the wet hops may be first pressed into blocks, then dried, and treated with a mixture of resin or pitch, and paraffin.

For use in dry-earth closets, the dry powdered hops are mixed with 5 cwt. of a suitable disinfecting powder to 15 cwt. of hops.—L. A.

*Improvements in Apparatus for the Electrical Treatment of Beer or other Liquid or Material.* L. Wagner and J. Marr, Baltimore, U.S.A. Eng. Pat. 23,553, December 4, 1894.

*See under* XI., *page* 280.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (A.)—CHEMISTRY OF FOODS.

*Proteids of the Wheat Kernel.* T. B. Osborne and C. L. Voorhees. J. Amer. Chem. Soc. 1894, **16**, 524—535.

The authors have separated from the wheat-kernel five distinct proteids—gliadin, glutenin, edestin, leucosin, and a proteose, and also small quantities of, apparently, another proteose.

*Gliadin* is readily dissolved from wheat-flour and from gluten by hot dilute alcohol. It also exists in the rye-kernel. When dried over sulphuric acid it forms a snow-white friable mass, which is easily reduced to a powder. If moistened with dilute alcohol or water and then dried, it forms thin transparent sheets resembling gelatin, but rather more brittle. Treated with a little cold water, it forms a sticky mass, and dissolves slightly on the addition of more water. It is much more soluble in boiling water, but separates out again on cooling or on the addition of a very little sodium chloride. If a little sodium chloride be added to distilled water, and the solution be applied to the moistened gliadin, a very coherent viscid mass results, which adheres to everything it touches; but if a 10 per cent. sodium chloride solution is used, the plastic mass is formed, but has lost its adhesive character. Gliadin is quite insoluble in absolute alcohol, but becomes more and more soluble when the alcohol is diluted with water up to a certain point, after which the solubility again diminishes. 70 per cent. alcohol dissolves an almost indefinite amount of the proteid. It is easily soluble in dilute acids and alkalis and is again precipitated unchanged from these solutions on neutralisation. It gives the usual proteid reactions with nitric acid, with Millon's reaction, and with the biuret test. When gliadin is dissolved in concentrated hydrochloric acid, a violet colour is gradually developed. Warm 50 per cent. sulphuric acid gives a similar coloration, which is intensified on boiling. On boiling its aqueous solutions, gliadin is coagulated, and is then insoluble in alcohol and in 0·2 per cent. potash, thus differing from glutenin. It forms about 4·25 per cent. of the wheat kernel.

*Glutenin* is soluble in dilute acids and alkalis; it is almost insoluble in cold water and cold alcohol, but appears to be slightly soluble in boiling dilute alcohol. With concentrated hydrochloric acid it gives a yellow colouration, which gradually changes to violet. With sulphuric acid it gives a brown colouration. Its composition is very nearly if not exactly that of gliadin, but the two substances are certainly distinct. It forms about 4 per cent. of the wheat kernel.

*Edestin* (this Journal, 1894, 828) is precipitated from its saline solutions by dilution or by saturation with magnesium or ammonium sulphate. It is partly precipitated from its solutions on boiling, but does not coagulate below 100°. The wheat kernel contains between 0·6 and 0·7 per cent. of edestin.

*Leucosin* is an albumin coagulating at 52° and precipitated from its solutions by sodium chloride or magnesium sulphate. It forms about 0·3—0·4 of the wheat kernel and when coagulated at 60° has the composition: C53·02 per cent. H 6·84, N 16·80, S 1·28.

The *Proteose* was obtained (after removing the edestin by dialysis and the leucosin by coagulation) by saturating the solution with sodium chloride. On concentration by boiling a coagulum was gradually formed, amounting to about 0·3 per cent. of the wheat kernel, and of the composition C 51·86 per cent. H 6·82, N 17·32, sulphur and oxygen 24·0.

*The Formation of Gluten.*—The authors have made a large number of experiments on this subject (this Journal, 1893, 1048), and conclude that no ferment action is involved in the formation of gluten, but that it consists solely of gliadin and glutenin, and is produced by the action of the peculiar adhesive properties of gliadin, in cementing together the insoluble glutenin into a sticky and strongly adherent mass. When gliadin is extracted from wheat flour by alcohol, no gluten can be obtained from the residual flour though a plastic dough is produced. Similarly, when gliadin was mixed with starch, a tough dough could be made, but no gluten obtained. Neither gliadin nor glutenin are able alone to form gluten.—L. T. T.

### *Modern Forms of Apparatus for Estimating Fat in Milk with special reference to those designed by Babcoch-Ahlborn, Thörner and Gerber.* J. Sebelien and K. Stören. Chem. Zeit. 1894, **18**, 1816.

*See under* XXIII. *page* 318.

## (*B.*)—SANITARY CHEMISTRY.

### *Quantitative Estimation of the Dust in the Air, with a Description of a New Dust-Catcher.* Karl Arens. Arch. Hyg. **21**, 325—358, Hyg. Inst. Würzburg.

The principle of the method here described is the same as that adopted by Hesse for the bacteriological examination of air. By means of a bellows-like apparatus a definite quantity of air is slowly aspirated through a glass tube filled with cotton wool, the weight of tube and wool together having been previously determined. After standing over concentrated $H_2SO_4$ for 48 hours, the tube is again weighed, and the increase in weight gives the amount of dust in the volume of air aspirated. The following quantities were found in a cubic metre of air from different sources :—

| | Mgrms. |
|---|---|
| Dwelling room | .. |
| Laboratory | 1·4 |
| School room | 10·0 |
| Horsehair spinning factory | 17·0 |
| Saw mill | 17·0 and 15·0 |
| Woollen factory, picking room | 7·0 |
| Woollen factory, cutting room | 20·0 |
| Flour mill | 22·0 and 28·0 |
| Iron foundry (15—20 workmen) | 28·0 |
| Iron foundry (not previously used) | 1·5 |
| Iron foundry (few workmen) | 12·0 |
| Iron foundry (during the work, after sand had been moistened) | 8·0 |
| Snuff manufactory | 72·0 |
| Snuff manufactory (before powdering) | 16·0 |
| Cement works (during the work) | 224·0 |
| Cement works (in an interval) | 130·0 |

Details are also given of the quantities of dust deposited in an hour, taking into account the strength of the wind, moistness of the atmosphere, and other conditions.

In conjunction with Lamb, the author has constructed an air-purifying apparatus on the foregoing principle, the object of which is to prevent outside dust from entering a room, and dust from factories from getting into the outside air. It consists essentially of a box with inlet and outlet, containing rough, moistened flannel, so arranged as to catch the dust carried by the air passing through the apparatus.
—C. A. M.

### *Dust in Factories, with Especial Reference to its Form, and Action on the Workmen.* H. Wegmann. Arch. Hyg. **21**, 359—414.

In many cases it is possible to prevent to a very large extent the distribution of dust by merely keeping moist the material being worked upon. Where this is not practicable the dust should be removed by ventilation, or, where this is not sufficient, by one of the mechanical appliances for removing it as soon as formed. In every instance in which such arrangements are ineffective, the eyes, mouth, and nose of the workmen must be protected, all conversation during work forbidden, and the breath taken through the nostrils instead of the mouth. Finally, should all these precautions prove insufficient to prevent the inhalation of dust, the hours of work should be shortened, and intervals fixed for removing the dust-laden air and replacing it by fresh.

A description and illustrations of the various sorts of dust occurring in different trades are given, and an account of their action on the lungs of the workmen.—C. A. M.

### *The Quality of Water Supplies.* W. P. Mason. J. Amer. Chem. Soc. **16**, 772—778.

A paper, with the above title, was read before the American Society of Civil Engineers, at their Niagara meeting, in which the writer, though appearing to be a believer in the power of water to spread disease, nevertheless makes statements which, in the opinion of Mr. Mason, are calculated to throw doubt upon scientific processes and results. Mr. Mason mentions that during an investigation into the cause of an outbreak of typhoid fever in the Tees Valley (England), the medical officer of the Local Government Board caused samples of pure water to be infected with small quantities (50 and 25 parts per million) of typhoid dejecta and submitted to prominent water analysts for examination; that no results upon which an adverse report could be based were obtained; and that, as a result, purely chemical methods of water examination received very severe criticism, and the advocates of purely bacteriological processes were correspondingly elated. He then points out that, under the actual conditions of development, typhoid germs contaminating a water would be accompanied by substances which would react with the chemical reagents and indicate sewage contamination; and that chemical analysis, by detecting these abnormal ingredients, or abnormal proportions of certain constituents, can give a warning before disease germs gain access to a water, or while they are present in numbers too few to be detected by bacteriological examination.

The paper criticised has much to say upon the imperfections of modern filters and the danger of using water therefrom, laying stress upon the fact that if only one or two bacteria per cc. remain in the water, yet from 250 to 500 may be imbibed in drinking a single glass, some of which may be pathogenic. Mr. Mason, in reply, points to the results of filtration at Altona during the Hamburg cholera epidemic of 1892. Taking the numbers showing the efficiency of the filters for one month of 1892, he points out that the average number of bacteria in 1 cc. of the filtered water was 90; in the raw Elbe water it averaged 28,667. This meant a removal of 99·69 per cent. of organisms of all kinds, and the city was protected from a cholera epidemic under remarkable circumstances. Household filters more often fail from neglect than from inherent defects. The Pasteur filter is referred to as a worthless contrivance; but extended tests made with it for the Connecticut Board of Health in 1892, showed that it may be depended upon if the porcelain cylinder be cleaned and sterilised once a week. Freundenreich has obtained similar results, and has also shown that the time during which the filter remains efficient depends upon the temperature.—L. A.

*Bacteriological Methods as a Test of Sand Filtration.* A. Reinsch. Centr. Bl. für Bak. und Parisitenk. **16**, 881—896. Altona VIII. internat. Köngr. f. Hygiene, Budapest.

From a bacteriological examination of the water delivered by the Altona sand filters, the conclusion is arrived at that although the "slimy" layer arrests a very large proportion of the micro-organisms present in the original water, the filtrate still contains too many to be fit for use from a hygienic point of view. To remove these as completely as possible, it is essential that the water shall pass through a sand layer of from 400—600 mm. in thickness. Even in a recently-cleaned filter 400 mm. was the thinnest layer which would give efficient results, and then only after a good slimy layer had been formed. Since the water in passing through the lowest part of the filter again acquires bacteria it is advisable to have the stone layer (the probable cause of this contamination) as small, and the sand layer as thick as possible.

When an untreated water is filtered through different filters at the same rate of delivery, the number of micro-organisms in the filtrate is similar when the sand layers are of the same thickness. Moreover, the conditions of filtration being otherwise similar, the bacterial condition of the filtrate is not dependent on the number of germs in the untreated water, provided the latter keep within the normal limits of 10,000 to 100,000 or 200,000. Should, however, the number be considerably higher, and at the same time a large amount of suspended matter be present, an impure filtrate is inevitable. The number of micro-organisms should always be the same in all parts of the water delivered by a filter in proper working order. It is advisable not to disturb the filter, but to allow it to continue at work day and night at the same speed. In forming the filter-bed the water should be allowed to stand undisturbed for 12 hours, and the initial rate of filtration should be slow (60 mm.).

The author has employed bacteriological methods in investigating the causes of former derangements in the Altona waterworks, and in finding a means of preventing them in the future.—C. A. M.

### PATENT.

*An Improved Mode of and Apparatus for Effecting the Separation of Water from Calcareous Impurities.* A. Dervaux, Brussels. Eng. Pat. 3684, November 20, 1893 (under International Convention).

*See under* I., *page* 259.

### (C.)—DISINFECTANTS.

### PATENTS.

*An Improved Manufacture of an Antiseptic and Microbicide.* Dr. A. Kraus and A. Chevrier, Paris. Eng. Pat. 5288, March 13, 1894.

Solid iodocresol is formed by the action of iodine upon either pure or crude cresol, and the reddish-purple precipitate is dried and used under the name of "*Traumatol.*" "It may be employed like iodoform, which it advantageously replaces, inasmuch as it is inodorous, non-poisonous, and has the property of counteracting fermentation; moreover, it does not irritate the mucous membranes." When crude cresol is employed, boiling between 180° and 210° C., the iodine is caused to react in presence of some iodic acid, to prevent the formation of hydriodic acid, and consequent destruction of some iodide already formed—

$$(5C_7H_8O + 2I_2 + HIO_3 = 5C_7H_7IO + 3H_2O).$$

The destructive action of hydriodic acid upon already formed iodide is thus shown, $C_7H_7IO + HI = C_7H_8O + I_2$.
—L. A.

*Improvements in Apparatus for the Treatment of Offensive and Infected Matters.* J. B. Alliott, London. Eng. Pat. 6049, March 22, 1894.

Excrementitious and other refuse matter from hospitals, which cannot conveniently be burnt, is disinfected by steam, before being discharged into a drain. In applying the invention to a water-closet, a suitable vessel is provided below the basin, into which the contents are first discharged, and in which the treatment by steam is effected.—L. A.

*An Improved Sterilising, Disinfecting, and Deodorising Fluid, applicable also for Use as an Insecticide.* C. T. Gardner, Worthing, Sussex. Eng. Pat. 23,135, November 29, 1894.

This fluid is prepared by taking a saturated solution of bleaching powder, and adding to it 1 per cent. or more by volume of a saturated solution of potash, pearlash, common salt, alum, or borax, or a mixture of two or more of these. The solution thus formed may be scented or coloured by any suitable agent, and is intended to be used for purifying infected woodwork, such as ships' decks, cattle pens, &c.—L. A.

## XIX.—PAPER, PASTEBOARD, Etc.

*Pyroxylin, its Manufacture and Applications.* W. D. Field. Part III. J. Amer. Chem. Soc. 1894, **16**, 543—549.

*See under* XXI., *page* 298.

### PATENTS.

*Improvements in Treating Tissues, Fibres, Paper, and the like.* A. Zimmermann, London. From T. Holfert, Berlin, Germany. Eng. Pat. 4697, March 6, 1894.

*See under* XIII., *page* 285.

*An Improved Manufacture of Paper for Bank Notes and other Documents.* P. W. Wilkinson, London. Eng. Pat. 5557, March 16, 1894.

The bank note, &c. consists of a fine woven fabric, coated with paper. The fabric bears some device, pattern, or letters, which can be clearly seen through the surrounding paper, even without holding the note up to the light. The design on the fabric may be made especially effective by printing it in a bright colour, such as red or blue. An additional safeguard against forgery is provided by employing notes thus prepared.—R. B. B.

# XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

### *Bismuth Salts.* B. Fischer and B. Grützner. Arch. Pharm. 1894, **232**, 460.

The authors have described a method of preparing basic bismuth salicylate and gallate, which consists in treating freshly precipitated bismuth hydrate with the calculated amount of acid. Other salts of bismuth have been obtained in the same way, well defined compounds being formed in the case of *m*- and *p*-cresotic acids, but not from the ortho acid. Similarly, anisic, benzoic, and cinnamic acids yielded bismuth salts constant in composition. Bismuth tartrate, $C_4H_4O_6 . 2Bi(HO)_2$, was obtained as an amorphous powder by suspending two molecules of bismuth hydrate in a solution of one molecule of tartaric acid, and evaporating the whole to dryness on the water-bath.—H. T. P.

### *Salicylates of Bismuth.* F. Thabuis. Monit. Scient. 1895 [4], **2**, 16—29.

For some years continued attempts have been made to substitute, for therapeutic use, salicylate of bismuth for subnitrate of bismuth, and proposals have even been made to eliminate the nitrate of bismuth from the German Pharmacopœia and replace it by the salicylate. Since the use of salicylic acid for preservation of foods, though recommended by many German chemists, has been very generally condemned by medical men as prejudicial to health, and as the salicylates of bismuth seemed likely to be very unstable and ill-defined, the author has carefully investigated the subject and collated his results with those of other investigators. From his results he draws the following conclusions :—

The salicylates of bismuth are very unstable and are decomposed by alcohol, glycerin, solution of sugar, acids, cold alkalis, and even by carbonate of magnesia. Washing with water, during their preparation, also causes variation in composition, and they must be considered rather as molecular compounds of bismuth oxide and salicylic acid than as true salts. This is shown by the fact that the more soluble salicylic acid is in one of the neutral solvents just mentioned, the greater, generally, is the decomposing action of that solvent. Thus a solution of sugar causes much more decomposition than water does, and salicylic acid is much more soluble in a saccharine solution than it is in water. Most of the salicylates of bismuth, when heated, begins to lose salicylic acid below 100°.

The continuous decomposition during the washing of these salts, and the difficulty of preparing them in a pure state or of definite composition, leads to the supply by makers of very various products.

This uncertainty in composition of the commercial drug results, of course, in uncertainty in its medicinal effect.

Salicylic acid, being both acid and phenolic in character, can form two series of bismuth salts, of which the four principal salts would be (*i.*) $Bi(C_7H_5O_3)_3$ and $BiO(C_7H_5O_3)$ and (*ii.*) $Bi_2(C_7H_4O_3)_3$ and $(BiO)_2(C_7H_4O_3)$. The author succeeded in preparing the neutral salt $Bi(C_7H_5O_3)_3$ by adding to a strong solution of 31·6 grms. of bismuth chloride, the theoretical quantity of sodium salicylate, allowing the resultant paste to stand for 24 hours, adding 2 litres water, filtering, and pressing the precipitate. The percentage of salicylic acid in this preparation was 65·2, theory requiring 65·87; it still contained a trace of sodium chloride. So prepared, this salt is a light, white granular powder. When heated (especially if moist) it gives up salicylic acid. It has a strong acid reaction, causes effervescence with carbonates, and has an acid and caustic taste. Water, alcohol, and other neutral solvents cause immediate partial decomposition.

The salt supposed to be used as a drug is the salt $BiO . C_7H_5O_3$ first prepared by Wolff, and containing 37·36 per cent. salicylic acid. A large number of commercial samples yielded, however, very varying results, of which the following are some examples :—

| — | A. | B. | C. | D. | E. |
|---|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Salicylic acid. | 33·3 | 39·4 | 11·87 | 7·30 | 6·5 |
| Bismuth oxide | 62·6 | 58·8 | 73·7 | 77·5 | 76·0 |
| Nitric acid… | Trace | Trace | 6·28 | 5·60 | 7·6 |

Some of these contained also as much as 2—3 per cent. of sodium salicylate, and 2—8 per cent. of water. If the nitric acid is calculated as subnitrate of bismuth the quantity of the latter would amount in E to 42·79 per cent. Very many commercial samples approximate to D and E, and it is said that salicylic acid being expensive, and there being no officially fixed composition, the percentage of salicylic acid is intentionally lowered. These results show the unreliability of this salt as a drug.

The author also calls attention to various impurities, some of which are highly noxious, which are liable to be contained in salicylic acid, and which have often led to evil results. The relative physiological action of the salicylate and the subnitrate is also discussed at great length, with a result favourable to the nitrate.—L. T. T.

### *Possible Impurities in Officinal Sulphuric Ether.* Adrian. Moniteur Scient. **8**, 1894, 835.

Although acetic acid and acetaldehyde are formed during the manufacture of ether, still even rectified ether, if containing traces of water, will by the action of the air give rise to these impurities. Distillation removes the acid, and the author states that the aldehyde may be precipitated by passing a current of dry ammonia gas through the ether when aldehyde-ammonia separates out and may be filtered off. Quantities varying from 0·5 to 3 per cent. have been detected by this method. The ether is subsequently purified by treatment with sulphuric acid which precipitates ammonium sulphate, and after filtering this off, the ether is distilled from potassium carbonate. The paper concludes with tests for various impurities in ether. If containing so-called oil of wine, the ether on shaking with water becomes cloudy. Sulphuric or acetic acid is detected by saturating with an alkaline carbonate, and testing the aqueous solution for sulphate or acetate. In both these cases the ether reddens blue litmus. The presence of alcohol is shown by the colouration with a crystal of magenta or by heating with iodine and an alkali when crystals of iodoform separate out on cooling. Aldehyde is detected by means of ammonia as above, and the presence of water is shown by shaking with dry copper sulphate which turns blue with a trace of water. Pure ether having a pleasant aromatic taste and a refreshing exhilarating smell, boils at 34·5° C., and has a sp. gr. 0·720 at 15°. It should not give any of the tests above mentioned, and may be used with safety as an anæsthetic.—T. A. L.

### *The Purification of Ether.* Lassar-Cohn. Annalen, 1895, **284**, 226—232.

In Boas' method for the estimation of lactic acid in the gastric juice, pure ether must be used, free from alcohol and other substances, capable of yielding aldehyde, when extracted by water and subsequently oxidised by boiling with manganese dioxide and sulphuric acid. In spite of numerous trials the author has failed to prepare ether fulfilling strictly the above requirement. The best results were obtained by boiling commercial ether under an inverted condenser for 24 hours with an alloy of potassium and sodium. This alloy, it may be mentioned, is much superior to either metal alone, in so far that it is fluid at low temperatures, and not liable to become crusted over with a protective layer of hydrate, &c. The ether, after fractionation, the first and last portions being rejected, gave no

coloration with Nessler's solution; but when tested by the extraction and oxidation method, a distinct turbidity was obtained after 3—4 minutes' boiling, equivalent (as found by quantitative analysis) to 0·001 per cent. of aldehyde.
—H. T. P.

### *Preparation of Pure Ethyl Bromide.* Adrian. Monit. Scient. **8**, 1894 (November), 834.

The author mentions various methods for the production of this substance, since its discovery by Sérullas in 1829, who obtained it by the action of bromine, hydrobromic acid, and phosphorus bromide on alcohol. According to the officinal method, 12 parts of sulphuric acid and 7 parts of alcohol are mixed in a flask, cooled with water, and 12 parts of potassium bromide are gradually added. The flask is then connected with a condenser, and, after 24 hours, is heated on a sand-bath at 125° C. The oil which distils over is collected in a receiver under water in order to retard loss by evaporation, and, after washing with a 5 per cent. potash solution, it is washed with 3—4 times its bulk of water, dried by means of fused calcium chloride, decanted after 24 hours into a tubulated retort together with 10 per cent. of sweet-almond oil, distilled from a water-bath at 39° C., and kept in the dark. The product so obtained is pure according to the *Codex Medicamentarius*, and has the following properties:—It is a colourless very refrangent liquid with a neutral reaction, has an alliaceous odour, boils at 38·5° C., and a sp. gr. 1·473; it is insoluble in water, but miscible with alcohol and ether. The author finds, however, that the method of purification is not sufficient, as several samples obtained from different sources all contain sulphuric ether, in some cases even as much as 15 per cent. In view of the importance of the product as an anæsthetic, he describes a method by which all traces of sulphuric ether may be removed and a perfectly pure product obtained. This depends upon the following test for ether by means of sulphuric acid. A sample of ethyl bromide suspected to contain ether is placed in a test tube and warmed to 20°. A few drops of sulphuric acid are then added and the liquid is shaken. The rise in temperature is a measure of the amount of ether present, and if the proportion present is 15 per cent., the temperature rises to about 34° C., and vigorous ebullition results. The ether forms a compound with the sulphuric acid which is insoluble in ethyl bromide, and this property is made use of in the purification method proposed, which is carried out as follows:—Well-cooled ethyl bromide, after drying with calcium chloride, is agitated with a small quantity of sulphuric acid. The oily drops which collect on the surface of the bromide are separated by means of a tap-funnel, and the product, after having been washed with dilute alkali, is distilled with oil as mentioned above. This process gives pure ethyl bromide, which does not become warm when mixed with sulphuric acid.—T. A. L.

### *Observations on American Oil of Turpentine.* J. H. Long. J. Amer. Chem. Soc. **16**, 844—847.

Continuing his former researches (this Journal, 1893, 544), the author has distilled six samples of crude turpentine from the spruce pine (*P. glabra*). The average specific gravity of the distilled oil, at $\frac{20°}{4°}$ was 0·862, and the odour, colour, and boiling points were also normal. The angles of rotation in the 200 mm. tube varied from $-63·1°$ to $-70·333°$, thus confirming the author's former suggestion that the $-$ rotation (or low $+$ rotation) sometimes found in American oil of turpentine may be due to the presence of the product from spruce trees. By fractionating the oil, it was found that the amount of rotation is greatest in the first and less in the higher fractions.

Berthelot showed that, by heating in a sealed tube, dextro-rotatory American oil is changed into an oil with higher boiling point and $-$ rotation. The author heated a fraction of one of the above distillates in a sealed tube to 280° for 2 hours, which reduced the rotation from $-69·133°$ to $-15·33°$. On further heating, the oil became yellowish and somewhat viscid, and the boiling point was raised considerably. The distillate smelled of oil of lemons, and the author concludes that it must be identical with Berthelot's isoterebenthene obtained from the lævo-rotatory French oil.
—L. A.

### *Scopolamine.* E. Schmidt. Arch. Pharm. 1894, **232**, 409.

In a previous communication (this Journal, 1893, 60) the author assigned to scopolamine the formula $C_{17}H_{21}NO_4$, and demonstrated its presence in *Scopolia atropoïdes* and other plants. It was also shown that Merck's hyoscine consisted mainly of scopolamine, and that hyoscine, $C_{17}H_{23}NO_3$, which Ladenburg isolated from the seeds of henbane, and considered to be isomeric with atropine and hyoscyamine (derived from the same source) is, in reality, identical with scopolamine. Whether a third alkaloid of the composition attributed to hyoscine exists in henbane seeds, &c., must be left in abeyance. Hitherto the author has failed to detect such a body. *Hyoscinum hydrojodicum verum*, a preparation introduced commercially by Merck, had *not* the composition of hyoscine hydriodide, $C_{17}H_{23}NO_3.HI$, but of the scopolamine salt, $C_{17}H_{21}NO_4.HI$.

*Scopolamine picrate*, $C_{17}H_{21}NO_4.C_6H_3(NO_2)_3O$, crystallises in fine yellow needles melting at 187°—188° C. By the action of methyl or ethyl iodide and acetyl or benzoyl chloride on scopolamine, the corresponding methyl-, &c. derivatives are readily obtainable. The action of the two latter reagents on atropine and hyoscyamine was also investigated. With acetyl chloride no reaction takes place in either case; but benzoyl chloride attacks both alkaloids, the respective mono-derivatives being sometimes identical, sometimes different, according as the conditions of experiment favour the transformation of hyoscyamine into atropine, or not. Acetic anhydride exerts simply a dehydrating influence on atropine and hyoscyamine, both yielding the same base, $C_{17}H_{21}NO_2$, identical with apo-atropine. Under similar conditions, scopolamine appears to yield a mixture of *aposcopolamine* and an acetyl derivative. Whilst ordinary scopolamine is strongly lævo-rotatory, and melts at 59° C., the author has also obtained a modification melting at 55°—56° C., the hydrobromide of which is almost optically inactive, and which is provisionally designated *i-scopolamine*.
— H. T. P.

### *Sterilisation of Cellars, Floors, Vats, &c. by Means of Formaldehyde Vapour, and its Behaviour towards Yeasts and Bacteria.* W. Windisch. Wochenschr. f. Brauerei, **11**, 1894, 1531.

*See under* XVII., *page* 290.

## PATENTS.

### *Improvements in the Extraction and Purification of Tannin.* O. C. Hagemann, New York, U.S.A. Eng. Pat. 24,273, December 16, 1893.

The finely divided raw material (nut-galls, sumach, &c.) is digested with amyl alcohol at 60°—70° C., and the tannin recovered from the alcoholic solution, either by evaporation in a vacuum—accompanied by the recovery of the amyl alcohol—or by treatment of the solution with some three times its volume of water, which will dissolve the tannin from the amyl alcohol. A third method of separating the tannin from the alcohol is to precipitate it by the addition of benzine or some other hydrocarbon solvent which will mix with amyl alcohol but will not dissolve tannin. For this separation to be effective, the amyl alcohol solution should contain not more than 25 per cent. of tannin, and the amount of hydrocarbon added should be equal to, or twice, the volume of the solution. The amyl alcohol should retain the chlorophyll, fats, waxes, and most of the gallic acid in solution.—A. G. B.

### *The Manufacture or Production of Acid Compounds derived from Gallic Acid Anhydrides.* H. E. Newton, London. From The Farbenfabriken of F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 1228, January 19, 1894.

The solubility of tannin in the juices of the stomach, and the consequent injurious effect produced when this material is exhibited, necessitate the employment in medicine of such tannin compounds as are only dissolved, and *pari passu* decomposed, with liberation of tannin, when they reach the alkaline fluid of the intestines. The conditions here indicated are satisfied by the mono- or diacetylated derivatives of the gallic anhydrides. These are insoluble in water, and are not altered by dilute acids at low temperatures, but dissolve in cold, dilute solutions of alkali carbonates, being slowly converted into gallic anhydrides or gallic acids. They are, in general, produced by treating the gallic anhydrides ("tannin and α- and β-digallic acid"), if necessary in the presence of a solvent or diluent, with a slight excess of acetic anhydride, acetic chloride, or acetic acid, adding, if desirable, a so-called condensing agent, such as phosphorus chlorides, phosphorus oxychloride, sodium acetate, acid sulphates, or the like.

For example, 1 part of dry tannin is mixed with ½ part of glacial acetic acid and 1 part of acetic anhydride, and the mixture is heated. After 6—7 hours the dark mass is poured in a thin stream into water, which is continually stirred. The resinous mass which separates, is washed with water until it becomes a light yellow powder, and the washings show no colour. The product is mainly a monacetyl derivative, containing a little diacetyl derivative. It is precipitated unchanged from its cold solutions in an alkaline carbonate on the addition of an acid, but on heating with alkalis it is decomposed. Consequently, such a compound would pass through the stomach without producing any effects, not being decomposed until it reached the intestine. —A. G. B.

### *Improvements in the Production of Ozone and in Apparatus therefor.* A. Schneller, Leyden, and W. J. Wisse, Haarlem, Holland. Eng. Pat. 5656, March 17, 1894.

*See under* XI., *page* 279.

### *A New Process of Producing Oxybenzylic Alcohols and their Homologues.* L. Lederer, Munich, Germany. Eng. Pat. April 5, 1894.

This process depends on the fact that, under proper conditions, the phenols react with formaldehyde in the sense of the following equation:—

$$C_6H_5OH + CH_2O = C_6H_4(OH)CH_2OH.$$

One part of phenol and 1½ parts of formic aldehyde (as commercial aqueous solution) are allowed to remain in contact with milk of lime either at the ordinary temperature or at 60° C. Samples are examined from time to time, and when no further formation of oxybenzylic alcohol is to be observed, the liquid is acidified with acetic acid, unaltered phenol distilled over with steam, and the oxybenzylic alcohol extracted by means of ether. Zinc powder may be substituted for milk of lime.

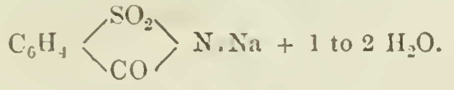
The homologues of phenol, and substituted phenols, may be similarly converted into the homologues and substituted derivatives of oxybenzylic alcohols.

In this way the patentee prepares the following alcohols:—Ortho- and para-oxybenzylic alcohols, $C_6H_4(OH)CH_2OH$. "Oxymethyl-1:2-benzylic alcohol," $C_6H_3(CH_3)(OH)CH_2OH$, which melts at 40° C. and dissolves in alcohol, ether, and benzene. "Oxymethyl-1:3-benzylic alcohol," which melts at 116° C. and is very slightly soluble in benzene. 1:4:2 Oxymethylbenzylic alcohol, which melts at 107° C., and dissolves in alcohol, ether, and hot benzene. 1:4:3-Oxymethylbenzylic alcohol, which melts at 133° C. and dissolves in hot alcohol and acetone. "Oxymethylpropyl-1:5:2-benzylic alcohol," melting at 78° C., and very soluble in alcohol, ether, benzene, and petroleum ether. "Oxymethoxyallyl-1:2:4-benzylic alcohols," (*a*) melting at 37° C., soluble in alcohol, ether, and benzene, but moderately soluble in gasoline. It has a bitter taste and acid properties, and behaves as an anæsthetic and an antiseptic; (*b*) melting at 87° C., very soluble in ether, moderately soluble in benzene and alcohol in the cold, readily when heated.—A. G. B.

### *The Manufacture and Production of a New Crystallised Compound of Anhydro-Orthosulphamine Benzoic Acid.* J. Y. Johnson, London. From F. von Heyden Nachfolger, Dresden, Germany. Eng. Pat. 22,726, November 23, 1894.

The most frequent impurity in commercial saccharine (anhydro-orthosulphamine benzoic acid) is para-sulphamine benzoic acid, which has an acid or sour taste and may constitute 40 per cent. of the so-called pure saccharine. Since saccharine is a white or dirty white powder devoid of any characteristic appearance, it lends itself to adulteration with a variety of substances which cannot be detected by inspection; for example, powdered sugar, which is 500 times cheaper than saccharine, is a frequent adulterant. The inventor prepares a crystalline form of saccharine, which he calls "crystallose," and which forbids adulteration, on account of the ease of detecting such by inspection.

*Crystallose* is the sodium derivative of anhydro-orthosulphamine benzoic acid, and has the formula—



$$C_6H_4\left\langle {SO_2 \atop CO} \right\rangle N.Na + 1 \text{ to } 2\ H_2O.$$

The taste of it is about $\frac{4}{5}$ as sweet as that of the free acid. When pure, it forms colourless, transparent crystals, readily soluble in water. The addition of hydrochloric acid to its aqueous solution precipitates anhydro-sulphamine benzoic acid.

To manufacture Crystallose, raw toluene sulphone-amide is dissolved in soda lye in an open vessel, the solution filtered, and the bulk of the amide reprecipitated by the addition of an acid; the reason for leaving a little sulphone-amide in solution is that this portion consists almost entirely of the parasulphone-amide, the portion first precipitated being nearly pure orthosulphone-amide. The precipitated amide is dissolved in hot water containing lime, whereby it becomes a calcium salt. Permanganate of potash is added to this liquid with constant stirring, until the pink colour, which is at first rapidly bleached, disappears slowly. The liquor is now filtered and the filtrate neutralised by hydrochloric acid. Concentration over steam, until a sample crystallises on cooling, now follows, in order that the potassium chloride and potassium para-sulphamine benzoate may crystallise. The mother-liquor is then acidified with hydrochloric acid and the precipitate of anhydro-orthosulphamine benzoic acid is filtered, washed, and dissolved in hot water containing a little soda; this solution is decolorised by animal charcoal whilst still hot, and then allowed to cool, whereupon well-formed crystals of crystallose should separate.

Processes for preparing crystallose from pure or nearly pure anhydro-orthosulphamine benzoic acid and from the mixture known as "saccharinum purum" in the trade, are also described.—A. G. B.

### *Improvements relating to the Curing of Tobacco and Analogous Substances, and to Apparatus therefor.* H. Neill, London. From H. A. Wickham, Cooktown, Australia. Eng. Pat. 24,381, December 11, 1894.

Instead of allowing the substance to ferment in heaps or stacks in a shed or drying-room, and then bulking, as hitherto practised, the tobacco or other substance is placed in a closed box or chamber and fermented therein under pressure, continuously maintained during the shrinkage by suitable springs, and without contact with the external air or influences. The tobacco is put in immediately after harvesting and partial drying, with a small quantity of already fermented tobacco to start the fermentation if necessary, and sufficient pressure is applied, not only to expel the greater part of the air from the mass of the substance, but also to liberate the juices and oils, which then permeate the whole bulk. Air is admitted if necessary, but the quantity can be regulated so as to prevent putrefaction. A temperature of between 60° and 80° F. should be maintained, as the rate of curing is slower at lower temperatures, although practically the same quality of product is obtained. The time taken, varies from two to six or seven months, but the tobacco may be left in the boxes for a year or more with advantage.—A. W.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*Pyroxylin, its Manufacture and Applications.* W. D. Field. Part III. J. Amer. Chem. Soc. 1894, **16**, 543—549.

The author gives a historical survey of the various solvents used and proposed for preparing collodion, celluloid, &c. The solvents for pyroxylin can be grouped chemically as follows:—Two of the monohydric alcohols, compound ethers of the fatty acids with monohydric alcohols, aldehydes, simple and mixed ketones of the fatty series, and, unclassified, amyl nitrate and nitrite, methylene dimethyl ether, ethidene diethyl ether, amyl chloracetate, nitro- and dinitrobenzene, coumarin, camphor, glacial acetic acid, and mono-, di-, and tri-acetin. They may also be divided into those which are solvents without the aid of heat or solution in alcohol, and those which are solvents when dissolved in alcohol or heated to their melting points. From the point of view of the properties of the solutions, these solvents may also be divided into hygroscopic and non-hygroscopic. The hygroscopic solvents—such as methyl alcohol, acetone, ethyl acetate, &c.—as they deposit the pyroxylin, absorb water, and this causes some of the pyroxylin to be deposited on the film as a white cloud. In some cases this cloudiness extends entirely through the film. The non-hygroscopic solvents deposit the pyroxylin in transparent films.

The acid mixture and method of nitrating has much to do with the action of the solvents. The influence of *uncombined* water in the acid mixture, of the immersion temperature, and of the relative proportions of nitric and sulphuric acid, is very great. The effect of the water is different according to whether it is added to the mixture of the acids, or weaker acids employed, so that the ultimate proportion of water in the nitrating liquid is the same. With two liquids containing the same ultimate percentage of water, the pyroxylin produced from that in which the free water is added mechanically, is generally more soluble in methyl alcohol, and less so in non-hygroscopic solvents; whereas, if the water is used in the combined form (*i.e.*, as more dilute nitric acid), the solubility in the non-hygroscopic solvents is increased, that in the hygroscopic solvents diminished. The film of the pyroxylin from the liquid containing the mechanically-added water is much more contractile, *i.e.*, dries to a much smaller bulk, than that of pyroxylin made by the all-acid liquid.—L. T. T.

### PATENTS.

*Improvements in or relating to Appliances for the Manufacture of Photographic Films.* T. H. Blair, and The European Blair Camera Company, Limited, London. Eng. Pat. 4627, March 5, 1894.

Hitherto, photographic films in rolls or long lengths have usually been manufactured by pouring the solution from a suitable hopper on to a table, or in some more recent instances on to the periphery of a revolving drum. This drum has to be of large diameter, in order to have sufficient distance from the point of application to the stripping point, for the film to form and dry, also the solution is apt to "run" on the cylindrical surface. In this invention the drum is dispensed with, and a belt or band carried on suitable pulleys employed. This band is made of thin metal or other suitable material, and may be coated on its under surface with fibre, rubber, &c., or the pulleys themselves may be coated in order to prevent slipping. Heating arrangements for drying, and a mechanical device for ejecting the "dope" or emulsion evenly on to the band, are described and claimed.—J. C. C.

*Improvements in the Preparation, Packing, and Storing of Photographic Chemical Compounds.* J. R. C. Gale, Sutton, and J. W. T. Cadett, Ashtead, Surrey. Eng. Pat. 4689, March 6, 1894.

Chemical compounds suitable for developing photographic images, are mixed with sufficient water, glycerin, gum, gelatin, or other media, and the mixture stirred or beaten until it assumes the consistency of a paste or cream, which is packed in any suitable receptacle, so as to be in a condition for immediate use.—J. C. C.

*Improvements in and connected with the Removal of the Fixing Agent from Photographic Plates and the like.* A. Zimmermann, London. From The Chemische Fabrik auf Actien vormals E. Schering, Berlin, Germany. Eng. Pat. 5561, March 16, 1894.

The reagent employed is a dilute solution of persulphate of potassium or ammonium, preferably made slightly alkaline, this renders any residue of hyposulphite harmless by oxidation.—J. C. C.

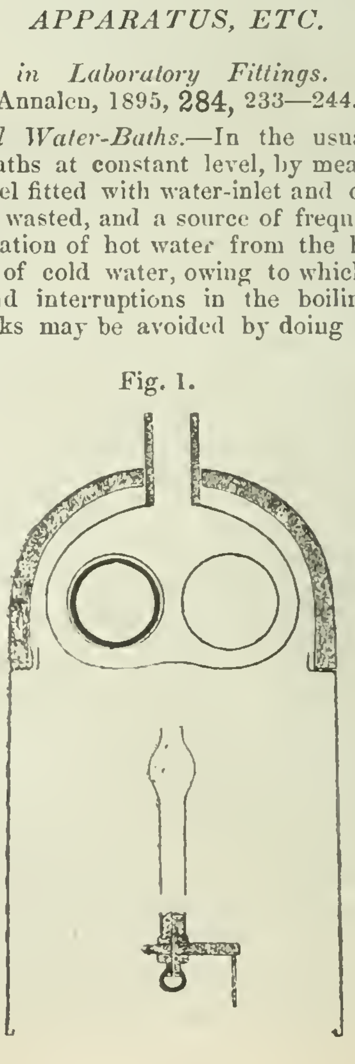
## XXIII.—ANALYTICAL CHEMISTRY.

### *APPARATUS, ETC.*

*Improvements in Laboratory Fittings.* J. Volhard. Annalen, 1895, **284**, 233—244.

*Constant-Level Water-Baths.*—In the usual method of maintaining baths at constant level, by means of a small subsidiary vessel fitted with water-inlet and overflow pipes, much water is wasted, and a source of frequent annoyance is the regurgitation of hot water from the bath, and subsequent inrush of cold water, owing to which variations in temperature and interruptions in the boiling may occur. These drawbacks may be avoided by doing away with the

Fig. 1.



overflow pipe altogether, and simply connecting the various baths to a relatively large water reservoir placed at a suitable level.

*Tube Oven (for Heating Sealed Tubes).*—The author employs an oil-bath of novel construction, a cross section of which is shown in Fig. 1. It consists of a copper boiler 56 cm. in length, of oval section, fitted with two tubes closed at one end by screw caps, open at the other. The boiler is provided with three tubulars, one for filling, the others for the reception of a small inverted condenser and a thermometer (Fig. 2). This condenser is connected to the boiler by a forked pipe, one of the branches of which is provided with a two-way tap. The boiler rests in a sheet-iron tray, and is covered with a dome of the same material lined with fireclay (Fig. 1). The sealed tubes to be heated are enclosed in stout wrought-iron tubes—closed by a screw-plug at one, by a screw-cap at the other end—that slide readily into the bath. To further minimise the risk attending possible explosions, the open ends of the oven tubes can be covered by an iron frame suspended from suitable brackets (Figs. 3 and 4). In operation, the boiler is charged with petroleum oil and heated to boiling, the distillate being collected, through the side tube of the condenser, in a separate vessel. During this proceeding the temperature of the oven, of course, steadily rises; but it may be maintained absolutely constant at any desired point, by simply allowing the condensed oil to flow back into the boiler.

Fig. 2.

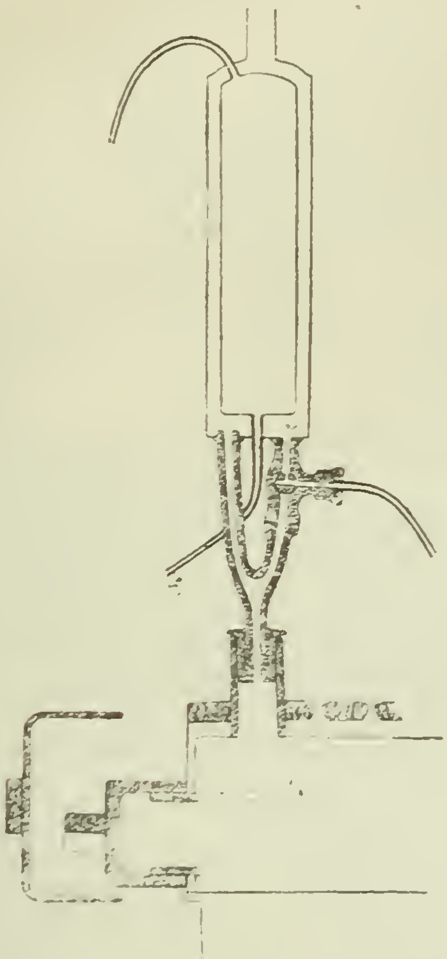


Fig. 3.

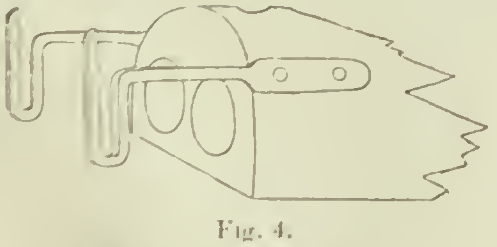
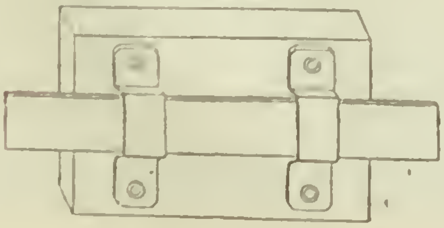


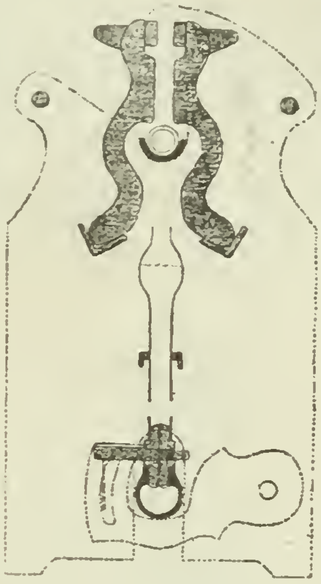
Fig. 4.



From ordinary petroleum, one-fifth distils over at 200° C., two-fifths at 250° C., three-fifths at 285° C., and two-thirds at 300° C. If temperatures above 250° C. be frequently required, the various fractions may with advantage be preserved separately. For temperatures near 100° C., toluene may be added to the petroleum.

*An Improved Combustion Furnace* (Fig. 5).—The improvement consists mainly in the use of tiles placed almost vertically and fitting closely round the combustion tube, in the manner shown in the drawing. By this means the flame is compelled to strike round and strongly heat every part of the tube, whilst the lower portions of the tiles, being almost vertical, reflect comparatively little heat on to the burner tubes.

Fig. 5.

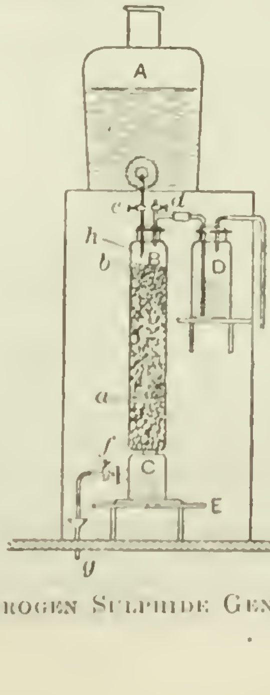


This furnace will give a far more intense heat than the ordinary Erlenmeyer form; whilst under identical working conditions the gas consumption is only about one-half.

—H. T. P.

### *Hydrogen Sulphide Generator.* H. G. Schanche. J. Amer. Chem. Soc. 16, 868.

The form of generator shown in the figure has been found, during seven years' use, to yield a uniform supply of gas.

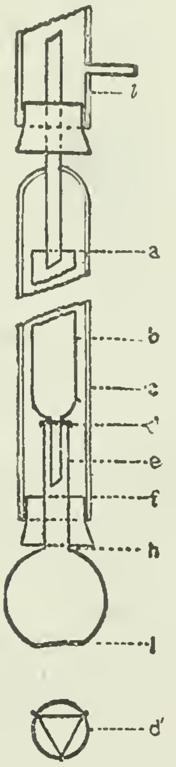


Hydrogen Sulphide Generator.

The acid reservoir A, delivers the acid into the generator B, containing ferrous sulphide resting on coarse pebbles. The ferrous chloride solution drains into C, and can be tapped off by opening *d* and *f* when necessary. D is a washing bottle. By means of the tap *e*, the flow of acid can be regulated so as to supply the gas at any desired rate; whilst the height of the column of ferrous sulphide, through which the acid percolates, assures a uniform supply of gas and complete neutralisation of the acid. The shelf E is movable, to facilitate the removal of B for cleaning and recharging.—L. A.

### *Modification of Knorr's Extraction Apparatus.* Oma Carr. J. Amer. Chem. Soc. **16**, 868—869.

The tube *a b*, containing the substance to be extracted, rests upon a small triangle on the neck of the flask, as shown at *d*', and is enclosed by the inverted dome-shaped tube *c*, joined to the tube of the condenser *l*. The flask may be of any convenient size, with a neck long enough to protrude about two inches above the cork *f*; the neck is simply rounded in the flame, and not flanged. The apparatus should be sunk into a water-bath to a depth sufficient to prevent accumulation of the solvent upon the cork *f*, which obviously requires no previous extraction. On completion of the extraction, the cork is removed and the flask wiped and dried.



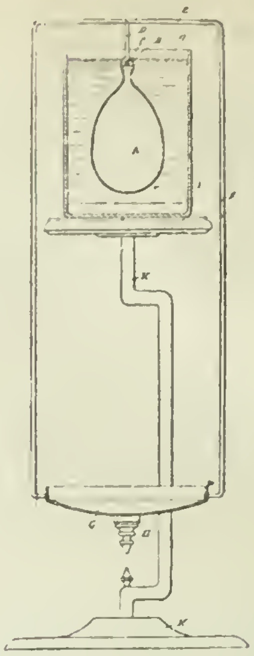
Extraction Apparatus.

—L. A.

## PATENT.

### *An Improved Float for Determining the Absolute Weight and Specific Gravity of Solid and Fluid Bodies.* T. Lohnstein, Berlin, Germany. Eng. Pat. 5686, March 19, 1894.

This consists in a stand K, supporting the cylinder I, which contains the liquid of which the specific gravity is required; in this liquid a glass bulb A floats; the neck of the bulb is ground quite flat, and is attached to the wire frame D E F, carrying a pan G, and a pointer H. By means of weights placed upon the pan G, the level of the float A is adjusted until the sharp edge of the top of the float exactly coincides with the surface of the fluid, thus eliminating the error due to capillarity. The instrument may also be used as a balance for determining the absolute weight of solid bodies.



Improved Float for Specific Gravity Determination.

—J. C. C.

## INORGANIC CHEMISTRY.—QUALITATIVE.

### *The Sensitiveness of Certain Zone-Reactions, and the Use of these Reactions in the Qualitative Tests for Acids.* H. Trey. Zeits. anal. Chem. 1894, **33**, 533—543.

The exact neutralisation necessary in applying the neutral silver nitrate test is troublesome and difficult if sodium carbonate be employed as the agent; yet it is not safe to add a slight excess of ammonia and boil to neutrality, because of the appreciable solvent action of the ammonium salts, which results from neutralisation of the free acid, upon the silver compound that should be precipitated, whereby the sensitiveness of the test becomes impaired. The author therefore describes a method of testing, which has been proved to simplify the operation. It consists in allowing a gentle stream of ammonia solution to flow down the walls of the test-tube containing a cold solution of the acid under examination, mixed with silver nitrate and nitric acid; a layer of ammonia thus rests upon an acid solution, and between the two there is a zone of neutrality in which the expected precipitate should form, the bulk and characteristics of the precipitate depending upon the proportion of the acid present. The reagents should be made up to twice normal strength, not to 10 per cent. solutions.

In applying these tests, the unknown substance is dissolved in water or acid, and mixed with an excess of sodium carbonate (or if insoluble, it is fused with dry sodium carbonate, and the fusion is extracted with water), and filtered if necessary. If tin or antimony be present, the substance must be boiled with nitric acid, precipitated with hydrogen sulphide, disregarding any undissolved matter, and filtered; the solution is then boiled to expel hydrogen sulphide, and neutralised as above. To the alkaline liquid excess of nitric acid is added; and then to the boiling solution, silver nitrate. Any precipitate of chloride, bromide, iodide, cyanide, ferro- or ferricyanide, or thiocyanate, is filtered off, after boiling well, to dissolve silver oxalate and to segregate the precipitate. The filtrate is cooled, and the ammonia is added in the manner already described, whereby phosphoric, arsenious and arsenic, chromic, oxalic, silicic, and boric acids are precipitated as silver salts. A second portion of the original sodium carbonate solution is acidified with hydrochloric acid, and tested with barium chloride for sulphates, seleniates, or silicofluorides; to the filtrate, calcium chloride is added, and then sodium acetate solution is introduced quietly, like the ammonia in the silver test, to ascertain the presence of hydrofluoric acid, or of chromic or oxalic acids, which latter should have been found already by the neutral silver nitrate test.

By making up normal solutions of the various acids to be examined, and diluting these, solutions ranging in strength from centinormal to one-millionth normal were prepared, and the sensitiveness of the neutral zone tests was determined with them. Boric and silicic acids gave a scarcely perceptible turbidity even with the centinormal solution. But each of the other acids in the neutral silver-nitrate group, gave a very clear band, varying in width with the strength of the solution, and clearly visible even in the one hundred-thousandth normal liquid; with the one-millionth normal solution a very thin veil-like turbidity was seen after standing for from 10 to 15 minutes, and this was proved by means of a blank test, not to have been due to the presence of hydrochloric acid in the ammonia used. Phosphoric, arsenic, and arsenious acids gave recognisable coloured bands of precipitate with millinormal, and chromic acid with one ten-thousandth normal solutions, the width of the precipitate zone for these acids and for oxalic acid being 1 to 2 mm. with centinormal liquids. With lead acetate, the chromic acid reaction is perceptible even in one hundred-thousandth normal solutions. The sensitiveness of the barium and calcium chloride test is markedly inferior, the limits being:—for chromic acid, one-thousandth normal; for oxalic acid, one-hundredth normal strength; and for silicic acid even less than this.—W. G. M.

### *The Detection of Small Quantities of Metallic Sulphides in Precipitated Sulphur.* R. Fresenius. Zeits. anal. Chem. 1894, **33**, 573—574.

As small quantities of cadmium, tin, or arsenic impart practically no colour to precipitated sulphur, their presence may be overlooked in qualitative analysis, unless a white precipitate with hydrogen sulphide be further examined just as if it were coloured. In order that time may be saved in the event of sulphides being absent, a rapid preliminary test may be made. A layer of benzene or petroleum ether, about 2 cm. deep, should be introduced into the test-tube containing the acidified liquid with the white precipitate. The mixture is vigorously shaken for a minute, the mouth of the tube being closed by the thumb, whereby the sulphur dissolves. The whole is then allowed to stand at rest for a minute; if any traces of metallic sulphides be present, they will then be seen forming a coloured pellicle between the two liquids, and on the walls of the tube above the solution; but in their absence, the upper liquid will be clear, and the lower one but slightly turbid. This test is only inapplicable in those rare cases, where the sulphur results from the passage of hydrogen sulphide gas into solutions containing sulphurous or nitrous acids or the like, and is therefore insoluble in the hydrocarbon; it never fails with sulphur precipitated by adding hydrochloric acid to ammonium or sodium sulphide containing polysulphides. If the presence of sulphides has thus been proved, the ordinary tests may be applied; or a larger quantity of the precipitate may be operated upon with the benzene as above, the solution being then poured through a moistened filter until the aqueous portion has completely drained away. The hydrocarbon can then be poured off, and will leave the sulphide adhering firmly to the filter paper, when it may be washed and examined in the usual way.—W. G. M.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Accuracy of the Commercial Assay for Silver.* F. P. Dewey. J. Amer. Chem. Soc. 1894, **16**, 505—516.

Whilst the fire assay for silver is generally considered to be very accurate, greater accuracy is very needful for commercial purposes. The three chief sources of loss in assaying are—(*i.*) from silver going into the slag, (*ii.*) from silver absorbed by the cupel, and (*iii.*) from volatilisation of silver. In dealing with rich materials, corrections are often applied to allow for these losses, and in the case of bullion, it has been sought to correct for all losses, by running a check assay as near as possible like the test. But even with such corrections or with poor ores (with which the error is not so great) the want of accuracy is very serious in works where large quantities of ore are worked. Thus, in an ore being worked by the Russell lixiviation process, the commercial assay gave 43·43 oz. to the ton, whilst in actual working 99·6 per cent. of the silver appeared to be recovered, together with a further 12·5 per cent. from the tailings. A re-assay, in which the slags and cupels were saved and assayed, showed an increase of 8 per cent. of silver, and the 4 per cent. still missing was probably accounted for by loss from volatilisation of silver during assay. Extended investigations have been carried out by the author, by the Russell Process Co., by H. E. Wood, and by the Dewey-Walter Co., on this subject, and a very large number of assays made.

In general, the percentage of inaccuracy of the ordinary commercial assay varies inversely with the value of the material assayed. This will be seen from the following abridged table, in which each set of figures is the average of a large number of assays of ores grouped according to 5-oz. periods:—

| Material. | Grade. | Commercial Assay. | Value in Slag and Cupel. | Corrected Value. | Percentage in Slag and Cupel. |
|---|---|---|---|---|---|
| | Oz. per Ton. | Oz. per Ton. | Oz. per Ton. | Oz. per Ton. | |
| Tailings...... | 1—5 | 2·8 | 0·7 | 3·5 | 18·0 |
| „ ...... | 5—10 | 7·8 | 1·4 | 9·2 | 15·2 |
| „ ...... | 10—15 | 12·2 | 1·8 | 14·0 | 13·0 |
| „ ...... | 15—20 | 18·0 | 1·7 | 19·7 | 8·6 |
| Roasted ore .. | 20—25 | 23·5 | 3·2 | 26·7 | 12·0 |
| „ .. | 25—30 | 27·3 | 3·5 | 30·8 | 11·4 |
| „ .. | 30—35 | 31·6 | 2·8 | 34·4 | 8·1 |
| „ .. | 35—40 | 36·8 | 3·2 | 40·0 | 8·0 |
| „ .. | 40—45 | 42·3 | 2·7 | 45·0 | 6·0 |
| Raw ore ..... | 20—25 | 24·2 | 4·6 | 28·8 | 16·0 |
| „ ..... | 25—30 | 27·7 | 3·5 | 31·2 | 11·2 |
| „ ..... | 30—35 | 31·8 | 3·8 | 35·6 | 10·7 |
| „ ..... | 35—40 | 37·5 | 3·3 | 40·8 | 8·1 |
| „ ..... | 40—45 | 43·5 | 3·3 | 46·8 | 7·1 |
| „ ..... | 45—50 | 45·5 | 2·4 | 47·9 | 5·0 |

The character of the ore influences the results. In three kinds of ores—(*i.*) base containing 75 per cent. sulphurets, (*ii.*) partially oxidised, and (*iii.*) completely oxidised carrying from 16·5 to 36·6 oz. silver per ton—the per cent. of silver found in the slag and cupels were (*a*) by scorification: (*i.*) 5·7, (*ii.*) 8·2, (*iii.*) 9·8; and (*b*) by crucible assay: (*i.*) 6·8, (*ii.*) 7·8, and (*iii.*) 11·3. Generally the loss in assay is greater with roasted than with raw ores. In assays by scorification of a large number (144) of rich ores, the loss ranged from 4·17 per cent. for ores, under 500 oz. to the ton to 1·26 per cent. for ores of 17,000—17,500 oz. The average cupel and slag absorption on the 144 lots was 2·03 per cent. of the total contents.

The following is recommended for assays of sulphides:—"Weigh out one-twentieth of an assay-ton of sulphide, 55 grms. of granulated test-lead, and 2—3 grms. of fused borax. One-half of the lead is put in the bottom of the scorifier and hollowed out; the sulphides are put into the hollow, and the rest of the lead poured over them; the borax is then placed on the top. The assay is then conducted in the usual way. The slag and cupel are ground up and assayed, and the result added to the main assay."

The following table gives the range of inaccuracy as averaged from a large number of assays:—

| Material. | Grade Value. | Range of Inaccuracy (Value in Slag and Cupel). | Average Inaccuracy. |
|---|---|---|---|
| | | Per Cent. | Per Cent. |
| Tailings ............... | 1—20 | 18·0— 8·6 | 13·7 |
| Washed ore ........... | 15—35 | 13·0—10·0 | 10·4 |
| Raw ore ............... | 20—50 | 16·0— 5·0 | 9·7 |
| Roasted ore............ | 20—45 | 12·0— 6·0 | 9·1 |
| Lead carbonate ........ | 50—100 | 5·1— 2·6 | 3·8 |
| Base sulphides ........ | 1,000—5,500 | 5·0— 1·8 | 3·0 |
| Regular sulphides ..... | 2,000—16,000 | 2·8— 1·2 | 1·7 |
| Copper-silver bullion, 300 "fine." | .. | 2·0 | 2·0 |
| Fine bullion, 999·3 "fine." | .. | 1·1 | 1·1 |

Separate estimations of the slag and the cupel silver showed no regularity in the ratio between them, but the cupel silver is generally much greater than the slag silver. In only two cases out of 29 was the cupel silver less than 1 oz. per ton, and in only two cases was the slag silver over 1 oz. per ton.

Straight assay of the nearly-proof silver gave 987, corrected for slag and cupel absorption it became 998·5, and with a check assay to correct for volatilisation 999·3 fine.

If the percentage of inaccuracy is considered on the whole material assayed it is found to be somewhat irregular, but generally follows the silver contents of the material, and with rich materials become very large. Thus in 2·3-oz. tailings the 21 per cent. loss is only 0·0017 per cent. of the total, but in a 17,500 oz. sulphide the 1·26 per cent. loss is equivalent to 0·756 per cent. of the total. This point is illustrated by the following table:—

| Material. | Grade. | Silver per Cent. of Total. | Inaccuracy per Cent. | |
|---|---|---|---|---|
| | | | of Silver. | of Total. |
| | | | Per Cent. | |
| Tailings ........ | 2·3 | 0·0079 | 21·8 | 0·0017 |
| Ore ............. | 20·3 | 0·0696 | 8·9 | 0·0062 |
| " ............. | 30·5 | 0·1011 | 5·0 | 0·0051 |
| " ............. | 31·0 | 0·1063 | 13·0 | 0·0138 |
| " ............. | 49·0 | 0·1680 | 8·8 | 0·0148 |
| Base sulphides.. | 431·0 | 1·477 | 8·6 | 0·12602 |
| " " .. | 5,078·0 | 17·41 | 2·2 | 0·38302 |
| Regular " .. | 5,538·0 | 18·98 | 8·4 | 1·59432 |
| " " .. | 10,698·0 | 36·33 | 1·5 | 0·54495 |
| " " .. | 15,046·0 | 51·58 | 1·2 | 0·61896 |
| " " .. | 17,500·0 | 60·00 | 1·26 | 0·756 |

In dealing with large quantities of ores these inaccuracies are very serious, making the checking of the mill working very difficult. The correction for slag and cupel ought always to be made, and it is very desirable that some means should be found of applying a correction for volatilisation. Though the fire assay still leaves much to be desired no better wet assay is available.

Assays of the same material made by different assayers, or by the same assayer at different times, occasionally vary considerably, but in the aggregate agree pretty closely.

—L. T. T.

### *Volumetric Determination of Phosphorus in Steel.* W. A. Noyes and E. D. Frohman. J. Amer. Chem. Soc. 1894, 16, 553—559.

The method described by Dudley and Pease (this Journal, 1894, 665) is very rapid and easy, but there is some difference (amounting to about 10 per cent.) between different operators as to the factor to be used for converting the iron equivalent of the permanganate into the phosphorus equivalent. If, as v. der Pfordten maintains, the reduction of the molybdic anhydride is to $Mo_2O_3$ the factor should be 0·01538. Wernckc states that the reduction is to $Mo_{12}O_{19}$, which gives the factor 0·01628. Dudley and Pease give the empirical factor 0·01724, whilst Doolittle and Eavenson give (this Journal, 1894, 666) 0·0160. The authors have carefully examined the reduction of $MoO_3$, and find that $Mo_2O_3$ is produced, but that this becomes very quickly partially re-oxidised unless the air is carefully excluded. The factor should therefore be 0·01538, and test analyses of samples of steel containing known percentages of phosphorus showed that this factor gave very accurate results, which were more correct than when any of the other factors were used.—L. T. T.

### *Method for Quantitative Separation of Arsenic, Antimony, and Tin.* W. Hampe. Chem. Zeit. 1894, 18, 1900—1901.

The three elements are first obtained as mixed sulphides by any of the known methods; the bulk of the precipitate is then transferred to a small beaker, the smallest possible quantity of recently prepared ammonium sulphide is poured over the residue clinging to the filter, and the solution is allowed to run into the beaker containing the precipitate. After nearly the whole of the latter is dissolved, the solution is acidified with hydrochloric acid, oxidised with potassium chlorate and, when most of the chlorine has passed off, mixed with sufficient tartaric acid and filtered. Excess of ammonia is now added, and should produce no precipitate if sufficient tartaric acid has been used—a larger proportion of this acid is required when tin is present. The arsenic is precipitated from this concentrated solution by means of magnesia mixture, and the precipitate is redissolved in hydrochloric acid and re-precipitated by ammonia. The two filtrates, mixed, are acidified and treated with hydrogen sulphide gas; and the mixed antimony and tin sulphides are dissolved in a minimum quantity of freshly-prepared sodium sulphide, and decomposed by gradual additions of sodium peroxide; the latter being taken from the interior of the box in which it is supplied, as the outside portions often contain traces of tin dissolved from the tin-plate of the case. As soon as the solution is colourless, and foams from the evolution of oxygen, on the further addition of peroxide, it is boiled, and then mixed with one-third of its volume of alcohol (sp. gr. = 0·833), and allowed to stand for 24 hours; in this way, the whole of the antimony is separated as sodium pyro-antimoniate, which is filtered off, washed first with diluted alcohol 1 : 1, and then with alcohol mixed with one-third of its volume of water, all the washing liquids containing a few drops of soda solution. The pyro-antimoniate is dissolved in a mixture of hydrochloric and tartaric acids, and precipitated with hydrogen sulphide; the bulk of the precipitate is heated in a current of carbon dioxide gas and weighed, the residue on the filter is redissolved in ammonium sulphide, the solution being then evaporated to dryness in a crucible, and the residue oxidised with nitric acid, ignited, and weighed. The filtrate from the pyro-antimoniate is evaporated to expel alcohol, acidified, and precipitated with hydrogen sulphide. The tin sulphide is ignited, cooled, treated with a few grains of ammonium carbonate, re-ignited, and weighed. When the precipitate is very bulky, it is first re-dissolved in ammonium sulphide and re-precipitated by sulphuric acid to ensure complete separation of fixed alkalis. If the original substance contain a comparatively great excess of antimony, the process may be varied by dissolving the three sulphides together in sodium (instead of ammonium) sulphide, and treating at once with the peroxide, by which the arsenic is converted into sodium arseniate, and does not interfere with the precipitation of the pyro-antimoniate. But the arsenic cannot be satisfactorily recovered from the filtrate without previous re-precipitation as sulphide, as ammonium-magnesium arseniate is distinctly soluble in ammoniacal sodium tartrate solutions. The process gives accurate results, and is far simpler than the existing methods of separation.

—W. G. M.

### *The Determination of Phosphoric Acid by the Molybdate, Magnesia Method.* B. W. Kilgore. J. Amer. Chem. Soc. **16**, 793—795.

To test the method recommended by the American Association of Official Agricultural Chemists for 1894, three samples were sent to various agricultural and commercial chemists for analysis. One of the samples was a solution of pure sodium phosphate (10 grms. of $Na_2HPO_4.12H_2O$ per litre). The theoretical percentage of $P_2O_5$ in this salt is 19·826; the results reported varied from 19·74 to 20·67, the average of the whole 34 determinations, made by 28 chemists, being 20·09 per cent. The tendency seems, therefore, to be towards high results. From a study of the reports sent in by each chemist, the author concludes that the high results are due to the presence of an excess of magnesia in the precipitate; and that correct results may be obtained either by re-dissolving and re-precipitating the magnesia precipitate, or by adding a little citric acid before precipitating with magnesia mixture.—L. A.

### *The Analysis of American Refined Copper.* H. F. Keller. J. Amer. Chem. Soc. **16**, 785—789.

"LAKE" copper, owing to its relative purity, always commands a higher price than copper from other localities, being generally preferred for electrical purposes. But of late years, owing to improved methods of refining, the quality of the copper made from sulphide ores has become equal, if not superior, to that of the native copper. Silver and iron are the chief impurities of the latter, while electrolytic copper not infrequently contains small quantities of bismuth, antimony, arsenic, selenium, and tellurium. That the exact manner in which these elements affect the physical properties of copper is not better understood, may be attributed to the want of a sufficiently rapid, and at the same time, accurate method of analysis. The author refers to the older methods of Hampe and Fresenius; he then describes in detail Hampe's new method (see this Journal, 1894, 421). After dissolving the copper and diluting, he passes sulphur dioxide without filtering, and eventually filters off the insoluble portion altogether; it may contain gold, silver, silver chloride, selenium, tellurium, lead sulphate, and traces of bismuth and antimony, occasionally also copper. The dry mixture is detached from the filter, and the latter is destroyed with fuming nitric acid. The rest is then added, and treated with nitric acid until completely oxidised. After evaporating on the water-bath, to remove excess of nitric acid, silver is precipitated as chloride by adding hydrochloric acid. From the filtrate, selenium and tellurium are thrown down by warming with hydroxylamine chloride. In the cold, this reagent has no effect, but on warming, a reddish turbidity is observed, which gradually collects in the form of dark flakes. These are collected on a tared filter, and dried at 105°—110°. The author has not effected a complete separation of the two elements. Gold, lead, and traces of antimony and bismuth are determined by the ordinary methods. The method described is in other respects the same as on page 421.

—L. A.

### *The Determination of Copper; and the Determination of Antimony in Antimonial Pyrites.* T. C. Cloud and G. J. Rogers. Australasian Assoc. for the Advancement of Science, 1893.

THE authors describe the methods in use in the laboratory of the Wallaroo smelting works. For estimating copper, 1 grm. of ore is mixed successively with 10 drops of strong sulphuric acid, 1 drop of hydrochloric acid (to precipitate silver), and 10 cc. of strong nitric acid. Mixture is aided by a rotary motion given to the containing beaker, and when the first vigorous action is over, the beaker is warmed on a steam-bath until fumes cease to be evolved, and all sulphur is oxidised, which latter readily happens if the liquid be not boiled. The cover and sides of the beaker are rinsed with distilled water, and the liquid is evaporated on the sand-bath until fumes of sulphuric acid appear, the caked residue having been previously broken up. After cooling, 100 cc. of nitric acid are added (one part of strong acid to 120 parts of $H_2O$), and then, without filtration, the solution is electrolysed. A flat spiral platinum wire anode is supported so that it almost (but not quite) touches the bottom of the beaker. The platinum cylinder cathode is maintained about $\frac{1}{8}$th of an inch above the spiral, and the level of the liquid in the beaker should be $\frac{1}{4}$ in. below the top of the cylinder. A definite time should be allowed for electrolysis (12 hours for 0·5 grm. copper), and this should not be greatly exceeded, or the texture of the deposit will suffer. After the allotted time is past, the sides of the beaker are rinsed with hot water, and the appearance of the portion of the cathode thus newly immersed is noted. If no fresh deposit of copper is seen, the action is complete, and the liquid in the beaker should be twice replaced with fresh water by means of a siphon, without breaking contact. The cathode is then well washed with water, and finally with alcohol, which is burned off; and the cylinder is weighed after suspension for 20 minutes in the balance case. If bismuth be present to the extent of 1 per cent. of the copper, the deposit will be darkened, whilst with larger quantities it is spongy. In such a case the bismuth must be separated before electrolysis; the ore is dissolved in aqua regia, evaporated dry, taken up with hydrochloric acid, filtered, and precipitated with hydrogen sulphide. The sulphides are oxidised with a minimum quantity of nitric acid (1 : 1), and the solution is nearly neutralised with ammonia; then ammonium carbonate and ammonia are added, and the copper is electrolysed from the filtered liquid, after acidification with nitric acid and evaporation to a convenient bulk. Arsenic and antimony should also be removed by precipitating the copper with hydrogen sulphide in caustic soda solution. Selenium and tellurium are similarly removed, while silver is precipitated as chloride and filtered. The battery consists of four cells of the Meidinger type, joined in series, each having an inner cylinder of lead 11 in. high and 2 in. in diameter, with the lower end slit and the two halves splayed out, and a ring of zinc 4 in. deep and $4\frac{1}{4}$ in. in diameter suspended in the upper portion of the cell. The lead cylinder is filled with crystals of copper sulphate, and the outer space with saturated solution of magnesium sulphate. The battery is got into working order at first by leaving it for 24 hours on closed circuit, and it must not be left on open circuit for longer than a day, or the copper solution will diffuse upwards to the zinc cylinder; when not in use it should be put on closed circuit for half an hour per diem. One cell every week, taken in rotation, is cleaned up, and the deposit of copper is detached from the lead cylinder. Four cells yield a current of 2 volts and 0·1—0·15 ampère (no external resistance specified).

The antimony determination is a combination of methods proposed by Clark (this Journal, 1891, **10**, 444), and Paul (this Journal, 1893, **12**, 64). 0·5 grm. of finely-crushed ore is weighed into a $4\frac{3}{4}$ in. porcelain dish and covered with a funnel with bent stem; 5 cc. of a ferric chloride solution (20 grms. of the chloride in 100 cc. strong HCl) is added, and 20 cc. of strong hydrochloric acid. After heating on a water-bath for half an hour, the funnel-cover is washed down with a little hot water, and the solution evaporated down to from 7 to 10 cc.; another 20 cc. of hydrochloric acid is now introduced, and evaporation carried to the same extent; and this is finally done a third time. But care must be taken not to continue the evaporation at any time until all the hydrochloric acid is expelled, or antimony trichloride will be lost also. A few drops of tartaric acid and 20 cc. of water are next added to the solution, which is then filtered into a 500 cc. beaker, the residue being washed with hot water. The filtrate is warmed with 2 cc. of saturated ammonium bisulphite solution (to reduce ferric salts) until all smell of sulphur dioxide has ceased. After dilution to 250 cc., hydrogen sulphide is passed through the heated solution until the precipitate becomes dense and granular, when the excess of $H_2S$ is expelled by carbon dioxide, and the precipitate is filtered on a weighed Gooch crucible, washed with hot water containing a little hydrogen sulphide, drained, dried, and treated in Paul's oven at a temperature of 220°—230° C. for half an hour in a gentle stream of carbon dioxide. Results are accurate when tested against those obtained by Fresenius' method; and an estimation may be completed in one working day.—W. G. M.

### *Iodide Assay for Copper.* E. D. Peters. Eng. and Min. J. 1895, **59**, 124.

A description of the well-known iodide method for wet copper assay, written by A. H. Low for the forthcoming edition of "Modern American Methods of Copper Smelting," is communicated, as correspondence, by E. D. Peters, jun. The process varies very little from that ordinarily practised. After dissolving the copper in nitric acid, the solution is rendered strongly alkaline with ammonia, heated to boiling for a minute to ensure the neutralisation of the nitric acid in the nitrate of copper, which is essential, and then re-acidified with acetic acid. The iodide is then added, and the titration conducted in the usual way. The writer of the description states that hyposulphite solution made of pure crystals and distilled water will keep, without any appreciable variation in strength, for a month, or longer.

In the treatment of ores by this process, one gramme is treated with hot strong nitric acid, to which is then added strong hydrochloric acid. After boiling, strong sulphuric acid is added, and the volatile acids evaporated off. After diluting, the sulphate of lead, &c. is filtered off, and the solution, which should not exceed 75 cc., is run into a beaker, at the bottom of which is a strip of aluminium 3 in. long, 1½ in. wide, and turned up at the ends so that the body of the strip can lie flat. The copper is all precipitated after boiling for six or seven minutes. The liquor is filtered off, and the loose and adherent copper is all dissolved in a little nitric acid. To this is added half a gramme of chlorate of potash, to fully oxidise any arsenic present, and the solution boiled down to small bulk, but not sufficiently low to produce a basic salt of copper. The solution is then neutralised with ammonia, &c., as before described, and titrated in the usual manner. Results are given showing the accuracy of this method, which is fully equal in this respect to the electrolytic method, and which requires very much less time.

The above scheme removes all interfering impurities, or renders them inert. Zinc is not such a good precipitant for the copper as aluminium, as some iron is also carried down even from strongly acid solutions. When aluminium is used, the precipitation may be effected without boiling by adding a little hydrochloric acid to the solution, but this is not so desirable as the method described. For the success of the titration it is essential that no free nitric acid or nitrate of copper be present. Cold ammonia in excess does not, apparently, entirely decompose the latter, hence the necessity for boiling.—A. W.

### *Analysis of Lead Glance and Argentiferous Lead with the Aid of Hydriodic Acid.* W. Hampe. Chem. Zeit. 1894, **18**, 1899—1900.

The hydriodic acid extraction method for lead ores, as described by Benedikt and Gans (this Journal, 1892, 181, and Chem. Zeit. 1892, **16**, 4, 12), even when the extraction is repeated, is apt to give low results, and to be both more lengthy and less accurate than the aqua regia method. But their iodide determination is the most accurate of the wet processes for the estimation of silver. Solutions of lead and silver nitrate made up to correspond to those of lead samples containing 0·0005, 0·01, and 0·1 per cent. of silver respectively, gave correct results, the weight of precipitated silver iodide varying from 0·0218 to 0·2185 grm. In actual use, from 10 to 100 grms. of the argentiferous lead are dissolved in dilute nitric acid free from chlorine, the nitric acid being in slight excess (by about 10 cc.). Tartaric acid is added when antimony is present. More than sufficient potassium iodide to precipitate the whole of the silver is now added, but excess of the reagent is to be avoided. The solution is now heated in a covered beaker until all the iodine liberated by the action of the nitric acid has been expelled and the solution is colourless. The silver iodide is then filtered off and weighed, either directly or after conversion into chloride.—W. G. M.

### *The Commercial Valuation of Lead-Tin and Lead-Antimony Alloys.* J. W. Richards. J. Amer. Chem. Soc. 1894, **16**, 541—543.

Lead-tin alloys (principally used for soft solders, tinfoil, &c.) and lead-antimony alloys (hard lead) are best tested commercially by determining their specific gravities. Lead has a density of 11·33, tin 7·43, and antimony 6·65. When tin is added to lead the density falls, though not uniformly. It is the same on adding antimony, except that with 1 per cent. thereof the alloy is heavier than lead, with 2 per cent. it is just the density of lead, and above that figure the gravity decreases as with tin; no homogeneous alloy of antimony and lead can be obtained containing more than 24 per cent. of antimony. To obviate the usual troublesome and delicate specific gravity determinations, J. Richards has proposed to weigh bullets cast in a standard mould. The balance used is of the yard-arm form, the long arm being graduated on one side for every 1 per cent., from pure lead to pure tin, on the reverse side for from 2 to 24 per cent. of antimony. The graduations are made by casting bullets of carefully made known alloys. The alloy to be tested has simply to be melted, a bullet thereof cast in the standard mould and weighed, and the quality directly read off on the beam. Accuracy to half a per cent. is attainable, and is quite sufficient as absolute homogeneity in these alloys is impossible. In casting, care must be taken to commence with the mould cold, and to continue pouring till the bullet sets to avoid the formation of a shrinkage cavity. The whole test need not take more than five minutes.—L. T. T.

### *A Method for Determining Calcium Oxide in Quicklime.* W. E. Stone and F. C. Scheuch. J. Amer. Chem. Soc. **16**, 721—725.

This method depends upon the facts that calcium oxide is considerably soluble in a 10 per cent. solution of sucrose at the ordinary temperature, whilst silica, alumina, ferric oxide, magnesia, and calcium carbonate are not soluble to any appreciable extent. The dissolved lime can be accurately titrated with standard hydrochloric acid. These facts were verified by experiments. It was also ascertained that 150 cc. of a 10 per cent. solution of sucrose was sufficient to completely dissolve 1 grm. of pure lime in the cold; but if the liquid be heated an insoluble compound is formed, which dissolves on cooling. Von Lippmann states (*Die Zucker-Arten*, 148) that magnesia is freely soluble in a solution of lime in sucrose, but an experiment showed that when ½ grm. each of magnesia and lime were shaken together with 150 cc. of 10 per cent. sucrose solution, no magnesia, but all the lime, was dissolved. The following process was therefore devised:—About 1 grm. (accurately weighed) of the finely powdered sample is shaken for 20 minutes with 150 cc. of a 10 per cent. solution of sucrose, at the ordinary temperature; the liquid is filtered, and the clear filtrate titrated with standard hydrochloric acid. Following are the results of assays of six samples of quicklime by this method, also the total lime in each sample determined by ordinary gravimetric analysis; the differences are attributed to small amounts of calcium carbonate in the samples.

| Sample No. | CaO per Cent. by Sucrose Method. | CaO per Cent. by Ordinary Method. | Difference. |
|---|---|---|---|
| 1 | 92·12 | 93·00 | 0·88 |
| 2 | 91·90 | 92·28 | 0·38 |
| 3 | 92·15 | 93·10 | 0·95 |
| 4 | 95·01 | 95·90 | 0·89 |
| 5 | 87·30 | 87·70 | 0·40 |
| 6 | 91·70 | 92·30 | 0·60 |

—L. A.

### *The Gunning Method for Total Nitrogen in Fertilisers.* W. E. Carrigues. J. Amer. Chem. Soc. 16, 795—799.

The Gunning method, modified to include nitrates, gives low results in the presence of nitrates; this the author shows by experiments made according to the directions of the Association of Official Agricultural Chemists, which are quoted, as follows, from Bulletin 38, United States Department of Agriculture:—

"In a digestion flask holding from 250 to 500 cc., place from 0·7 to 2·8 grms. of the substance to be analysed, according to the amount of nitrogen present. 10 grms. of potassium sulphate, 5 grms. of sodium thiosulphate, and 30—35 cc. of the salicylic acid mixture, *i.e.*, 30 cc. of sulphuric acid to 1 grm. of salicylic acid, are then added, and the whole digested at a low temperature until frothing ceases," &c.

The low results are attributed to adding the potassium sulphate at such an early stage, the large quantity of dry powder protecting the sample for some time from the proper action of the acid. The salicylic acid mixture should first be added to the sample in the flask, which should then be shaken until the liquid has thoroughly wetted the dry organic matter, and allowed to stand for about 15 minutes. The thiosulphate is added next, in 4 or 5 portions, with constant shaking, waiting until each portion has dissolved before adding the next. Lastly, the potassium sulphate is put in, and the whole is well agitated and proceeded with in the usual manner. Analyses are given showing that by working in this way results are obtained which agree very closely with those yielded by the Kjeldahl process. Neither process gave results sufficiently accurate for the valuation of sodium nitrate, the results being variable and always low; it is therefore recommended to report the highest figure in closely agreeing duplicates, instead of the customary average.—L. A.

### *The Acidimetry of Hydrogen Fluoride.* T. Haga and Y. Osaka. Proc. Chem. Soc. 1895 [147], 22.

The authors have separately examined the behaviour of the usual indicators in the neutralisation of hydrofluoric acid. That its alkali salts blue litmus, and that its avidity number places it among the vegetable acids rather than with the strong mineral acids, appear to be the only two facts yet recorded bearing upon its acidimetry.

To get uniform indications it was found necessary to have not only the acid pure, but the titrating solutions also; a little silica, alumina, or carbon dioxide affecting the titration more than it would in the case of the ordinary mineral acids.

*Phenolphthaleïn* is the best indicator, and leaves nothing to be desired when potash or soda is used for the titration. *Rosolic acid* is almost equal to it, and can be used besides with ammonia. With both indicators the change of colour has the advantage of being very evident in platinum vessels.

Both *cochineal* and *brazil-wood* infusions give satisfactory results. Brazil-wood paper shows alkalinity before all the acid is neutralised, and cannot, therefore, be used. *Turmeric paper* gives fairly good results. *Methyl orange* is useless.

*Litmus, lacmoïd* and *phenacetolin* are all capable of being made to yield accurate results in the hands of an experienced person. Some peculiarities in the behaviour of litmus are described in the paper, which suggest the conclusion that the molecule of hydrogen fluoride may be $H_3F_3$ or $H_4F_4$.

### *The Volumetric Determination of Manganese.* J. Keddrop and H. Ramage. Proc. Chem. Soc. 1895 [148], 33.

The authors have examined a method proposed by L. Schneider (this Journal, 1888, 693), in which the manganese salt is oxidised by bismuth peroxide in presence of nitric acid to permanganic acid. After filtration through asbestos, the permanganic acid is determined by titration with hydrogen peroxide. The best strength of nitric acid is 250 cc. (sp. gr. 1·2) per litre, but the permanganic acid decomposes in the acid solution, and to prevent this decomposition, it is filtered into an excess of hydrogen peroxide, and finally titrated with potassium permanganate. It is shown that the error in Schneider's method is at least 0·6 per cent. in the analysis of ferromanganese, and 0·06 per cent. in that of steel.

Sodium bismuthate prepared from materials free from chlorine, replaces the bismuth peroxide used by Schneider. It is prepared by fusing soda, basic bismuth nitrate, and sodium peroxide; on washing with water the insoluble compound remains.

The analysis of ferromanganese, spiegel, silico spiegel, iron, and steel are described in detail, and the accuracy of the method established by experiments on quantities of manganese ranging from 0·1 per cent. to 80·7 per cent. In a sample of ferromanganese, they obtained by the ordinary gravimetric method, using ammonium salts and correcting for impurities, 80·63 per cent.; by Pattinson's method, 80·70 per cent.; by the present method, 80·67 per cent. Chromium, copper, nickel, and cobalt up to 5 per cent., are shown to raise the results but very slightly. Sulphuric acid up to normal strength does not interfere, and may therefore be used to expel hydrochloric acid from solutions in which it has been used in dissolving the sample.

The oxidation, filtration, and titration may by this method be completed within 15 minutes.

### *How to Use Plumbago Crucibles.* J. A. Walker. Eng. and Mining J. 1895, 59, 127.

*See under X., page 278.*

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *The Adulterations of Cochineal Carmine and their Detection.* E. Donath. Dingler's Polyt. J. 294, 188.

The author has already shown (Chem. Zeit. 1891, Nos. 30 and 40) that in addition to starch, clay, and brick-dust, several substances are used for the adulteration of cochineal carmine, noticeably the lead oxide and alumina lakes of eosine, which are of little value, and the baryta lake of the red coralline (peonine), which is scarcely to be distinguished from the genuine substance. It is also possible that certain red azo colouring matters, such as Biebrich scarlet and Ponceau scarlet, may be used. Such adulterations are easily detected with but little chemical examination. Genuine cochineal carmine is completely soluble in ammonia, and in this is distinguishable from certain other animal colouring matters used for rouge. The odours given off by the different substances when heated on the lid of a porcelain crucible are also characteristic. That from genuine cochineal carmine resembles the smell from proteid substances decomposed by heat, whereas the eosine lake smells like bromine and the peonine lake like phenol. The baryta lake of Biebrich scarlet gives a peculiar odour, which can be easily distinguished from that of genuine carmine. Finally, the substance is burnt in a crucible, and the ash, which in cases of adulteration will be considerably larger than in the genuine substance, is subjected to a qualitative analysis. With regard to the composition of genuine cochineal carmine, see this Journal, 1893, 256.

—C. A. M

## DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (*Continued from page* 195.)

A. Lehne and A. Rusterholz. Färber Zeit. 1891 *et seq.*

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| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 40.<br>Chrysoïdine.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre and liquid bright red; on addition of water—both orange.<br>*Dil.*:—Heated—fibre redder, liquid deep orange; with excess of ammonia—almost colourless. | *Conc.*:—Fibre immediately red, then brown, and finally yellow; liquid yellow.<br>*Dil.*:—Fibre redder, liquid orange; heated—fibre brighter. | *Conc.*:—Fibre and liquid brown; on addition of water—fibre brighter, liquid red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid yellow.<br>*Dil.*:—Heated—fibre brighter, liquid bright yellow; acidified—orange. | Extracts colouring matter on boiling; solution yellow; on acidification—orange. | Almost decolorised on heating. | Same as ammonia. | .. .. |
| 41.<br>Orange II. [B.]<br>Orange No. 2.<br>β-Naphthol-orange.<br>Tropäoline 000 No.2.<br>Mandarine.<br>Mandarine G extra.<br>Chrysaurein.<br>Golden orange. [By.]<br>Orange extra. [C.]<br>(*Animal fibre.*) | *Conc.*:—Fibre scarlet, liquid faint red; on addition of water—fibre again orange, liquid reddish.<br>*Dil.*:—Heated—liquid orange; with excess of soda—reddish. | *Conc.*:—Fibre ponceau-red, liquid red: after a while, fibre again orange, liquid red; on addition of water—fibre bright yellow, liquid orange.<br>*Dil.*:—Slowly heated—fibre red, liquid reddish, fibre suddenly citron yellow, liquid colourless; with excess of soda—again yellow. | *Conc.*:—Fibre and liquid carmoisine red; on addition of water—fibre bright orange, liquid brick-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre brownish-red; liquid the same on addition of water.<br>*Dil.*:—Fibre redder, heated—liquid rose; acidified—orange. | Heated—liquid faint yellowish-red. | Heated—decolorised immediately. | .. .. | Heated with ammonium acetate—liquid orange: on addition of excess of soda-lye—rose. |
| 42.<br>Orange G. [A.] [M.] [B.]<br>(Orange yellow.)<br>Orange GG. [C.]<br>(*Animal fibre.*) | *Conc.*:—Liquid reddish-orange; on addition of water—fibre brighter.<br>*Dil.*:—Heated—liquid orange; almost decolorised by excess of soda-lye. | *Conc.*:—Fibre brighter, liquid reddish-orange.<br>*Dil.*:—Liquid orange. | *Conc.*:—Liquid orange; on addition of water—fibre brighter.<br>*Dil.*—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre deep red, liquid orange.<br>*Dil.*:—Fibre brick-red, liquid rose; acidified—intense orange. | Heated—liquid orange. | Heated—immediately decolorised. | .. .. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 43.<br>Orange R. [Bi.] [C.]<br>Orange T. [K.]<br>Mandarine G R. [A.]<br>Kermesine orange [L.]<br>(*Animal fibre.*) | *Conc.*:—Fibre deep red, liquid rose; on addition of water—again orange.<br>*Dil.*:—Heated—liquid brick-red. | *Conc.*:—Fibre immediately deep red, then again orange, liquid rosaniline red; on addition of water—fibre bright orange, liquid orange.<br>*Dil.*:—Heated—fibre at first deep red, then bright orange; liquid at first red, then faint orange, with excess of soda-lye—yellow. | *Conc.*:—Same as concentrated hydrochloric acid.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—On addition of water after heating—fibre dark brick-red, liquid orange.<br>*Dil.*:—Heated—fibre deep red, liquid yellowish-red. | Heated—liquid brick-red. | Heated—fibre decolorised. | Colouring matter extracted on boiling. | .. .. |
| 44.<br>Ponceau 2 G. [A.] [B.] [M.]<br>(*Animal fibre.*) | *Conc.*:—Fibre red; heated—liquid red; on addition of water—fibre again orange.<br>*Dil.*:—Heated—liquid rose, decolorised by excess of soda lye. | *Conc.*:—Fibre and liquid red; on addition of water—fibre again orange.<br>*Dil.*:—Heated—fibre and liquid red. | *Conc.*:—Heated—fibre deep-red, liquid scarlet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid brick-red, on acidification, bluish-red. | Heated—liquid brick-red. | Heated—completely decolorised. | .. .. | .. .. |
| 45.<br>Brilliant Orange. [M.]<br>Ponceau 4 GB. [A.]<br>Crocein orange. [M.]<br>Orange G R X. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre red, liquid faint red.<br>*Dil.*:—Heated—liquid bluish rose; with excess of soda-lye—faint orange. | *Conc.*:—First red, then bright orange, liquid faint bluish-red; on addition of water—liquid almost decolorised.<br>*Dil.*: Fibre red, liquid brownish-red. | *Conc.*:—Fibre and liquid red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid intense brick-red. | .. .. | On heating—quickly and completely decolorised. | Hardly any perceptible action. | With bleaching powder—fibre at first bluish, then decolorised. |
| 46.<br>Toluylene Orange G. [O.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brown, liquid colourless; on addition of water—original colour restored to fibre.<br>*Dil.*:—No action. | *Conc.*:—Fibre and liquid reddish-violet; on addition of water—fibre and liquid colourless.<br>*Dil.*:—Heated—fibre brighter. | *Conc.*:—Fibre rosaniline red; on addition of water—again orange.<br>*Dil.*:—No action. | *Conc.*:—Heated—fibre redder.<br>*Dil.*:—Heated—fibre redder, liquid colourless. | .. .. | Fibre decolorised on heating. | .. .. | .. .. |
| Toluylene Orange R. [O.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre pale red.<br>*Dil.*:—Fibre redder, liquid colourless. | *Conc.*:—Fibre at first pale reddish violet, then dirty bluish-grey, liquid faintly red; on addition of water—fibre bleached.<br>*Dil.*:—Fibre at first redder; heated—colourless. | *Conc.*:—Fibre reddish-brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | No action | .. .. | Fibre redder; heated—slowly decolorised. | .. .. | .. .. |

## Detection of Artificial and Natural Colouring Matters on the Fibre—*continued.*

| — | Hydrochleric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 48.<br>Acid Yellow D. [A.]<br>Diphenylamine Orange.<br>Diphenyl Orange.<br>Orange IV. [B.]<br>Tropäoline O O. [C.]<br>Orange M. [Bi.]<br>Jaune d'Aniline.<br>Acid Yellow.<br>Orange G S.<br>New Yellow. [By.]<br>Orange N. [B.]<br>(*Animal fibre.*) | *Conc.:*—Fibre and liquid at first reddish-brown, then violet.<br>*Dil.:*—Fibre reddish-brown; heated—reddish-violet; liquid same (but colour more intense); with excess of soda lye—colourless. By rinsing with water—colour again restored. | *Conc.:*—Fibre and liquid at once reddish-violet, then red; on addition of water—fibre and liquid reddish-violet; with an excess of ammonia—colourless. Fibre bright yellow on rinsing with water. | *Conc.:*—Fibre and liquid at first dark brown, then dark violet; on addition of water—liquid intensely reddish-violet.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—No action.<br>*Dil.:*—Heated—liquid yellow; acidified—violet. | Same as dilute soda-lye. | Warmed—fibre reddish-brown to violet; boiled quite colourless. | Colouring matter extracted on boiling—yellow solution passing into violet on addition of sulphuric acid. | .. .. |
| 49.<br>Congo Orange R. [A.]<br>(*Vegetable fibre.*) | *Conc.:*—Fibre immediately bluish-grey, liquid colourless; on addition of water—fibre brownish.<br>*Dil.:*—Heated—fibre dirty flesh colour. | *Conc.:*—Fibre reddish-violet, liquid red; on addition of water—fibre and liquid decolorised.<br>*Dil.:*—Fibre violet-grey, liquid colourless; heated—fibre decolorised, liquid rose; with excess of soda lye, colourless. | *Conc.:*—Fibre blue, liquid colourless; on addition of water—both reddish violet.<br>*Dil.:*—Fibre dirty violet. | No action | .. .. | Fibre pale violet: heated—colourless. | .. .. | .. .. |
| 50.<br>Benzo-orange. [By.] [A.]<br>(*Vegetable fibre.*) | *Conc.:*—Fibre blue, liquid colourless.<br>*Dil.:*—Fibre immediately pale blue. | *Conc.:*—Fibre and liquid at first violet, then fibre dark blue, liquid colourless.<br>*Dil.:*—Fibre at first pale blue; heated—colourless. | *Conc.:*—Fibre and liquid dark navy-blue.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Fibre red, liquid colourless.<br>*Dil.:*—Heated—fibre red, liquid rose; acidified—colourless. | .. .. | Fibre immediately pale blue; heated—colourless. | Extracts the colouring matter very slightly. | .. .. |
| 51.<br>Cloth Orange. [By.]<br>(*Animal fibre.*) | *Conc.:*—Fibre violet-black, liquid colourless; on addition of water—fibre dark reddish-brown.<br>*Dil.:*—Heated—fibre dark reddish-brown, liquid rose; with excess of soda-lye—reddish. | *Conc.:*—Fibre violet-black, liquid reddish-violet; on addition of water—fibre original colour, liquid orange.<br>*Dil.:*—Fibre immediately violet-black, liquid faint reddish-violet; heated—fibre bright brown, liquid orange. | *Conc.:*—Fibre blackish-violet, liquid violet; on addition of water—fibre and liquid dark brown.<br>*Dil.:*—Heated—fibre reddish-brown, liquid colourless. | *Conc.:*—Heated—fibre deep red, liquid reddish; on addition of water—fibre bluish-red, liquid intensely coloured.<br>*Dil.:*—Fibre bright red, liquid cherry-red: acidified—colourless. | Heated—liquid intense orange; with excess of soda-lye—cherry-red: acidified—colourless. | Cold—fibre dark brown: heated—almost decolorised. | Colouring matter extracted on boiling—solution golden yellow, becoming red on addition of soda-lye or hydrochloric acid. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride+ Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 52.<br>Acridine orange. [L.]<br>(*Animal fibre.*) | *Conc.:*—Fibre and liquid bright red; on addition of water original colour restored.<br>*Dil.:*—Heated—fibre redder, liquid rose: with excess of soda-lye—bright yellow. | *Conc.:*—Fibre brighter, liquid intense yellow.<br>*Dil.:*—Fibre and liquid bright yellow. | *Conc.:*—Fibre almost decolorised, liquid colourless; on addition of water—fibre and liquid red.<br>*Dil.:*—Heated—fibre and liquid rose; with excess of soda-lye—bright yellow. | *Conc.:*—Fibre bright yellow; on addition of water—fibre darker, liquid rose.<br>*Dil.:*—Fibre bright yellow; heated—liquid yellow; acidified—rose. | Heated—liquid yellow; acidified—rose; fibre unaltered. | Cold—fibre and liquid intense bluish-red; heated—fibre decolorised, liquid red. | Colouring matter extracted on boiling—solution yellow with green fluorescence; acidified—rose, fluorescence disappearing. | .. .. |
| 53.<br>Alizarine orange. Nitro-alizarine. [B.] [M.]<br>Alizarine O R. [By.]<br>Alizarine O G. [By.]<br>(*Animal fibre.*) | *Conc.:*—Fibre brighter; heated—liquid faint yellowish.<br>*Dil.:*—Heated—fibre and liquid orange (chromic mordant) or yellow (alumina mordant): with excess of soda—bluish red. | *Conc.:*—Liquid yellow; on addition of water—fibre yellow, liquid faint yellow.<br>*Dil.:*—Heated—fibre and liquid yellow. | *Conc.:*—Heated—fibre brighter, liquid reddish-brown or yellow (alumina mordant); on addition of water—fibre almost decolorised, liquid yellow.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Fibre somewhat darker, liquid Bordeaux red or yellow (alumina mordant).<br>*Dil.:*—Heated—liquid bluish-red; acidified—yellowish. | No action (chromic mordant).<br>Fibre darker (alumina mordant). | Fibre brighter on boiling, liquid intense golden yellow; finally fibre decolorised. | .. .. | Boiled with baryta water—fibre Bordeaux-red. |
| 54.<br>Fuchsine. [B.] [By.] [C.] [M.] Rubine. [A.] Magenta. Aniline Red. Roseine.<br>(*Animal and vegetable fibre.*) | *Conc.:*—Fibre at first ponceau, then orange, and finally yellow, liquid yellowish; on addition of water—fibre reddish-violet, then greyish-violet, liquid colourless.<br>*Dil.:*—Fibre darker; heated—liquid reddish, fibre pale violet. Original colour restored by washing. | *Conc.:*—Fibre immediately orange, then yellow, and finally yellowish-olive, liquid yellow; on addition of water—fibre again yellow.<br>*Dil.:*—Fibre at first ponceau, then orange, and finally yellow, liquid yellowish. | *Conc.:*—Same as concentrated hydrochloric acid.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Heated—fibre considerably brighter; on addition of water—decolorised.<br>*Dil.:*—Fibre brighter; warmed—colourless, liquid colourless. | Fibre decolorised. | Almost decolorised on boiling; colour partially restored by washing. | Extracts the colouring matter. | Decolorised by sodium sulphide. Fuchsine is distinguished from orchil and aurin as follows:—Amyl alcohol extracts a bluish-red colour (fuchsine), a yellow colour (aurine), a rose or violet colour (orchil).<br>On addition of ammonia to the alcoholic extract, fuchsine is decolorised, orchil becomes bluish-red, aurine remains unaltered. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 55.<br>Fuchsine S. [B.]<br>Rubine S. [A.]<br>Acid Fuchsine. [M.]<br>Acid Rubine.<br>Acid Magenta. [B.] [H.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid reddish; on addition of water—fibre redder.<br>*Dil.*:—Heated—liquid bluish red. | *Conc.*:—Fibre immediately dark Bordeaux to black, then greenish olive, liquid the same, and finally yellow.<br>*Dil.*:—Fibre darker; heated—yellow. | *Conc.*:—Fibre at first dark red, then reddish-brown, liquid the same; on addition of water—colour again restored, liquid bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre almost decolorised; on addition of water completely decolorised.<br>*Dil.*:—Fibre immediately decolorised; liquid on acidification bluish-red. Colour restored to fibre by dilute acid. | Fibre decolorised; colour restored by degrees on exposing fibre to the air. | Fibre unaltered by boiling, liquid intense bluish-red. | Slightly extracted on boiling. | .. .. |
| 56.<br>Phloxine. [B.]<br>Phloxine P. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre slowly decolorised; on addition of water—fibre decolorised.<br>*Dil.*:—Fibre brighter; heated—colourless, liquid colourless. | *Conc.*:—Fibre immediately yellow, liquid colourless.<br>*Dil.*:—Fibre decolorised by degrees. | *Conc.*:—Fibre at first scarlet, then orange, liquid reddish-yellow: on addition of water—fibre and liquid decolorised.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre dark violet; on addition of water—fibre brighter, liquid bluish-red.<br>*Dil.*:—Heated—liquid bluish-red with yellowish-green fluorescence; acidified—colour and fluorescence vanishes. | Same as dilute soda-lye. | Heated—immediately decolorised. | Very little colouring matter extracted by boiling. | Ammonium acetate extracts colouring matter on boiling (fluorescence); on addition of hydrochloric acid—colour and fluorescence destroyed. |
| 57.<br>Rose Bengal. [B.]<br>Rose Bengal N. [C.]<br>(*Animal fibre.*) | *Conc.*:—Fibre decolorised by degrees.<br>*Dil.*:—Heated—fibre decolorised; colour partially restored on rinsing. | *Conc.*:—Fibre immediately decolorised.<br>*Dil.*:—In the cold decolorised by degrees. | *Conc.*:—Fibre bright orange, liquid faint orange; on addition of water—fibre and liquid colourless.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre darker, liquid colourless; on addition of water—liquid faint bluish-red.<br>*Dil.*:—Heated—liquid bluish-red; acidified—colourless. | Extracts the colouring matter slightly. | Fibre completely decolorised in the cold. | .. .. | .. .. |
| 58.<br>Eosine A. [B.]<br>Eosine. [B.]<br>Eosine yellowish. [A.]<br>Eosine G G F. [C.]<br>Soluble eosine. [M.]<br>Eosine B.<br>Eosine A extra. [D.H.]<br>Eosine 3 J, 4 J extra. [L.]<br>(*Animal fibre.*) | *Conc.*:—Fibre orange.<br>*Dil.*:—Heated—fibre bright orange; with excess of soda-lye—liquid bluish-red with fluorescence. | *Conc.*:—Fibre immediately yellow; on addition of water—orange, liquid colourless.<br>*Dil.*:—Fibre orange; heated—fibre and liquid yellow. Exactly neutralised with ammonia—liquid intensely bluish-red; with excess of ammonia—faint yellowish-red. | *Conc.*:—Fibre at first scarlet, then orange, liquid faintly yellowish; heated—fibre yellow, liquid intensely yellow; on addition of water—fibre orange, liquid colourless.<br>*Dil.*:—Heated—fibre orange, liquid yellowish. In other respects, as with dilute hydrochloric acid. | *Conc.*:—Heated—fibre dark red, liquid colourless; on addition of water—liquid bluish-red.<br>*Dil.*:—Warmed—fibre orange, liquid bluish-red (strong fluorescence); acidified—colour and fluorescence destroyed. | Fibre yellow, liquid yellow with fluorescence. | Fibre orange-yellow, liquid pale yellow. | Eosine soluble in water—not extracted, if well dyed.<br>Eosine soluble in alcohol, easily extracted by absolute alcohol. | Hot aqueous ammonia extracts soluble eosines, forming a rose-coloured solution.<br>*Eosine G.* Boiled with 20—40 per cent. potash-lye, orange-red solution becoming on protracted boiling purple-red and finally blue, with strong green fluorescence. Colour and fluorescence unaltered by dilution. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 59.<br>Erythrosine B. [A.]<br>Erythrosine. [B.] [M.]<br>Erythrosine. D. [C.]<br>Pyrosine B. [Mo.]<br>Iodeosine B.<br>Rose B. à l'eau [Bi.]<br>Soluble primrose. D.H.<br>Eosine bluish.<br>Dianthine B.<br>Eosine J [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre orange.<br>*Dil.*:—Heated—fibre bright orange, liquid colourless; with excess of soda-lye—faint bluish-red.<br>Colour restored by rinsing. | *Conc.*:—Fibre immediately yellow, liquid yellowish; on addition of water—orange.<br>*Dil.*:—Fibre orange; heated—yellow. | *Conc.*:—Fibre at first scarlet, then orange, liquid faint orange; heated—fibre yellow; on addition of water—fibre orange, liquid reddish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre more bluish; on addition of water—liquid bluish-red.<br>*Dil.*:—Liquid immediately intense bluish-red; acidified—faint yellowish-red. | Same as dilute soda-lye. | Fibre orange on boiling. | .. .. | *Eosine B.* Boiled with potash-lye gives a bluish-violet solution with pale green fluorescence. On dilution—reddish-purple colour.<br>*Eosine B N.* Boiled with potash-lye—olive-green solution without fluorescence.<br>*Methyleosine* gives the same reactions as Eosine A. |
| 60.<br>Safranine T. [B.]<br>Safranine.<br>Safranine extra G. [A.]<br>Safranine S. [C.]<br>Aniline rose.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre and liquid blue; on addition of water—red.<br>*Dil.*:—Heated—fibre bluer, liquid reddish-violet; with excess of soda-lye—red. | *Conc.*:—Fibre immediately blue, liquid blue, then green, and finally yellowish-olive; on addition of water—yellow.<br>*Dil.*:—Fibre violet, then blue, liquid colourless; with excess of ammonia—reddish. | *Conc.*:—Fibre brownish-red; heated—green, liquid the same; on addition of water—both again blue, and finally violet.<br>*Dil.*:—Heated—fibre and liquid violet; with excess of soda-lye—red. | *Conc.*:—Fibre dark red; on addition of water—red.<br>*Dil.*:—Heated—liquid red; acidified—violet. | Same as dilute soda-lye. | Fibre decolorised on warming; liquid colourless. | Colouring matter extracted on boiling; solution fluorescent. | .. .. |
| 61.<br>Ponceau 2 R. [M.] [A.] [B.]<br>Xylidine red.<br>Xylidine ponceau.<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid red.<br>*Dil.*:—Heated—liquid red; with excess of soda-lye—colourless. | *Conc.*:—Fibre at first darker, then again brighter, and finally yellow.<br>*Dil.*:—Heated—fibre bright yellow, liquid colourless. | *Conc.*:—Fibre at first darker; on addition of water—brighter, liquid red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—On addition of water, with subsequent warming—liquid brownish-red.<br>*Dil.*:—Fibre almost decolorised, liquid brownish-red; acidified—bluish-red. | Fibre brighter | Fibre decolorised | Little action | .. .. |
| 62.<br>Ponceau 3 R. [M.] [A.] [B.]<br>Cumidine red.<br>Cumidine ponceau.<br>(*Animal fibre.*) | *Conc.*:—Fibre deep red; on addition of water—fibre as originally, liquid reddish.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda-lye—considerably brighter. | *Conc.*:—Fibre immediately Bordeaux, then yellow, liquid bluish-red.<br>*Dil.*:—Heated—fibre yellow, liquid colourless. | *Conc.*:—Fibre darker, liquid intensely red; on addition of water—fibre as originally.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—On addition of water after warming—fibre brownish-red, liquid the same.<br>*Dil.*:—Fibre brownish-red, liquid brick-red; acidified—bluish-red. | No action | Fibre decolorised | Very slightly extracted on boiling. | .. .. |

Detection of Artificial and Natural Colouring Matters on the Fibre—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 63.<br>Fast Red A. [B.]<br>Fast red.<br>Roccelline. [D.H.]<br>Rauracienne.<br>Cerasine.<br>Orcelline.<br>Rubidine.<br>(*Animal fibre.*) | *Conc.*:—Fibre dark red to Bordeaux; on addition of water—colour restored, liquid colourless.<br>*Dil.*:—Heated—liquid bluish-red, fibre unaltered. | *Conc.*:—Fibre immediately dark violet, liquid reddish-violet; after immediate addition of water—fibre as originally, liquid red. By protracted action of nitric acid—fibre orange, and on addition of water yellow.<br>*Dil.*:—Heated—fibre and liquid bright yellow; with excess of ammonia—intensely golden yellow. | *Conc.*:—Fibre dark violet, liquid intense bluish-violet; on addition of water—fibre as originally, liquid yellowish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre Bordeaux, liquid colourless; on addition of water—intensely dark red.<br>*Dil.*:—Fibre darker, liquid bluish-red; acidified—no alteration. | Colouring matter extracted on boiling. | Completely decolorised on warming. | Colouring matter extracted on boiling. | *Fast Red E* gives the same reactions. |
| 64.<br>Palatine red. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre darker, liquid bluish-red; on addition of water—fibre again brighter.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda-lye—faint yellowish-red. | *Conc.*:—Fibre and liquid at first reddish-violet, then scarlet, and finally orange; on addition of water—yellow.<br>*Dil.*:—Heated—fibre yellow, liquid colourless. | *Conc.*:—Fibre and liquid at first violet, then blue on addition of water—rosaniline red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre brownish-red; on addition of water—liquid brownish.<br>*Dil.*:—Fibre and liquid immediately brownish-red; acidified—bluish-red. | Colouring matter extracted on boiling—solution becomes bluer on acidification. | Fibre completely decolorised on warming. | .. .. | .. .. |
| 65.<br>Palatine Scarlet. [B.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid bluish-red.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda lye—yellowish. | *Conc.*:—Fibre and liquid at first dark-red, then brighter to orange; on addition of water—yellow, liquid brick red.<br>*Dil.*:—Liquid bluish-red; heated—fibre yellow, liquid colourless; with excess of ammonia—yellow. | *Conc.*:—Fibre deep red to Bordeaux, liquid intense rosaniline red; on addition of water—fibre as originally.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre reddish-brown, liquid yellow; on addition of water—fibre brighter.<br>*Dil.*:—Fibre immediately reddish-brown, liquid brown; acidified—intensely bluish-red. | Same as palatine red. | Immediately decolorised on warming. | .. .. | Distinguished from palatine red by the reaction with concentrated sulphuric acid. |
| 66.<br>Erica. [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Heated—fibre somewhat yellower; on addition of water as originally.<br>*Dil.*:—No action. | *Conc.*:—Heated—liquid somewhat more reddish; on addition of water—almost decolorised, liquid colourless.<br>*Dil.*:—Heated—fibre brighter. | *Conc.*:—Fibre pale reddish-violet; on addition of water—brighter and more yellowish.<br>*Dil.*:—No action. | *Conc.*:—Heated—fibre almost decolorised; on addition of water—as originally.<br>*Dil.*:—Fibre brighter. | .. .. | Immediately decolorised on warming. | .. .. | .. .. |

—A. R. L.

*Possible Impurities in Official Sulphuric Ether.* Adrian. Monit. Scient. **8**, 1894, 835.

*See under* XX., *page* 295

*Note on the Test for Strychnine.* W. P. Mason and J. W. Bowman. J. Amer. Chem. Soc. **16**, 824—825.

Solutions containing known weights of pure strychnine sulphate were evaporated to dryness on a water-bath, the residues were treated with a little strong sulphuric acid and severally tested with the oxidising agents named, to ascertain their relative delicacy. One quantity of each was also evaporated in a platinum dish and tested by Letheby's battery test; the dish being connected with the + pole of the battery, and the acid solution touched with a wire joined to the − pole, the strychnine colour instantly flashes out.

| Milligrammes of Strychnine Sulphate used. | Oxidising Agent used. | | | | | | Galvanic Test. |
|---|---|---|---|---|---|---|---|
| | $KMnO_4$ | $K_2Cr_2O_7$ | $PbO_2$ | $K_3FeCy_6$ | $MnO_2$ | $H_2CrO_4$ | |
| 0·500 | Very strong | Very strong | Fair | Strong | Strong | Very strong | Strong |
| 0·400 | ,, | ,, | ,, | ,, | ,, | ,, | Fair |
| 0·300 | ,, | ,, | Weak | ,, | ,, | ,, | Negative |
| 0·250 | ,, | ,, | Negative | ,, | ,, | Strong | ,, |
| 0·150 | Strong | Strong | ,, | ,, | ,, | ,, | ,, |
| 0·050 | ,, | Fair | ,, | Fair | ,, | Weak | ,, |
| 0·025 | ,, | Weak | ,, | ,, | Fair | Negative | ,, |
| 0·020 | Weak | Very weak | ,, | Weak | Weak | ,, | ,, |
| 0·015 | Very weak | Negative | ,, | Very weak | ,, | ,, | ,, |
| 0·010 | Negative | ,, | ,, | Negative | Very weak | ,, | ,, |

Letheby's test fails long before the bitter taste disappears. $MnO_2$, though the most delicate test, is slow, and the presence of a little organic matter masks its action. Preference is given to $KMnO_4$, but, owing to the colour of this reagent, it is recommended to make a parallel blank test with sulphuric acid alone.—L. A.

*Composition and Manufacture of Some Candle Material; also Determination of Melting Points.* W. E. Garrigues. J. Amer. Chem. Soc. **16**, 825.

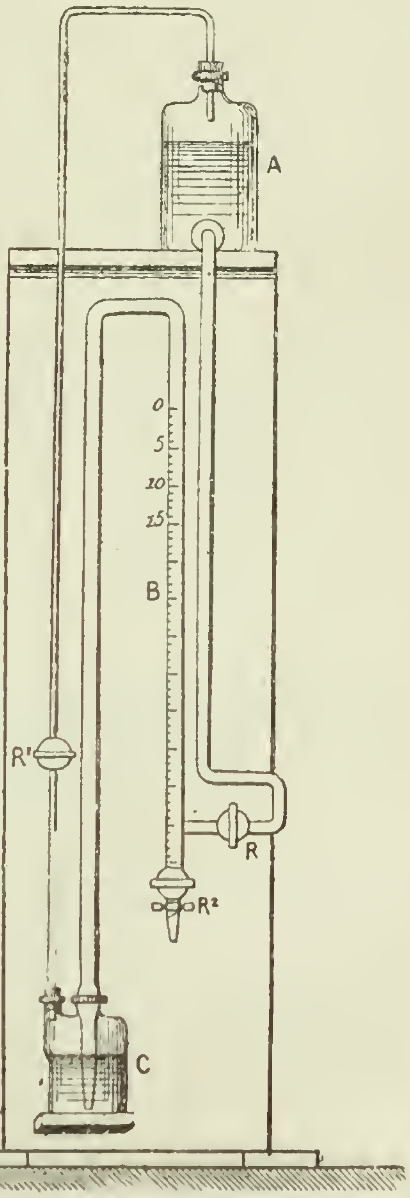
*See under* XII., *page* 281.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

*Characterisation of Petroleums.* A. Riche and G. Halphen, J. d. Pharm. et Chim. 1894, **30**, 289—305.

The authors recommend, as the best means of distinguishing the various kinds of petroleum, the estimation of the solubility in a mixture of equal volumes of anhydrous chloroform and 93 per cent. alcohol (this Journal, 1895,* 191). The quantity of this solvent required for fractions of equal density but different origin (and therefore containing hydrocarbons of different series) is very striking. Owing to the volatility of the chloroform, this solvent should not be left exposed to the air, and on this account an apparatus, as shown in the accompanying sketch, is advisable. The chloroform-alcohol solution is introduced into A and some into C. R and $R^2$ are ordinary cocks, $R^1$ a three way cock. To fill the burette B, $R^1$ is turned so that both A and C communicate with the air, and R is then opened till the burette is filled to just above zero. The cock R is then closed, $R^1$ turned so as to leave C only open to the air, and the liquid is adjusted to zero by means of $R^2$. The apparatus is then ready for use. When not in use $R^1$ is turned so that A and C are in connection, but communication with the air is cut off.

1. *Refined Petroleums.*—The density of the sample is taken at 15°, and then 4 grms. are accurately weighed (to 0·01 grm.) into a conical glass flask. The solvent is gradually run in from the burette (a rotary shake being given to the flask after each addition, to assist mixture) until the whole becomes suddenly clear, and the number of



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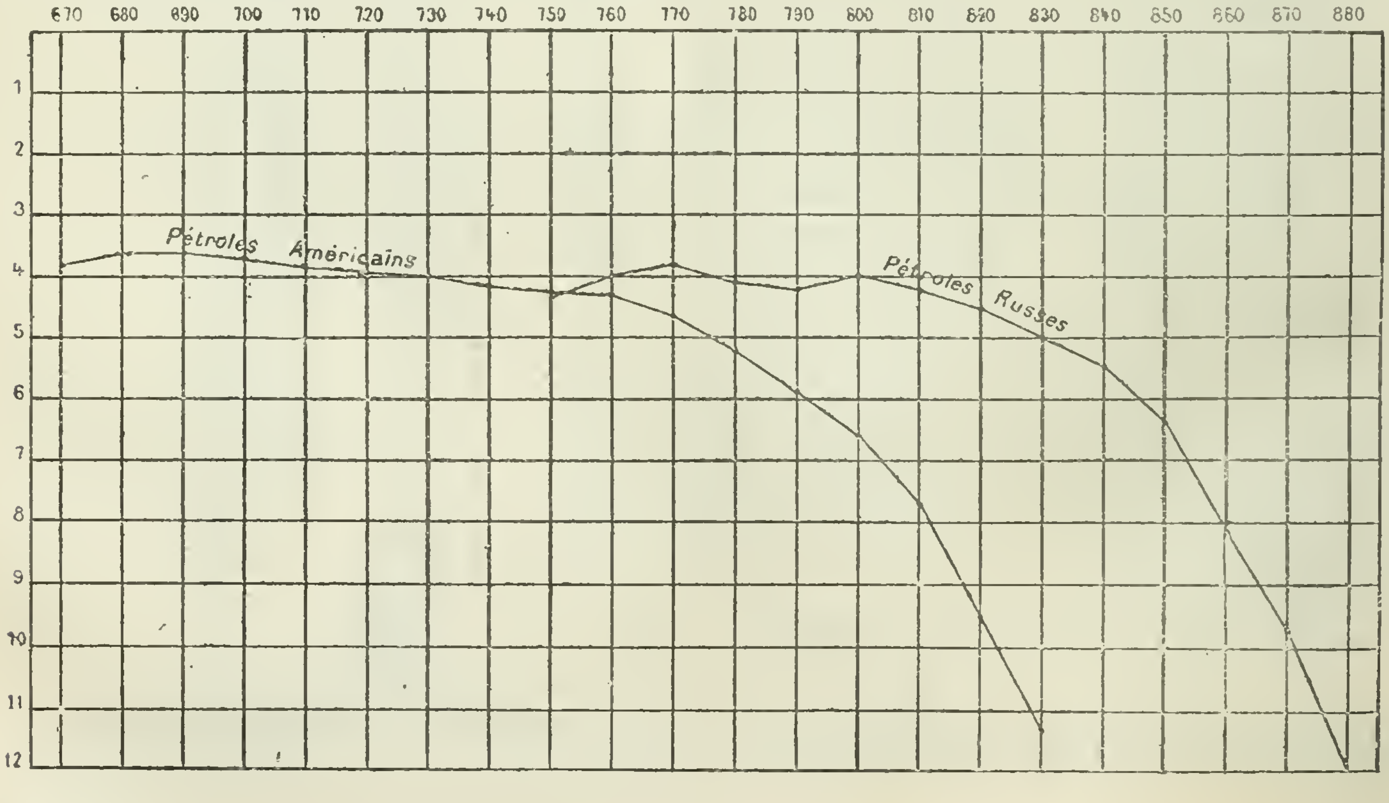
* Erratum.—In the paragraph in inverted commas, at the page cited, col. 1, 13 lines from the bottom, the words after "since," *viz.*, "*the higher boiling and*" should be deleted, the sentence now reading as follows:—"since the more volatile portions do not exhibit," &c.

cc. of the solvent used are noted. Sometimes, with heavy oils, whilst the liquid as a whole becomes clear, light flocks appear. In this case the quantity of solvent used is noted, another 0·5 cc. added, and if the flocks do not disappear the first reading is taken. The following table gives the results of a very large number of experiments :—

| Density of Sample. | American Petroleums. | | | Russian Petroleums. | | | Number of Determinations. |
|---|---|---|---|---|---|---|---|
| | Cc. of Solvent required. | | | Cc. of Solvent required. | | | |
| | Maxima. | Minima. | Mean. | Maxima. | Minima. | Mean. | |
| 0·670 | 4·6 | 3·0 | 3·8 | .. .. | .. .. | .. .. | 5 |
| 0·680 | 4·4 | 2·9 | 3·6 | .. .. | .. .. | .. .. | 11 |
| 0·690 | 4·4 | 2·8 | 3·6 | .. .. | .. .. | .. .. | 19 |
| 0·700 | 4·4 | 3·0 | 3·7 | .. .. | .. .. | .. .. | 21 |
| 0·710 | 4·4 | 3·2 | 3·8 | .. .. | .. .. | .. .. | 24 |
| 0·720 | 4·5 | 3·3 | 3·9 | .. .. | .. .. | .. .. | 27 |
| 0·730 | 4·7 | 3·3 | 4·0 | .. .. | .. .. | .. .. | 28 |
| 0·740 | 4·8 | 3·4 | 4·1 | .. .. | .. .. | .. .. | 28 |
| 0·750 | 4·9 | 3·5 | 4·2 | .. .. | .. .. | 4·3 | 29 |
| 0·760 | 5·0 | 3·7 | 4·3 | .. .. | .. .. | 4·0 | 22 |
| 0·770 | 5·3 | 3·9 | 4·6 | 3·9 | 3·7 | 3·8 | 33 |
| 0·780 | 6·0 | 4·4 | 5·2 | 4·8 | 3·4 | 4·1 | 36 |
| 0·790 | 6·9 | 5·0 | 5·9 | 4·9 | 3·5 | 4·2 | 41 |
| 0·800 | 7·8 | 5·5 | 6·6 | 4·3 | 3·8 | 4·0 | 44 |
| 0·810 | 8·8 | 6·6 | 7·7 | 4·5 | 3·9 | 4·2 | 44 |
| 0·820 | 11·0 | 8·0 | 9·5 | 4·8 | 4·3 | 4·5 | 41 |
| 0·830 | 18·0 | 9·6 | 11·3 | 5·6 | 4·4 | 5·0 | 35 |
| 0·840 | .. .. | .. .. | .. .. | 6·1 | 5·0 | 5·5 | 13 |
| 0·850 | .. .. | .. .. | .. .. | 7·0 | 5·8 | 6·4 | 13 |
| 0·860 | .. .. | .. .. | .. .. | 10·1 | 6·3 | 8·2 | 9 |
| 0·870 | .. .. | .. .. | .. .. | 12·7 | 6·8 | 9·7 | 7 |
| 0·880 | .. .. | .. .. | .. .. | 15·4 | 8·5 | 11·9 | 3 |

It is seen that the quantities of solvent required for fractions of the same density, but of different origin, are markedly different, and that this method gives a safe means of determining the source of a refined oil, especially if fractions of a density of from 0·800 to 0·830 are employed. The results are shown more strikingly by the following curves :—



2. *Crude Petroleums.*—Crude petroleums are found to require, with very few exceptions, more than 15 cc. of the chloroform-alcohol mixture for the solution of 4 grms. of the oil. The crude oil is tested as described above, and a portion is then distilled and the fraction of the same density as the crude oil is similarly tested. As it is difficult to obtain a fraction of this exact density the next higher and next lower fractions are tested and the required number calculated from these two results. If the oil be a crude oil, the difference between the amount of solvent required by the original oil and by the distillate will be very marked, and the amount required by the latter will, with the help of the above table, indicate the origin of the crude oil. If the supposed crude oil be really a mixture of refined oil and residuals, the two numbers obtained for the original oil and for the distillate will agree very closely. The following table gives a few of the many results recorded by the authors :—

| Nature of Oil. | Density. | Cc. of Solvent required by Original Oil. | Cc. of Solvent required by Distillate of the same Density. |
|---|---|---|---|
| *a. Russian Petroleums.* | | | |
| Crude :— | | | |
| From Balakhany .... | 0·871 | Above 15 | 9·1 |
| „ Batoum........ | 0·877 | „ | 10·2 |
| Unmarked........... | 0·851 | „ | 6·8 |
| Mixtures :— | | | |
| Balakhany........... | 0·819 | 4·6 | 4·6 |
| Russian oil + 10 per cent. distillate. | 0·822 | 4·2 | 4·3 |
| Mixed; refined and residual. | 0·830 | 4·2 | 5·0 |
| *b. American Petroleums.* | | | |
| Crude :— | | | |
| From Pennsylvania .. | 0·790 | Above 15 | 5·7 |
| „ Washington ... | 0·788 | „ | 6·0 |
| „ Zelienople ..... | 0·785 | 8·7 | 5·6 |
| „ Harmony ...... | 0·769 | 7·2 | 5·2 |
| Mixtures :— | | | |
| Luciline ............. | 0·779 | 5·4 | 5·6 |
| Artificially prepared mixture. | 0·786 | 6·0 | 5·6 |

Even with the very abnormal oil from Harmony the difference between the crude oil and the distillate therefrom is greater than the difference between maxima and minima for that density (see preceding table), so that the characterisation is definite as to its being an American and not a Russian crude oil (compare also the graphic interpolation curves on p. 311).—L. T. T.

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*Technical Analysis of Asphaltum.* Laura A. Lynton. J. Amer. Chem. Soc. **16**, 809—822.

The authoress calls attention to the discovery by Boussingault, that bitumens yield to certain solvents a portion of their constituents, to which he gave the name of "Petrolene," and to certain other solvents another portion, to which he gave the name of "Asphaltene." She then refers to the various analyses of asphalts published by different analysts, pointing out that, owing to the diversity of solvents employed and the absence in some cases of details as to methods, such analyses are worthless for purposes of comparison. Experiments with Trinidad and Cuban asphalts are next described, and, as a result, the following method of analysis is recommended :—

Water is first to be determined, if present, by drying in a water-oven to constant weight. The finely-powdered sample, ½ grm. if rich in bituminous matter, several grms. if rich in mineral constituents, is digested over night, in a 4-oz. Erlenmeyer flask, with 50 cc. of petroleum ether. The solution is decanted on to a weighed filter contained in a 3-inch funnel having a tap in the spout. The residue in the flask is digested for 2—3 hours with fresh petroleum ether, which is decanted as before, and this process is continued so long as any colour comes away. Then the insoluble residue is transferred to the filter, dried and weighed, any traces adhering to the flask being estimated by weighing the flask. The portion dissolved by the petroleum ether is put down as "Petrolene." The flask is rinsed with boiling turpentine, which is poured on the filter (replaced in the funnel), and enough boiling turpentine is poured on the filter to wholly submerge it, left to digest for several hours or over night, and then allowed to filter through. The digestion with boiling turpentine and filtering, is continued as long as any colour comes away, and then the process is repeated with chloroform; after which, the filter is again dried and weighed, and the loss is entered as "Asphaltene." The filter is now burned, with the contents, the ash is treated with ammonium carbonate to restore $CO_2$ to any lime which may have been formed, and the loss of weight is put down as "Other organic matter," the remainder being "Mineral matter." The following analyses were all made by this method :—

| No. | Water. | Petrolene. | Asphaltene. | Other Organic Matter. | Mineral Matter. | Total. |
|---|---|---|---|---|---|---|
| 1 | 2·03 | 32·45 | 22·11 | 8·12 | 35·29 | 100·00 |
| 2 | 0·39 | 25·46 | 54·41 | 2·47 | 17·03 | 99·76 |
| 3 | .. | 35 09 | 63·18 | 1·73 | .. | 100·00 |
| 4 | .. | 8·52 | 3·92 | 25·79 | 61·76 | 99·99 |
| 5 | .. | 7·49 | 4·32 | .. | 88·20 | 100·01 |
| 6 | .. | 8·79 | 3·27 | .. | 87·95 | 100·01 |
| 7 | .. | 3·35 | 2·42 | .. | 94·23 | 100·00 |
| 8 | 0·33 | 11·32 | 3·81 | 1·12 | 83·41 | 99·99 |
| 9 | .. | 49·96 | 50·04 | .. | .. | 100·00 |
| 10 | .. | 64·57 | 21·25 | 13·71 | 0·36 | 99·89 |
| 11 | .. | 63·50 | 29·97 | 6·09 | .. | 99·56 |
| 12 | .. | 4·39 | 2·83 | 4·10 | 88·65 | 99·97 |
| 13 | 0·43 | 6·67 | 1·87 | 3·70 | 87·33 | 100·00 |
| 14 | .. | 66·79 | 31·93 | 1·28 | .. | 100·00 |

1. Crude Trinidad asphaltum.
2. Cuban asphalt.
3. Egyptian asphalt; an Assyrian asphalt taken from the Dead Sea and imported into Egypt.
4. Natural asphaltic rock; from Val de Travers, Switzerland.
5. Seyssel asphaltic rock.
6. Turrellite; from a deposit in Uvalde county, Texas, consisting of a mass of sea shells cemented together by bitumen into a solid rock mass.
7. Kentucky asphaltic rock.
8. Asphaltic sandstone; from California.
9. Grahamite; a so-called asphaltum taken from a vein in Ritchie County, West Virginia.
10. Hard artificial asphalt; an asphaltic residue obtained from the distillation of petroleum obtained near Santa Paula, California.
11. Soft artificial asphalt; from same source as 10.
12. Asphaltic pavement from Franklin Avenue, Buffalo, N.Y. It was laid in 1878, of Trinidad asphalt, wax tailings,

and very fine sand. It is remarkable as having been laid for 15 years with almost no need of repairs.

13. Asphaltic pavement from Governor's Island, New York Harbour, laid within the fort at an unknown date, but so old that it has begun to break up from natural causes.

14. Dubbs' artificial asphalt. A so-called asphaltum obtained in operating the Dubbs' patent process for the manufacture of asphaltum by adding sulphur to hot Lima tar.—L. A.

### *A Constant Error in the Results of Nitrogen Determinations, when deduced from the Metallic Platinum obtained by the Ignition of Ammonium Platinic Chloride.* L. L. de Koninck. Chem. Zeit. 1894, **18**, 1816.

In analytical practice it is not usual to reduce weighings to *vacuó*; and, so long as the substance under examination and the element or compound finally weighed do not differ much in specific gravity, the error thus introduced into the results is insignificant. When, however, the density difference is large, as is the case, for instance, in the determination of nitrogen in organic bodies, &c., by the method indicated in the heading, the error, due to neglect of the correction for air-buoyancy, becomes sensible, and would, assuming the density of the substance analysed to be 1·2, and that of platinum 21·5, amount to one-thousandth of the whole. —H. T. P.

### *Rapid Examination of Vaselin for Fatty Oils.* Crauzel. Union Pharm. per Rep. de Pharm. 1894, **50**, 453.

To detect the presence of fatty oils in vaselin, five drops of a saturated solution of potassium permanganate are thoroughly ground up with 5 grms. of the sample. If the vaselin be pure, the colour of the permanganate remains unchanged; otherwise, reduction takes place and a brownish mixture results. Quantitative results may be obtained by using a dilute titrated solution of permanganate and adding it to the vaselin until the violet coloration remains permanent.—H. T. P.

### *Analysis of Acid Tan-Liquors.* J. Pässler. Dingler's polyt. J. 1895, **295**, 141—143.

The hide-powder process for the gravimetric estimation of tannin is not applied to the testing of acid liquors, because the hide absorbs a certain proportion of the acid which is thus estimated as tannin. Meerkatz attempted to adapt the process to the test by first neutralising the liquor with barium carbonate; but Bartel (this Journal, 1891, 863) has shown that very serious errors are thus introduced. The author has now experimented with the view of ascertaining the actual error caused by the absorption in the ordinary process, believing it to have been greatly exaggerated. Oak extract, containing tannin, 28·33; organic matter, not tannin, 12·27; ash, 1·59; insoluble matter, 0·06; and water, 57·75 per cent., was diluted to two strengths, viz., 1 grm. and 0·1 grm. per 100 cc., and different portions of these liquors were mixed separately with 0·1 and 0·5 grm. of free acid, forming four solutions, viz., one with much and one with little tannin, but each containing little free acid, and one strong and one weak liquor, each with much free acid. A mixture of acetic and lactic acids in equivalent proportions (1 : 1·5) was used, but both were reckoned as acetic acid, so that the 0·1 grm. of free acid quoted above contained really 0·05 grm. of $CH_3.COOH$ and 0·075 grm. of $C_2H_4.OH.COOH$. The analyses were made in the usual way, excepting that in determining the total extract matter in the acid liquors, 250 cc. was evaporated nearly to dryness, mixed again with water, evaporated quite dry, and weighed; and similarly, before shaking with hide-powder, the 250 cc. sample used was evaporated twice to dryness, and finally made up again to its original volume with water.

The results are incorporated in the following table:—

| In 100 Cc. | Strong Liquor. 1 Grm. per 100 Cc. | | | | Weak Liquor. 0·1 Grm. per 100 Cc. | | | |
|---|---|---|---|---|---|---|---|---|
| | Without Acid. | With 0·1 Grm. Acid. | Without Acid. | With 0·5 Grm. Acid. | Without Acid. | With 0·1 Grm. Acid. | Without Acid. | With 0·5 Grm. Acid. |
| | Grm. | Grm. | Grm. | Grm. | Grm. | Grm. | Grm. | Grm. |
| Tannins | 0·9945 | 1·0345 | 0·9955 | 1·0800 | 0·1000 | 0·0970 | 0·1010 | 0·0615 |
| Organic matter, not tannin | 0·4700 | 0·4910 | 0·4755 | 0·6170 | 0·0480 | 0·0850 | 0·0490 | 0·1805 |
| Ash | 0·0535 | 0.0475 | 0·0505 | 0·0530 | 0·0050 | 0·0070 | 0·0060 | 0·0060 |
| Total residue | 1·5180 | 1·5760 | 1·5215 | 1·7500 | 0·1530 | 0·1890 | 0·1560 | 0·2480 |

It will be observed that while the amount of tannin found in the strong solution is somewhat too high in the acidified portion, and the error is greater in the more acid liquid, there is even a loss of tannin in operating upon acidified weak liquor, and that this loss is most serious when the acid is in greatest excess. This reversible effect is due to the operation of compensating errors; with the strong liquor the plus error caused by the absorption of acid by the hide is predominant, and is most marked when the acid is strong; but with weak liquors the increased solubility of the hide powder in acid liquids, as compared with that in the blank experiment with distilled water, introduces a minus error, which, in this case, far surpasses the other, and gives rise to very low readings, which are most strongly accentuated in the most acid solution. But with the exception of the fourth experiment, which represents conditions rarely to be found in actual practice, the absolute variation in any experiment is very small, and does not exceed a few 100ths of 1 per cent. It may therefore be claimed that, provided the greater proportion of the volatile acid has been previously removed by repeated evaporations, the hide-powder process may usually be applied to the testing of tan-liquors containing acetic and lactic (and similar) acids, without serious error; and that the results of such tests are sufficiently accurate for due control of the tannin process, and far more accurate than those obtained by the Löwenthal or Meerkatz processes.—W. G. M.

### *Estimation of Cane Sugar in Malt.* Wochens. f. Brauerei, **11**, 1894, 1536—1537.

Some researches on this subject have recently been communicated by E. Jalowetz to the transactions of the brewing and malting research station at Vienna. The methods compared are those of Kjeldahl, in which invertase solution is used (Zeits. f. d. gesam. Brauw. 1881, 477), Meissl's method as recommended by Jais (Zeits. f. d. gesam. Brauw. 1893, No. 39 and Wochens. f. Brauerei, 1893, 1071 and 1179) and Clerget's optical method as modified by the author. In examining worts, extracts, &c. by this last method, 75 cc. of the solution are placed in a long-necked 100 cc. flask, 5 cc. of HCl (of sp. gr. 1·188) added, and the flask kept in a water-bath at a temperature of 69°—71° C. for 10 minutes with frequent rousing. In this way, 4 or 5 minutes are required for the solution to acquire the temperature of 69° C. at which it remains for 5 minutes. A little animal charcoal is then added, the solution is quickly cooled, filtered, and polarised. Then if $\alpha$ be the reading obtained in a 200 mm. tube before inversion and $\alpha_1$, after inversion, the cane sugar per 100 cc. is obtained by

$$S = \frac{\alpha - \alpha_1}{1\cdot782}.$$

1 grm. of cane sugar per 100 cc. reads $1\cdot33°$, and after inversion, $-\ 0\cdot43°$, but since 1 part of cane sugar produces 1·05 parts of invert sugar, the total rotation produced is $1\cdot33 + 0\cdot43 \times 1\cdot05 = 1\cdot782$.

The inversion has no action upon any maltose, dextrose, or dextrin present. A comparison of Kjeldahl's and Clerget's methods gave the following amounts of cane sugar in grms. per 100 cc.

| —— | Kjeldahl. | Clerget. |
|---|---|---|
| Wort (1) ........................ | 0·50 | 0·48 |
| „ (2) ........................ | 0·52 | 0·50 |

Meissl's method, as recommended by Jais, is a gravimetric one, and depends upon a constant ratio being maintained between the cane sugar to be inverted and the HCl used, so that although it may be used for pure cane sugar solutions, it is unreliable for worts (cf. Ehrich, "Bierbrauer," 1894, No. 5; Prior, Baierischen Brauerjournal, 1894, No. 5; and Amthor, Zeits. f. Nahrungsmittel, 1894, No. 7).

Jalowetz arrives then at the following conclusions:—Meissl's method cannot be employed for estimating cane sugar in malt worts and cold malt extracts, since the ratio of cane sugar and HCl employed yields too low results. On the other hand, the ratio employed by J. Jais for malt extract and HCl gives too high results. The cupric reducing power of the solution after inversion is a function of the amount of HCl used, and not only represents the inverted cane sugar present but also other reducing bodies, formed during inversion. These facts have also been elucidated by Erich and Prior.

For alcoholic extracts, the Meissl's method can be used, but excessive addition of HCl must be carefully avoided. The modified inversion method of Clerget gives reliable results with worts, malt extracts, and alcoholic extracts. The cane sugar content of a malt is best estimated in an aqueous extract made by digesting 50 grms. of malt with 400 cc. of water for one hour.—T. A. G.

*A Comparison of Methods for the Determination of Starch.*
W. E. Stone. J. Amer. Chem. Soc. **16**, 726—733.

The author points out the necessity for improvements in our methods of food analysis, so far as regards the large number of widely varying substances which are at present often grouped together under the name of non-nitrogenous extract matter. Starch, for example, almost always occurs together with other soluble carbohydrates, especially the pentosans or gums; and as these substances behave towards many analytical processes just like starch, a result which is interpreted to mean starch may in reality be due largely to other bodies. To show the discrepant results obtained, samples of 9 different food materials were first extracted with water and ether to remove soluble carbohydrates and fats, and were then each assayed for starch by five known methods, with the following results:—

| Material. | Sachsse's Method. Inversion by HCl and Titration by Fehling's Solution. | Guichard's Method. Inversion by $HNO_3$ and Polarisation. | Guichard Modified. Inversion by Oxalic Acid, Filtering, Heating with $HNO_3$, and Polarisation. | Baudry's Method. Inversion by Salycilic Acid and Polarisation. | Von Asboth's Method. Precipitation by $Ba(OH)_2$ Solution, and Titration of Excess of $Ba(OH)_2$. |
|---|---|---|---|---|---|
| | Percentage of Starch. | | | | |
| Pure potato starch ................ | 85·75 | 85·50 | 85·75 | 85·47 | 85·58 |
| Dried potato ...................... | 70·92 | 69·79 | 68·53 | .. | 64·25 |
| Wheat flour ....................... | 77·69 | 70·65 | 65·29 | 69·38 | 59·76 |
| Corn meal ......................... | 73·24 | 66·81 | 70·55 | .. | 62·11 |
| Wheat bran ........................ | 65·86 | 40·25 | 38·68 | .. | 70·77 |
| Hay ............................... | 3·48 | 19·10 | 19·10 | .. | 66·47 |
| Wheat middlings ................... | 30·00 | 63·09 | 60·24 | .. | 60·41 |
| Cotton-seed meal .................. | 4·15 | .. | .. | .. | 51·65 |
| Mixture of starch, sugar, and dextrin | 9·58 | 21·00 | 21·08 | 18·80 | 33·99 |

The results with potato starch show that each method gives a correct estimate, when dealing with starch alone; but, with the other materials, the results obtained are not only discordant, but in some cases inexplicable. Thus, hay and cotton-seed meal, neither of which gives the iodine reaction, are each credited with containing starch in quantity. Evidently other bodies present behave like starch, and we know that pentosans are present in materials such as these. A sample of xylan was prepared, by boiling wheat straw with lime-water and precipitating the xylan with alcohol. It was free from any other carbohydrate, but contained 6 per cent. of ash. Assayed by each of the above methods, except the salicylic, which was not applicable, it yielded results equivalent to from 44·73 to 67·16 per cent. of starch; proving that the pentosan, which is most characteristic of feeding stuffs, and which has been shown to occur in all such materials, behaves like starch towards all the ordinary methods; and that none of these can therefore be employed for determining starch, with any degree of accuracy, in materials such as grains or forage plants, where the presence of pentosans is probable.

What is wanted is a method for dissolving the starch without affecting the accompanying carbohydrates. The use of diastase is suggested. The weighed material is boiled with water (best under pressure), to convert the starch into paste; after cooling to 65°, a small quantity of malt infusion is added, and the temperature is kept at 60°—65° for ½ hour. The starch reaction having disappeared, the solution may be filtered off, washing the residue thoroughly, the filtrate warmed with a few cc. of acid to complete the conversion into dextrose, and finally neutralised, made up to a definite volume, and titrated. It remains to be seen what the effect of this process may be upon the pentosans and other similar bodies, concerning which there are few data at hand. An experiment with the sample of xylan already mentioned, showed that it was not altered.—L. A.

*Modern Forms of Apparatus for Estimating Fat in Milk, with Special Reference to those designed by Babcock-Ahlborn, Thörner, and Gerber.* J. Sebelien and K. Stören. Chem. Zeit. 1894, **18**, 1816—1820.

The apparatus designed by Babcock-Ahlborn, Thörner, and Gerber respectively, are all volumetric in principle, and intended for rapid work, the milk-fat being separated by chemical and mechanical means, and its volume subsequently measured. The authors have made numerous comparative analyses by means of these contrivances, and detail their experience of them at length, as regards relative ease of manipulation, accuracy, cheapness &c. The conclusions are given in the table below :—

| —— | Accuracy of Results. | Simplicity of Construction. | Remarks on the Centrifugal Apparatus. | Reading-off. | Relative Cost. |
|---|---|---|---|---|---|
| Babcock-Ahlborn ...... | Practically the same in all three methods, the error being usually less than 0·10 to 0·15 per cent.; but occasionally reaching 0·25 to 0·30 per cent. | Greatest simplicity. | Easily manipulated. Two centrifugings necessary for six and one minute respectively. | Difficult. | High. |
| Thörner ............... | | Less simple. | Less simple; one treatment of three minutes required. | Easy. | Highest. |
| Gerber................. | | Unsuitable method of pipetting; rapid deterioration of the caoutchouc stoppers used. | Exceedingly simple circular centrifuge. | Easy. | Low. |

As regards the cost of chemicals required, Babcock's method is the cheapest, ordinary concentrated sulphuric acid (not chemically pure) being the only reagent needed.

—H. T. P.

*Composition and Analysis of Malt.* T. Crossman. J. Amer. Chem. Soc. 1894, **16**, 559.

*See under* XVII., *page* 290.

*The Purification of Ether.* Lassar-Cohn. Annalen, 1895, **284**, 226.

*See under* XX., *page* 295.

*Quantitative Estimation of the Dust in the Air, with a Description of a New Dust-Catcher.* Karl Arens. Arch. Hyg. **21**, 325.

*See under* XVIII. B., *page* 293.

## ANALYTICAL AND SCIENTIFIC NOTES.

*Action of Metallic Magnesium on Manganous Salts.* J. G. Hibbs and E. F. Smith. J. Amer. Chem. Soc. **16**, 822—823.

Authorities differ as to the action of metallic magnesium on neutral manganous salts, some stating that metallic manganese is precipitated, and others that it is not. As a result of three experiments, the authors conclude that the precipitate obtained is, in all probability, not metallic manganese, but a hydrated oxide, as suggested by Kern (Chem. News, **33**, 326), who used a saturated solution of manganous chloride, and allowed magnesium to act upon it for 6—8 hours, with this result—

$$3MnCl_2 + 3Mg + 3H_2O = 3MnO + 3MgCl_2 + 3H_2.$$

In presence of water the manganous oxide passes into the sesquioxide.—L. A.

## New Books.

Organic Chemistry: the Fatty Compounds. By R. Lloyd Whiteley, Principal of the Municipal Science School, West Bromwich. London: Longmans, Green and Co. New York: 15, East 16th Street. 1895. Price 3*s.* 6*d.*

This work forms one of Messrs. Longmans' Elementary Science Manuals, and is an 8vo volume bound in cloth, containing 285 pages of subject matter, and an alphabetical index. In the preface, the author states that since he considers organic chemistry a branch of science which it is quite impossible to learn only by the perusal of books, he has endeavoured to give information that will enable the student to gain a practical acquaintance with it. Hence, throughout the work there are interspersed 45 illustrations of pieces of apparatus, diagrams, &c., which are to be used in conducting the experiments, preparations, and estimations described.

The following are the leading subjects treated of in the text. I. Sources of purification of organic bodies. Elementary Organic Analysis. Percentage Composition, Empirical Formulæ. Determination of Molecular Formulæ. II. Fatty Hydrocarbons, Haloid Paraffins, Monohydric Alcohols and their Derivatives. III. Cyanogen and Carbonic Acid Derivatives. IV. Derivatives of Unsaturated hydrocarbons. V. Dihydric Alcohols and their Derivatives. VI. Polyhydric Alcohols and their Derivatives.

Steel Works Analysis. By J. O. Arnold, Professor of Metallurgy at the Sheffield Technical School. Whittaker and Co., 2, White Hart Street, Paternoster Square, London. 66, Fifth Avenue, New York. 1895. Price 10*s.* 6*d.*

8vo volume containing prefaces, table of contents, and 346 pages of subject-matter, including an appendix, with methods of determining the specific gravity of iron or steel, the determination of the carbides in steel, the experimental determination of the evaporative power of coal, and finally tables of typical analyses, &c. The work concludes with an alphabetical index. The text is illustrated with 22 woodcuts, and is sub-divided into sections dealing with the following subjects:—The Steel Works Laboratory and its Appliances. Analysis of Steel and Wrought-Iron. Analysis of Pig-Iron. Analysis of Spiegel and Ferro-Manganese; of Ferro-Chrome, Ferro-Silicon, Ferro-Aluminium, Aluminium Metal, Ferro-Tungsten, Metallic-Tungsten, Ferro-Nickel, Metallic Nickel, Analysis of Iron Ores, Manganese Ores, Chrome Iron Ore, Wolfram, Analysis of Refractory Materials, Fuels, Slags, and Boiler-Water.

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Lens Work for Amateurs. By Henry Orford. Whittaker and Co. London: 2, White Hart Street, Paternoster Square. New York: 66, Fifth Avenue. 1895. Price 3*s*.

This is a practical guide for lens-makers of the class of young workmen or amateurs, and takes the form of a small 8vo volume, with Table of Contents, List of Illustrations, 131 in all, and Subject-Matter filling 225 pages. The book ends with an Alphabetical Index.

The subject-matter deals with the following grades of work in lens-making:—I. Definition of a Lens; Distinguishing Names of Lenses; Spherical Aberration and Cause of Achromatism. II. and III. Tools used by Lens-Workers. IV. Pitch and Holding Mediums used in Lens-Work. V. Different Systems of Lenses. VI. The Post; Washing Emery, &c. VII. Working the Shallow Surfaces of the System. VIII. Mounting Diamonds for Turning, &c. IX. Making Patterns, &c. X. The Aperture of Diaphragms. A Photographic Lens and its Action Described. XI. Eye-Pieces, &c. XII. Curves of Huyghenian Eye-Pieces, &c. XIII. Compensating Eye-Pieces, &c. XIV. Spectral Eye-Pieces, &c. XV. Wollaston Camera Lucida, &c. XVI. Large Angle Abbé Illuminator, &c. XVII. Illumination. XVIII. Simple Microscopes, &c. XIX. Curves for Magnifiers, &c. XX. Working Flat and Shallow Spherical Surfaces. XXI. and XXII. Prism Work; A Binocular Prism, &c. XXIII. Methods of Mounting Lenses, &c. XXIV. Testing Different Lens Systems, &c. XXV. General Testing of Systems of Precision. XXVI. Testing the Aperture of Lenses and Description of the Instruments and Method.

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Deutscher Färber Kalendar für das Jahr 1895. Herausgegeben von Dr. A. Ganswindt, Redacteur der "Deutschen Färberzeitung." Munich: Verlag von Georg D. W. Callwey. London: H. Grevel and Co., 33, King Street, Covent Garden, W.C. Price 3*s*.

This pocket-book for dyers, is one as to style, size, and general appearance, resembling Biedermann's Chemiker Kalendar. Like the latter, it is strongly bound in waterproof cloth and contains an almanack for 1895, following the table of contents, and immediately thereafter follows a diary arranged for every day of the year and provided with blank paper for memoranda and notes. After the diary there are some 32 pages of blank pages for note-taking, &c. There is next arranged a useful and concise *Jahresbericht* on the subjects of "Textile Fibres," "Bleaching, Washing, and Chemical Cleaning," "New Chemicals, &c.," "New Mordants and their Uses," "Dyeing," "Printing," "Finishing," and "New Apparatus and Machinery," the latter being carefully tabulated, under (1) the names of the machines and apparatus; (2) the firms making them; and (3) the German patents under which they figure. Then appears a review of all the dyestuffs still actually in the trade, and used in dyeing or printing textile fibres, their synonyms, sources, and modes of employment. This is a carefully tabulated review, the dyestuffs being classified as to their colours, in suitable groups. After this appears another and further tabulated list of new dyestuffs, appearing since the framing of the previous review; it concludes with a statistical report on the new dyestuffs. The next section of the work is devoted to a table covering 14 pages, which deals with a series of tests for the detection and recognition of colouring matters on the fibre. This is immediately succeeded by a table giving the series of substances designated "Dyer's Chemicals," with their chemical formulæ and molecular weights.

A useful glossary of technical words and terms used by dyers and in the technical literature is next given, and then a list of teaching institutions or schools of dyeing, among which are included the following British dyeing schools: the Bradford Technical College, the Huddersfield Technical School, the Yorkshire College, Leeds, the Manchester Municipal Technical College, the Nottingham Technical School, and the Stockport Technical School. The work concludes with a series of useful tables of liquors, solutions, acids, and alkalis of various strengths, with specific gravities given, a chemical directory of manufacturers of dyers' chemicals, and also of the dyers and printers in Germany, followed by a coloured map of the German Empire.

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Kalendar für Gas- und Wasserfach - Techniker. Zum Gebrauche für Dirigenten und technische Beamte der Gas- und Wasserwerke, sowie für Gas- und Wasserinstallateure. Bearbeitet von G. F. Schaar, Ingenieur. Achtzehnte Jahrgang, 1895. München und Leipzig. R. Oldenbourg. London: H. Grevel and Co., 33, King Street, Covent Garden. Price 4*s*. 6*d*.

Pocket-book, bound in black leather, and gilt. Inside the cover is an almanack for 1895. Apart from the space occupied by nearly 100 pages of advertisements, the contents of the little volume are usefully distributed as follows:—I. and II. Tables of Mensuration, Weights and Measures of Coals and Coke; Weights of Cast-Iron Gas Retorts, &c. III. Tabulated Data about Coals; Composition of Coals and Coke; Yields of Gas and Coke from different Coals. The Weathering and Spontaneous Ignition of Coals. Occurrence of Coals. Decomposition- and By-Products. IV. Illuminating Gas and its Preparation. Tabulated Data, Statistics, &c. V. Oil-Gas. VI. Wood-Gas. VII. Peat-Gas. VIII. Working-up the Gas Liquors. IX. Direction and Engineering of a Waterworks System. 1. Condition of the Water Supply. 2. Provision of Water Supply; Filtration; Reservoirs, Water - towers, &c. 3. Services of Pipes. 4. Water - meters. 5. The Pumps. X. Additional Tabulated Matter. Quality of the Gas; Street-illumination Calendar; Installation Prices, &c.

An additional portion of the volume, termed the "Beilage Zum 16te Jahrgang des Kalenders," is devoted to Tables, Data, and Statistics relating to the Physico-Chemical, Mathematical, and Mechanical Questions involved in the manufacture of Coal-Gas. The little work concludes with a diary, a few pages serving as an address note book, and some further blank pages for general notes.

# Trade Report.

## *PRIZES.*

It is with pleasure we learn that Messrs. Cross and Bevan and Clayton Beadle, of London, have been awarded the "John Scott" legacy medal and premium, by the Franklin Institute, Philadelphia, for their "discovery of a new plastic compound of cellulose."—*Chemical Trade Journal.*

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

### FOREIGN AND COLONIAL IMPORT DUTIES ON SUGAR.

See *Board of Trade Journal* for March 1895, pp. 306—311.

### RUSSIA.

#### *Customs Decisions.*

Sulphate of lead, in a dry state, to be cleared under section 112. Duty, 1 rouble 50 cop. gold per poud, gross. The same product prepared with oil to be cleared under section 137. Duty, 3 roubles gold per poud.

Artificial silk, spun (Charbonet), chemically prepared, to be cleared under corresponding points of section 185, as real silk. Duty, from 40 roubles to 56 roubles gold per poud.—*Board of Trade Journal.*

### MAURITIUS.

#### *Tariff Changes.*

The following modifications have been introduced into the Mauritius tariff for 1895 :—Margarine, or any substance sold or used as butter, is to pay a duty of 4·57 rupees per 100 kilos.; Prussian blue, a duty of 1 rupee per kilo.; and chloride of potassium, carbonate of baryta, phosphoric acid (solid), substances imported to be used in the destruction of insects or other parasites prejudicial to agriculture, and sulphate of potassium, a duty of 25 cents per 1,000 kilos.—*Imperial Institute Journal.*

### UNITED STATES.

#### *Customs Decisions.*

The appraisers from Portland submitted for classification the question of molasses containing over 20 per cent. of moisture, but not showing by the polariscopic test 40 per cent. saccharine strength.

After discussion it was agreed that to admit molasses free under the law two conditions are necessary: first, the degree of saccharine strength must not exceed 40; and second, there must not be over 20 per cent. of moisture present.

Should there be more than 20 per cent. of water in the given sample, the molasses would be dutiable at the rate of 2 cents per gallon under paragraph 182½ and by the assimilation clause.—*Board of Trade Journal.*

### VICTORIA.

#### *Tariff Decisions.*

Drugs, &c., viz. :—Piperazine, pure, in 1-oz. bottles (recommended), are dutiable at 25 per cent. *ad valorem.*

The following articles are free of duty :—

Drugs, &c., viz. :—

Pepsin in scales, in oz. bottles.

Visculose for stopping fermentation in beer.

Glissol, a liquid preparation for thinning printing ink. —*Ibid.*

## *GENERAL TRADE NOTES.*

### THE NORWEGIAN WOOD-PULP INDUSTRY.

The following particulars of the Norwegian wood-pulp industry are contained in the *Moniteur Officiel du Commerce* of the 14th February :—

There at present exist in Norway 61 machine wood-pulp factories, of which three are annexed to the cardboard factories and 10 to the paper factories.

The total export from Norway of moist machine wood-pulp, including merchandise coming from Sweden and shipped in Norwegian ports, is estimated for the year 1894 at about 240,000 tons, as compared with 230,000 tons in 1893, 215,000 tons in 1892, 230,000 tons in 1891, 207,000 tons in 1890, and 190,000 tons in 1889. These 240,000 tons represent a value of from 9,500,000 to 10,000,000 krona.

Notwithstanding a heavy fall in prices during the year the result is very satisfactory. This fall has not had in fact any appreciable effect on the total yield, whilst four-fifths of the annual production has already been sold since the commencement of the year, and the dry paste reached the price of 85 krona per ton.

The anticipations for 1895 are less encouraging by reason of the reserve maintained by purchasers with the idea of forcing prices, which hitherto have not exceeded 33 to 36 krona per ton (50 per cent. moist), whilst the dry pulp will only reach 65 krona.

#### *Chemical Wood-Pulp or Cellulose.*

The production of cellulose in Norway and Sweden has increased considerably in the course of last year. There are at the present time 10 cellulose factories "au sulfite," and four soda factories (*natroncellulose*).

The exportation of these products in 1894 was about 34,000 tons of dry and 10,000 tons of moist pulp, against 32,000 tons of dry and 13,000 tons of moist in 1893.

The value of this export may be estimated at between 6,000,000 and 6,500,000 krona.

Prices have fallen during the year. Fears are expressed that this industry is on the eve of a serious and lengthened crisis. America, which is the chief country for the disposal of this merchandise, made much smaller purchases than usual.

### THE GERMAN CHEMICAL TRADE.

The exports of chemical products, dyestuffs, &c., from Germany in 1894 amounted to 6,034,913 kilos. weight, of a declared value of 277,783,000 m., against 5,821,790 kilos. weight, value 265,671,000 m. The imports have increased from 9,127,146 kilos. (value 233,823,000 m.) in 1893 to 9,480,336 kilos., value 237,975,000 m.—*Chemist and Druggist.*

### THE PRODUCTS OF SIERRA LEONE.

The United States Consul at Sierra Leone, in a recent report to his Government, says that the produce of Sierra Leone consists chiefly of rubber of various grades (extracted from trees and vines), palm oil, palm kernels, benne seed, ginger, arrowroot, coffee, chillies, guinea grains, cocoa, kola nuts, calabar beans, hides, horns, ivory, gum copal, cassava, ground-nuts, rice, copra, cotton, cam-wood, and other hard woods. Of these but little is exported to the United States, there being no market at all for palm kernels, and very little for palm oil, which are the principal articles of export from Sierra Leone.

American inquiry has lately been made made for kola nuts; at this moment the price for these is about 15 dols. per basket of 135 lbs., which is considered a very low quotation, the price being at times 30 dols.

A large quantity of ground nuts used to be sent hence to New York, but the tariff completely excluded this article.

Para-rubber being mostly in favour in the United States, but little, if any, rubber is now sent from Africa. More attention is being given to the preparation of rubber here. Formerly, the natives were very indifferent as to the mode of manipulation, and had but little scruple in mixing mud and other foreign substances with the produce of the trees and vines. To such an extent had this reached that the principal firms, in self-defence, entered into a mutual agreement not to purchase any rubber unless the balls or pieces were all thoroughly dried and cut asunder, so that fraud might the more easily be detected. The practice of soaking rubber for a considerable time in water and mud had obtained for the purpose of increasing weight, but it is alleged that in this, at least, the savage only imitated his more civilised European brother. If honestly and properly prepared, such qualities as Manoh twists, &c. (usually quoted at about 55 cents per lb. on the Liverpool exchange), might, under more careful and scientific manipulation, be made to equal some, if not all, the para grades.

Copra (the dried meat of the cocoa-nut) is also an article worthy of notice, as large quantities might be produced here. It is exported to Liverpool in bags, and the oil expressed by machinery there and also in Hamburg and Marseilles.

The present low quotation for light hides, plus the competition by the South American States, has reduced this branch of the Sierra Leone trade to a minimum as compared with former years.

### Production of Nickel in New Caledonia.

On the occasion of the opening of the extraordinary session of the General Council of New Caledonia, M. P. Feillet, Governor of the Colony, referred at some length to the question of the production of nickel.

According to the "Bulletin du Musée Commercial" for the 16th February last, M. Feillet expressed the opinion that the present is no longer the time when it is possible to limit at leisure the production of the nickel with a view to maintaining this metal at high prices. Canada has commenced to work its wealth of nickel, and the capital which it has spent on this enterprise has been so abundant and so judiciously utilised that the sale price of the article will very possibly be reduced to a rate hitherto unknown.

However, neither the wealth nor the intelligence of the Canadian miners will be able to compete with the abundance and purity of the New Caledonian product.

Admitting that, for the use of nickel in its alloys with copper, Canada may compete with New Caledonia, such is not the case in regard to the use of pure nickel or of alloys with steel, the consumption of which will be, in the near future, the most important.—*Board of Trade Journal.*

### The Prospect in Nickel.

The future of the nickel trade is causing much interest in metallurgical circles. Since June last nickel has fallen between 40*l.* and 50*l.* per ton, and this heavy drop has had a serious effect on the industry, which was already in a sufficiently bad way. For the year ended June, 1894, the well known firm of Hussey, Vivian and Co. lost over 40,000*l.*, and now the balance-sheets of the great French company, Société le Nickel, furnish an equally unsatisfactory record. The year showed, as compared with 1892–93, a deficiency of 41,760*l.*, there being 34,560*l.* less profits and 7,200*l.* more expenses. The profit from the sales has fallen from 80,000*l.* to 56,000*l.*, and the interest on debentures has gone up 8,610*l.* Out of the profit balance of 56,120*l.* the directors propose to appropriate 26,800*l.* on depreciation account—6,800*l.* to write off works in Europe, plant, machinery, &c., and 20,000*l.* to be set aside to meet further depreciation on items where it may appear necessary to the council. This permits of only 1,200*l.* being carried over to the current year. What will be the effect of the further great drop in the price of nickel on the accounts to be made up to June next?—*Financial News.*

### Shark Oil.

Shark oil is exported in large quantities from Iceland to Germany. It is of a fine colour, never becomes thick, and is said to possess similar medicinal virtues to cod-liver oil; and no doubt it is often sold in the name of the latter product. A fleet of 100 boats is engaged in the industry every year from January to August. They are schooners of from 30 to 50 tons, with a crew of from 8 to 10 men. The sharks are captured about 20 miles from the coast in the winter, and in the summer about 100 miles away, in deeper water. Every two or three weeks the boats return to port, with from 100 to 120 barrels of liver, which is boiled in dirty and evil-smelling hovels. The sharks captured by the Icelanders reach 20 feet in length and 5 feet in thickness. A liver yields up to five gallons of oil. The neighbourhood of a shark oil refinery is not to be mistaken, as the odour arising therefrom is far from pleasant. The fishermen earn about 35*s.* per month, with a premium of 6*d.* on each barrel of liver. The captain gets 2*s.* 3*d.* per barrel for the first 100, and 3*s.* 4*d.* per barrel for all in excess. Sickness seems to be very rife among sharks, judging from the small quantity of healthy livers, belonging to healthy fish, compared with the greenish ones, from the fish suffering from disease, and the red livers, from the thin, ill-conditioned fish. The Icelanders only take the livers from the fish, and they neglect the fins, skin, and teeth; but that is not so in the Tasmanian fisheries, as in Sydney fins fetch 28*l.* per ton.—*British and Colonial Druggist.*

### Coal in the Faroe Islands.

In several of the Faroe Islands there are coal deposits, more especially in Sudero. Through a long series of years researches and tests have been going on, without, however, much coming of it, and the rights have changed hands more than once. A syndicate has now the matter in hand, and while Professor Johnstrup, the Danish geologist just dead, estimated the deposits as containing upward of 50,000,000 tons, the last report brings the figures up to some 225,000,000 tons in Sudero alone, in addition to which there are deposits of iron and copper ore, &c. The quality of the ore is understood to be quite satisfactory, and the cost is calculated at some 33 per cent. less than that of the Scotch coal.—*Engineering and Mining Journal.*

### Adulterated Borax in the United States.

Complaint is being made in America of the prevalence of adulteration in the borax-packet trade. It is said that several concerns are known to use adulterants extensively in packing borax for their trade. The Pacific Coast Borax Company has published five tests for detecting earthy impurities, alum, carbonates and sulphates, salt, and soda, for the guidance of those interested in the article.—*Chemist and Druggist.*

### Java Castor Oil.

Castor oil is now manufactured on a commercial scale in Java (Dutch Indies), where the plant is plentiful. The oil is made by the cold-drawn process from the seed covered with the husk—the Italian method of husking the seed having proved unsuitable. Samples which have been sent to Europe are said to show a pale yellow odourless oil. It is intended to try the European market with shipments of the article.—*Ibid.*

### The Historic Mine of Aramo.

At the November meeting of the Société de l'Industrie Minerale, M. Grand'Eury presiding, M. Martin, Ing. Civ. Min., made a communication as to the prehistoric mine of Aramo, near Pola de Lena, in the Asturias, as to which he observed that the portion not yet explored will constitute a copper and cobalt mine unique in the whole world. The mine remains the same as it was in the Bronze Age, 30 centuries ago, having been surprised either by a cataclysm or by a hostile invasion. The entries consist of small vertical shafts of 5 to 6 metres (mean 18 ft.), at the mouth of which soldiers probably kept watch to prevent the slave miners from escaping. In one place a skeleton was found bent double in the position of working, and in a fall, a little distance off, another skeleton with tools of horn and polished stone, "matches" (allumettes) of resinous wood the size of a pencil, and torches smeared with fat. Small tubs of wood, with the bottom consisting of a separate piece, sewn together with thongs, served to take up the ore. Throughout the whole mine no trace was found of an iron tool or of prop wood; but the miners must have driven their headings with great patience and considerable muscular force. At the present time a drift is being pushed forward into the same rocks with the best drills and dynamite; but the advance is only 5 m. (16 ft.) per month. Everywhere finger marks are found on the clay in the cracks which was taken out by the hand. The mine has been proved for a vertical height of 150 m. (164 yards); and 12,000 square metres (14,350 square yards) have been worked in a large number of veins from 20 cm. (8 in.) to 2 m. (6 ft. 7 in.) thick, consisting of almost pure oxide of copper and cobalt, with merely a trace of manganese, iron and nickel. The mine was only worked for copper; and the cobalt, derived from the ancient word kobold (witchcraft), interfering with the treatment of copper, was left severely alone. Hollow stones show that the copper was taken out in a nearly pure state; and the refuse constitutes an ore very rich in copper. A ton of refuse taken from various points in the mine yields 80 per cent. of large lumps, 13·5 per cent. of grains, and 6·5 per cent. of powder, producing on an average 15·5 per cent. of copper and 1·5 of cobalt, while numerous samples of the cobalt ore left in the mine show 32 per cent. of cobalt.—*Engineering and Mining Journal.*

### The Almaden Quicksilver Mines in Spain.

The complete statement of the work done at the Almaden quicksilver mine for the year 1894, as given by the "Revista Minera," is important and of much interest. During the year there was excavated at Almaden 6,680 cubic metres of ore, and only 561 cubic metres of barren rock had to be taken out. Most of the mineral was obtained in the crosscuts and galleries on the 12th level, and it was on this level that most of the stoping has been done during the year. The permanent work required the construction of 8,309 cubic metres of masonry in the various galleries and chambers. In weight the extraction for the year amounted to 19,428 metric tons of ore and 1,828 tons of barren rock.

The development work, which is most interesting if we consider the future of the mine, has consisted of the running of a long crosscut on the 12th level starting from the San Teodoro shaft at a depth of 340 metres, the general direction being towards the San Pedro and San Diego shafts, which it is expected will be reached by the end of the present year. The intention is to continue crosscutting north-east of the San Nicholas shaft. It is also intended to open communication between the 11th and 12th levels. All this work, together with that of taking out the necessary amount of mineral to keep up the production, will require some time, especially as all the work now planned will be ended in the year 1900, when the well known contract with the Rothschild house will terminate. In order to hasten the work it is proposed to have recourse to the use of power drills, as proposed some time ago by the mining engineer.

In the furnaces of the Almaden during the year 1894 there were 18,744 tons of ore treated, which produced altogether 44,521 flasks of quicksilver, representing a total weight of 1,535,988 kilos. of quicksilver, the average yield of the mineral treated having been 8·19 per cent. This shows an improvement over the preceding year, when the yield was only 7·82 per cent. The furnaces were run for seven months of the year, having been shut down through the hot season from May to September inclusive. The highest yield reported was 8,059 flasks in December, and the lowest 2,912 flasks in October.—*Ibid.*

### Department of Scientific and Practical Research, Imperial Institute.

(*From Annual Report*, 1894, *Imperial Institute Journal, March* 1895, 115.)

In their report for 1893, the Executive Council directed attention to the necessity for establishing a Department of Scientific and Practical Research at the Institute, if it were hoped to secure the full advantage which should accrue to the Colonies and India, and to the commercial and industrial progress of the Empire generally, from the display at the Institute of the various natural products of its constituent countries in all parts of the globe, the objects of that display being not merely to familiarise the commercial, industrial, and general public with the resources of distant parts of the Empire, but also to provide material for the acquisition of knowledge respecting the nature, properties, and possible uses of new or little known natural products procurable from the Colonies and India. The importance of such knowledge, and the possibility of its attainment through the medium of the Imperial Institute, were recognised at the outset by the Government of India, whose expert authorities, in arranging for the collection, in different parts of India, of samples of products for display at the Institute, directed special attention to the early transmission of such as needed investigation, and appeared to present prospects of advantageous utilisation. The preliminary steps taken towards the establishment of a Department of Research were recounted in last year's report. Not long after the annual meeting, representations were made to the Royal Commissioners for the Exhibition of 1851 as to the prospects of usefulness of such a department, with the result that a small sum of money was granted by the Commissioners towards its establishment, together with an annual grant of 200*l.* for five years, for the payment of skilled employés in it. An application to the Goldsmiths' Company for aid in carrying out the proposal resulted in the munificent grant of 1,000*l.*, to be expended upon fitting up and equipping suitable laboratories. The Committee of Advice, composed of a number of the most eminent scientific workers, was brought together, and divided itself into sub-committees, who undertook to inspect, from time to time, the products of different classes exhibited by the Colonies and India, and to select those which appeared to merit scientific examination and practical testing with promise of advantageous results. Honorary Expert-Referees were appointed to deal with the practical examination of such products as timbers, building stones and cements, fuel, fibres, gums and resins, oils, &c., and individual members of the Scientific Committee themselves have undertaken the investigation of products, of which supplies have been furnished to them from the collections of the Institute. Thus, Messrs. Hummel and Perkin, of the Yorkshire College, Leeds, have investigated several Indian dyestuffs, and have obtained interesting scientific and practical results, which have been published; Messrs. Cross and Bevan have been occupied with the examination of several varieties of fibres, which hitherto have not received application; Messrs. Deering and Redwood have thoroughly investigated the comparative properties of a considerable series of castor oils from India; Professor Dunstan is engaged in the Research Laboratory of the Pharmaceutical Society of Great Britain upon the examination of *Podophyllum emodi* and *Chione glabra*, supplied to him from the collections. Professor Unwin, the well-known engineer, has submitted to mechanical tests a number of woods from African and other localities, and is engaged upon further experiments of this class. Mr. C. E. Collyer (Expert-Referee) has furnished a valuable practical report on the qualities and market value of various Indian fibres, and Mr. Allan Ransome (Expert-Referee) is examining the working properties of various timbers, while the Director of Ordnance Factories is making trials of woods from India and Australia, as substitutes for walnut in the manufacture of gunstocks, and for other purposes connected with the production of war material.

### *The Research Laboratories.*

On the 1st of October last, work was commenced in the the Research Laboratories of the Institute, under the personal superintendence of the Secretary and Director, and one of the first objects dealt with was the technical examination of a series of 30 coals from different parts of India, included in the Indian collections, and the complete analysis of those which proved to be most promising. This investigation will shortly be concluded and reported to the Indian Government. At the same time, a number of fibres from various localities have been chemically and microscopically examined, and the samples, treated in various ways in strict comparison with each other, have been suitably mounted to form the commencement of a reference collection of treated fibres, which will be open to the inspection of manufacturers and merchants. The comparative examination has been commenced of large varieties of Colonial barks and pods, not hitherto utilised, for the purpose of ascertaining their yield of tannin, its particular character in each case, and its behaviour as a dyestuff.

The identification of ores and minerals included in the collections, and other experimental work of a similar kind, are always in progress. This outline of the classes of work undertaken in, and in connection with, the Research Department, the results of which are communicated to the Colonial Authorities concerned, or to the Indian Government, and are published in the Journal of the Institute, will afford some indication of the future practical value of this newly-established branch of the Institute, in advancing a knowledge of the natural resources of the Empire and their utilisation.

### Metric Weights and Measures.

The Weights and Measures Act of 1878 gives a table of equivalents of metric with imperial weights and measures, and provides (section 18) that this table "may be lawfully used for computing and expressing in weights and measures weights and measures of the metric system." Section 21 provided that "a contract or dealing shall not be invalid . . . on the ground that the weights or measures expressed . . . are weights or measures of the metric system"; and section 38 gives the Board of Trade power to verify metric weights and measures by the standards in their possession "if they are satisfied that such weights or measures are intended to be used for the purpose of science or of manufacture, or for any lawful purpose not being for the purpose of trade within the meaning of the Act." The Act of 1889 (section 2) further gives the Board of Trade power to provide local authorities with copies of their metric standards if they think fit to do so. Lastly, in the Model Regulations issued by the Board of Trade in 1890, it is stated that "measures and weights of metric denominations may not be stamped by the inspector for use in trade," but he may verify them for purposes of science or manufacture if he is provided with the standards, or he may send them to the Standards Department.

In November last an inspector under the London County Council informed a London chemical firm that a set of metric weights which he saw on their premises was subject to confiscation, and that they were liable to a penalty for keeping them in their possession. On the matter being brought to the knowledge of the Chemical Section of the London Chamber of Commerce, very little time was lost in drafting a Bill for Parliament, the principal clause of which declares that the Weights and Measures Acts of 1878 and 1889 "shall be so construed as not to prohibit or penalise the use of metric weights and measures, verified by the Board of Trade or local authorities, *by export traders.*"

Instead of proceeding with the Bill, Sir Albert Rollit, the President of the London Chamber of Commerce, moved for and obtained a Select Committee of the House of Commons "to inquire whether any, and what, changes in the present system of weights and measures should be adopted." This Committee has already held two sittings, with Sir Henry Roscoe as Chairman, the other members being Sir John Barran, Mr. Burt, Mr. Crombie, Mr. Charles Fenwick, Mr Allan Gibbs, Mr. Godson, Sir Edward Hill, Mr. Justin McCarthy, Sir Samuel Montagu, Mr. Jasper More, Mr. Fletcher Moulton, Sir Albert Rollit, Mr. Stewart Wallace, Mr. Webster, Mr. Whiteley, and Mr. Wrightson. The Chamber of Commerce, we understand, has named the following four gentlemen a committee to prepare and offer evidence in support of the action desired:—Mr. Charles Finney, Chairman of the Chemical Section, Mr. David Howard, Mr. Francis Yates, and Dr. Stevenson, of Guy's Hospital; and the President of the Pharmaceutical Society and Mr. Martindale are ready to give evidence on behalf of pharmacy generally.

### The Use of Aluminium in Marine Construction.

*Dingler's polyt. J.* 1895, **295**, 62–63.

The success of the small aluminium naphtha boat built by Messrs. Escher, Wyss, and Co. (Zürich) in 1891, and of the yacht "Vendenesse" in 1892, led the French Government to construct the two sectional sloops "Etienne" and "Davoust" for African service, and to place an order with Messrs. Yarrow and Co. for a torpedo boat, followed by a second order for five others for delivery in 1896. Five sloops and some gunboats for the Madagascar station are now on order by the same Government, whilst Messrs. Escher, Wyss, and Co. are preparing two gunboats for the Dutch colonial service, and the Germans are building an aluminium steamer for use on the Victoria Nyanza. The mechanical value of the metal was brought out at the last German manœuvres, where aluminium pontoons, besides being so light that they could be carried by three or four men, resisted well both thrust and blow, showing only harmless indentations, where steel would have been perforated or ruptured. Its resistance to sea-water has been shown by a steamer, which, after 1½ years' use in the Mediterranean, is perfect below the water-line, and only slightly rough above. But this resistance is only possible when the metal is not in direct contact with less electro-positive metals, such as brass or copper. Wherever such contact is made, the aluminium becomes rapidly corroded. Galvanised iron is almost without action, and this or aluminium itself should always be used in place of brass or bronze for fittings in metallic connection with the aluminium shell of the vessel. If the use of other metal be unavoidable, either the aluminium surface immediately adjoining should be in the form of a replaceable plate, or a layer of an insulating material should be placed between the surfaces. Similarly, it was recently found at Kiel that alloys of aluminium (*e.g.*, 94 aluminium and 6 copper) should be always protected with a sea-resisting coat of paint, or they will also, *per se*, become rapidly corroded through local action produced between the copper and aluminium in the alloy itself. Aluminium-nickel alloys gave similar results when tried by the United States navy. The United States reported unfavourably upon the excessive fouling of aluminium bottoms by marine molluscs. This is an experience, however, directly contrary to that of the German authorities at Kiel, who specially observed that aluminium was less fouled than iron under like conditions. Specially unfavourable conditions appear to have prevailed in the American waters.—W. G. M.

### The United States Patent Office in 1894.

Commissioner John S. Seymour reports that at the United States Patent Office during 1894 there were received 38,987 applications for patents, 1,357 applications for design, 95 applications for re-issues, 2,296 caveats, 2,053 applications for registration of trademarks, and 371 applications for labels. There were 20,803 patents granted, including designs; 64 patents re-issued, and 1,806 trademarks registered. The number of patents which expirnd was 12,920. The number of patents which were by operation of law forfeited for non-payment of the final fee was 3,812. The total expenditures were 1,100,047 dols. The surplus of receipts over expenditures were 87,392 dols., and the total balance to the credit of the Patent Office in the Treasury of the United States now amounts to 4,369,136 dols. In proportion to population, more patents were issued to citizens of Connecticut than to those of any other state; next in order came Massachusetts, the District of Columbia, New Jersey, Montana, Rhode Island, New York, and Colorado, in the order named. The fewest patents in proportion to the number of inhabitants were issued to citizens of South Carolina, Mississippi, North Carolina, Arkansas, and Georgia, following in that order. After referring at some length to various practices by which applications without merit were kept for years before the bureau, and recommending a remedy against this practice, the Commissioner says: "I respectfully reiterate my former recommendation that the working force of the Patent Office be increased, and that the appropriation be increased by 64,000 dols., in order that the work of classification which now falls to the present examining corps may be assigned to the increased force. Perfect classification is the indispensable condition upon which reasonably accurate examinations upon the question of novelty may be made. If it were possible to make this accurate examination upon the question of novelty, very much litigation concerning patents would be avoided."—*Engineering and Mining Journal.*

### IMPORTS AND EXPORTS OF COLOURS THROUGH GERMAN CUSTOMS IN 1893 AND 1894.

*Färber Zeitung*, 6, 1894–95, 148—150.

| Imports—I. Exports—E. | | Total Imports and Exports in 1893. | Total Imports and Exports in 1894. | Imports from Exports to Gt. Britain in 1894. |
|---|---|---|---|---|
| | | 100 Kilos. | 100 Kilos. | 100 Kilos. |
| Indigo | I. | 12,725 | 15,072 | 4,577 |
| | E. | 5,917 | 6,066 | 71 |
| Indigo carmine | I. | 592 | 273 | .. |
| | E. | 583 | 514 | .. |
| Logwood | I. | 437,581 | 453,781 | .. |
| | E. | 83,868 | 92,894 | .. |
| Fustic | I. | 55,912 | 54,938 | .. |
| | E. | 10,464 | 13,193 | .. |
| Redwoods | I. | 25,902 | 33,553 | .. |
| | E. | 8,310 | 10,793 | .. |
| Dyewood extracts | I. | 53,823 | 46,535 | 2,219 |
| | E. | 16,945 | 13,438 | 1,096 |
| Madder | I. | 2,449 | 1,936 | .. |
| | E. | 1,545 | 1,819 | .. |
| Cochineal | I. | 757 | 712 | .. |
| | E. | 331 | 287 | .. |
| Safflower | I. | 16 | 12 | .. |
| | E. | 1 | 9 | .. |
| Quercitron | I. | 9,776 | 10,210 | .. |
| | E. | 796 | 946 | .. |
| Catechu | I. | 57,190 | 59,692 | 7,504 |
| | E. | 13,521 | 12,800 | .. |
| Orchil, orchil extract, &c. | I. | 5,194 | 2,028 | .. |
| | E. | 1,335 | 2,260 | .. |
| Alizarin | I. | 391 | 295 | 58 |
| | E. | 80,358 | 77,346 | 24,521 |
| Aniline and coal-tar colours | I. | 7,302 | 7,405 | 1,059 |
| | E. | 115,599 | 123,681 | 24,970 |
| Colour lakes | I. | 77 | 61 | .. |
| | E. | 5,858 | 4,560 | 1,187 |
| Vermilion | I. | 179 | 79 | .. |
| | E. | 2,487 | 2,930 | 1,410 |
| Red lead | I. | 3,842 | 4,122 | 3,868 |
| | E. | 56,574 | 55,257 | 13,150 |
| Prussian blue | I. | 2,863 | 1,367 | .. |
| | E. | 6,393 | 7,142 | 2,068 |
| Ultramarine | I. | 461 | 465 | .. |
| | E. | 41,423 | 40,979 | 15,418 |
| Printers' ink | I. | 282 | 271 | .. |
| | E. | 8,850 | 9,774 | .. |
| Lamp black | I. | 2,133 | 2,786 | .. |
| | E. | 9,788 | 11,298 | .. |
| Natural mineral colours | I. | 76,565 | 64,256 | 16,375 |
| | E. | 96,801 | 101,366 | 7,161 |
| Painters' and distemper colours | I. | 756 | 850 | 219 |
| | E. | 13,544 | 13,831 | 2,116 |

—H. I.

## *BOARD OF TRADE RETURNS*

### SUMMARY OF IMPORTS.

| Articles. | Month ending 28th February 1894. | Month ending 28th February 1895. |
|---|---|---|
| | £ | £ |
| Metals | 1,529,142 | 1,302,753 |
| Chemicals and dyestuffs | 721,477 | 620,393 |
| Oils | 509,931 | 404,087 |
| Raw materials for non-textile industries. | 2,438,774 | 1,875,018 |
| Total value of all imports | 33,984,085 | 28,134,489 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 28th February 1894. | Month ending 28th February 1895. |
|---|---|---|
| | £ | £ |
| Metals (other than machinery) | 2,117,208 | 1,811,973 |
| Chemicals and medicines | 696,458 | 613,476 |
| Miscellaneous articles | 2,032,485 | 2,005 897 |
| Total value of all exports | 17,679,449 | 15,968,395 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. 1894. | Quantities. 1895. | Values. 1894. | Values. 1895. |
|---|---|---|---|---|
| | | | £ | £ |
| Alkali ............ Cwt. | 5,695 | 2,393 | 5,149 | 2,25[illegible] |
| Bark (tanners', &c.) „ | 17,324 | 8,517 | 7,126 | 3,783 |
| Brimstone ........ „ | 46,505 | 66,5[illegible]0 | 10,377 | 11,948 |
| Chemicals...... Value £ | .. | .. | 122,963 | 71,961 |
| Cochineal ........ Cwt. | 421 | 824 | 2,532 | 6,111 |
| Cutch and gambier Tons | 3,701 | 445 | 66,903 | 11,207 |
| Dyes :— | | | | |
| Alizarin ...... Value £ | .. | .. | 20,010 | 28,441 |
| Aniline and other „ | .. | .. | 20,422 | 16,001 |
| Indigo ........... Cwt. | 12,707 | 16,751 | 262,219 | 326,990 |
| Nitrate of potash . „ | 26,478 | 11,763 | 24,118 | 11,172 |
| Valonia ........... Tons | 2,986 | 1,976 | 39,173 | 23,410 |
| Other articles... Value £ | .. | .. | 140,485 | 107,083 |
| Total value of chemicals | .. | .. | 721,477 | 620,393 |

### IMPORTS OF OILS FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut........ Cwt. | 22,616 | 7,997 | 28,257 | 8,757 |
| Olive ............. Tuns | 1,966 | 546 | 54,658 | 21,971 |
| Palm ............. Cwt. | 70,323 | 89,274 | 83,228 | 93,471 |
| Petroleum ........ Gall. | 9,112,689 | 8,442,378 | 133,214 | 129,113 |
| Seed ............. Tons | 1,626 | 2,849 | 41,954 | 61,299 |
| Train, &c. ........ Tuns | 1,336 | 917 | 23,585 | 16 625 |
| Turpentine ....... Cwt. | 38,619 | 11,176 | 43,352 | 10,748 |
| Other articles .. Value £ | .. | .. | 101,683 | 62,103 |
| Total value of oils ... | .. | .. | 509,931 | 404,087 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 8,577 | 2,871 | 15,160 | 4,664 |
| Bristles.......... Lb. | 180,630 | 219,381 | 29,043 | 23,823 |
| Caoutchouc...... Cwt. | 24,188 | 27,212 | 294,394 | 332,019 |
| Gum :— | | | | |
| Arabic......... „ | 5,721 | 4,760 | 13,905 | 11,698 |
| Lac, &c. ....... „ | 4,781 | 6,951 | 25,257 | 33,074 |
| Gutta-percha .... „ | 3,830 | 2,872 | 29,626 | 25,151 |
| Hides, raw :— | | | | |
| Dry............ „ | 37,713 | 24,363 | 88,566 | 51,904 |
| Wet ........... „ | 49,159 | 39,640 | 101,873 | 77,390 |
| Ivory ............ „ | 506 | 1,329 | 22,363 | 50,794 |
| Manure :— | | | | |
| Guano ......... Tons | 3,623 | 554 | 20,707 | 3,843 |
| Bones.......... „ | 12,395 | 9,290 | 58,774 | 41,475 |
| Nitrate of soda... „ | 13,079 | 5,410 | 120,749 | 47,886 |
| Phosphate of lime „ | 27,260 | 21,810 | 55,827 | 41,135 |
| Paraffin.......... Cwt. | 48,319 | 64,010 | 52,614 | 62,751 |
| Linen rags....... Tons | 1,251 | 1,052 | 12,436 | 10,625 |
| Esparto.......... „ | 19,315 | 13,854 | 81,933 | 61,614 |
| Pulp of wood .... „ | 19,777 | 14,608 | 104,962 | 75,847 |
| Rosin............ Cwt. | 155,505 | 110,905 | 35,988 | 24,924 |
| Tallow and stearin „ | 80,658 | 31,905 | 105,628 | 40,928 |
| Tar ..............Barrels | 1,655 | 101 | 1,063 | 34 |
| Wood :— | | | | |
| Hewn ......... Loads | 120,356 | 88,883 | 185,943 | 122,562 |
| Sawn .......... „ | 64,451 | 34,576 | 154,989 | 81,567 |
| Staves ......... „ | 3,838 | 4,186 | 19,578 | 22,522 |
| Mahogany ..... Tons | 4,759 | 2,184 | 40,176 | 17,149 |
| Other articles....Value £ | .. | .. | 764,220 | 609,633 |
| Total value ....... | .. | .. | 2,138,774 | 1,875,018 |

Besides the above, drugs to the value of 55,696*l.* were imported, as against 68,366*l.* in February 1894.

### IMPORTS OF METALS FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper :— | | | | |
| Ore............ Tons | 3,354 | 3,869 | 24,454 | 16,716 |
| Regulus ........ „ | 4,707 | 6,453 | 120,376 | 175,692 |
| Unwrought .... „ | 4,301 | 3,967 | 184,685 | 162,243 |
| Iron :— | | | | |
| Ore............ „ | 333,464 | 296,668 | 239,626 | 204,623 |
| Bolt, bar, &c. ... „ | 2,455 | 1,756 | 19,363 | 13,448 |
| Steel, unwrought.. „ | 488 | 396 | 4,997 | 3,717 |
| Lead, pig and sheet „ | 13,895 | 9,855 | 127,880 | 94,985 |
| Pyrites ........... „ | 53,133 | 44,899 | 86,828 | 72,795 |
| Quicksilver....... Lb. | 465,750 | 1,250,080 | 40,998 | 108,303 |
| Silver ore....... Value £ | .. | .. | 290,382 | 99,718 |
| Tin ............... Cwt. | 44,565 | 58,486 | 161,148 | 178,204 |
| Zinc .............. Tons | 3,730 | 3,037 | 61,201 | 44,612 |
| Other articles ...Value £ | .. | .. | 167,204 | 127,697 |
| Total value of metals | .. | .. | 1,529,142 | 1,302,753 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 8,129 | 7,856 | 31,615 | 29,965 |
| Copper :— | | | | |
| Unwrought ..... „ | 25,841 | 32,402 | 58,593 | 69,836 |
| Wrought........ „ | 30,500 | 18,449 | 82,594 | 48,353 |
| Mixed metal .... „ | 31,471 | 14,190 | 70,048 | 31,095 |
| Hardware ..... Value £ | .. | .. | 140,298 | 124,487 |
| Implements....... „ | .. | .. | 90,556 | 77,688 |
| Iron and steel..... Tons | 173,861 | 157,830 | 1,316,379 | 1,294,758 |
| Lead ............. „ | 3,606 | 2,338 | 42,274 | 29,679 |
| Plated wares... Value £ | .. | .. | 17,291 | 19,070 |
| Telegraph wires „ | .. | .. | 133,118 | 9,411 |
| Tin ............... Cwt. | 10,078 | 6,624 | 38,593 | 21,500 |
| Zinc .............. „ | 10,611 | 11,351 | 7,825 | 9,367 |
| Other articles .. Value £ | .. | .. | 58,024 | 46,964 |
| Total value ......... | .. | .. | 2,117,208 | 1,811,973 |

### EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 429,758 | 394,760 | 126,952 | 99,640 |
| Bleaching materials ,, | 77,237 | 98,446 | 30,455 | 34,319 |
| Chemical manures. Tons | 33,839 | 25,034 | 246,125 | 194,423 |
| Medicines....... Value £ | .. | .. | 77,895 | 75,739 |
| Other articles ... ,, | .. | .. | 215,031 | 209,355 |
| Total value .......... | .. | .. | 696,458 | 613,476 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 28TH FEBRUARY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 661,800 | 327,000 | 15,956 | 7,326 |
| Military stores.. Value £ | .. | .. | 99,610 | 98,222 |
| Candles.......... Lb. | 1,399,700 | 1,767,200 | 25,023 | 29,350 |
| Caoutchouc ..... Value £ | .. | .. | 81,817 | 89,446 |
| Cement.......... Tons | 26,822 | 14,347 | 44,299 | 23,160 |
| Products of coal Value £ | .. | .. | 87,012 | 105,075 |
| Earthenware ... ,, | .. | .. | 102,155 | 120,512 |
| Stoneware ...... ,, | .. | .. | 13,551 | 8,304 |
| Glass:— | | | | |
| Plate........... Sq. Ft. | 100,990 | 92,048 | 5,304 | 4,781 |
| Flint........... Cwt. | 6,320 | 6,336 | 14,774 | 13,991 |
| Bottles......... ,, | 49,627 | 45,770 | 24,092 | 21,864 |
| Other kinds.... ,, | 10,627 | 13,316 | 8,620 | 10,317 |
| Leather:— | | | | |
| Unwrought .... ,, | 11,130 | 9,429 | 102,913 | 83,711 |
| Wrought ..... Value £ | .. | .. | 16,040 | 24,296 |
| Seed oil.......... Tons | 5,888 | 3,171 | 123,552 | 63,548 |
| Floorcloth ..... Sq. Yds. | 1,861,600 | 2,273,600 | 66,639 | 73,279 |
| Painters' materials Val. £ | .. | .. | 105,579 | 101,568 |
| Paper ........... Cwt. | 65,663 | 60,077 | 104,239 | 97,916 |
| Rags............. Tons | 4,161 | 2,790 | 22,559 | 17,779 |
| Soap............. Cwt. | 46,846 | 38,094 | 46,455 | 40,956 |
| Total value .......... | .. | .. | 2,032,485 | 2,005,897 |

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### APPLICATIONS.

3490. T. Labinal. Improvements in pumps for rarefying or compressing gases. Complete Specification. Filed February 18. Date applied for September 24, 1894, being date of application in France.

3595. J. N. Carey. Improvements in filters. Complete Specification. February 19.

4282. J. J. Green and W. Oates. *See* Class II.

4429. C. Zimmermann. Improvements in and relating to apparatus for drying superphosphates and other granular materials. March 1.

4680. G. C. Marks.—From E. Wauquier and Fils, France. Improved centrifugal apparatus for the continuous decantation of liquids and the automatic separation of any matter in suspension therein. Complete Specification. March 5.

4684. C. Kramer. Improvements in wooden vessels for the transportation of acids and other corrosive liquids. March 5.

4792. J. E. Carroll. Improvements in boiler feed-water heating and purifying apparatus. March 6.

4882. V. J. Kuess. Retort for distilling heavy bodies in general, and particularly gum and resin. March 7.

5103. E. C. Mills and J. G. Chamberlain. Improvements in surface condensers. March 11.

5113. P. F. Holmes. Improvements in apparatus for washing gases. Complete Specification. March 11.

5496. J. B. Alliott. Improvements in evaporating apparatus. March 15.

### COMPLETE SPECIFICATIONS ACCEPTED.*

1894.

3414. A. J. Boult.—From P. de Mol and A. Wilbaux. Improvements in or relating to the filtration and purification of liquids, and apparatus therefor. March 20.

6495. E. Hermite, E. J. Paterson, and C. F. Cooper. A process for protecting iron pipes from corrosion by passage of electrolysed chloride solutions employed as disinfectants. March 6.

8643. C. L. W. Albach. Improvements relating to the lixiviation of dyewood, bark, hops, and other materials, and to apparatus therefor. March 13.

9815. P. M. F. Laurent. Improved apparatus for sterilising liquids, applicable also for heating, cooling, condensing, distilling, and other similar purposes. February 27.

20,175. O. Perrier. Improvements in processes and apparatus for distillation. March 6.

24,199. J. A. Fisher. Improvements in non-conducting compositions for coating boilers and for like uses. March 13.

1895.

803. G. Morris and H. L. Wethered. *See* Class XVII.

1889. S. Taylor. Improvements in appliances for use with crucibles or melting-pots during the melting of metals and metallic alloys in the said crucibles or pots. March 6.

1956. D. P. F. Cardozo. Improvements in evaporating apparatus. March 20.

## II.—FUEL, GAS, AND LIGHT.

### Applications.

3487. H. Strache. Improved process of and apparatus for the generation of water-gas from coke, coal, or other fuel. February 18.

3715. J. B. Torres. Improvements in and connected with the production and manufacture of gas, gaseous compounds, and hydro-carbides. February 21.

3962. J. J. Green and W. Oates. Improvements in gas retorts. February 25.

4282. J. J. Green and W. Oates. Improvements in retorts for the manufacture of gas and for other purposes. February 28.

4437. A. Baker. An improved method of rendering water-gas odoriferous. March 1.

4750. W. Ure and S. T. Croasdell. Improvements in constructing and working coke ovens for the manufacture of metallurgic coke. March 6.

4799. J. E. Campbell. Improvements in the manufacture or preparation of materials for the purification of gas, sewage, or the like. March 6.

4879. G. Haycraft. Improvements relating to the manufacture of artificial fuel. March 7.

5036. J. West. Improvements in machinery or apparatus for charging gas retorts. Complete Specification. March 9.

5128. R. E. Middleton and J. E. Harris. Improvements in the production of steam or gases from water. March 11.

5528. P. Jensen.—From O. Arlt, Germany. Improvements in the manufacture of block fuel. March 15.

5529. H. H. Lake.—From E. N. Dickerson and J. J. Suckert, United States. An improved process of and apparatus for producing and liquefying acetylene gas. Complete Specification. March 15.

### Complete Specifications Accepted.

1894.

5092. F. Williams. An improved method of using small coke or breeze in the manufacture of coke and coke bricks. February 27.

7599. J. A. A. Nystrom. An improved fire-lighter. March 20.

7911. R. Middleton. Improvements in machinery for manufacturing blocks or briquettes of fuel or materials for smelting and analogous purposes. February 27.

23,297. N. van der Sleen and A. Schnellen. Improvements in and relating to an apparatus and a method for causing chemical changes of gases and mixtures of gases by dark electric discharges. March 20.

1895.

283. G. Huttemann and G. Spiecker. Improvements in the manufacture of blocks or briquettes of fuel. February 13.

988. J. M. Rusby. Improvements in water-gas apparatus. March 20.

1961. A. J. Boult.—From G. Cabric. Improvements in carburettors. March 6.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Complete Specifications Accepted.

1894.

7862. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. Improvements in the purification of anthracene. February 27.

8371. J. Bryson, J. Jones, and W. Fraces. Improvements in or relating to retorts for the distillation of shale and other bituminous substances. March 6.

## IV.—COLOURING MATTERS AND DYES.

### Applications.

3488. S. Pitt.—From L. Cassella and Co., Germany. Manufacture of blue safranine-azo dyestuffs. February 18.

3497. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of naphthafluoresceine. February 18.

3498. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of azo colouring matters and their treatment on fibre. February 18.

3579. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. Improvements in the manufacture or production of azo dyestuffs from sulphonic or sulphaminic acids, and in the mode of obtaining these sulphonic or sulphaminic acids. February 19.

3580. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of a new dihydroxynaphthalene, and of certain sulphonic acids derived from this dihydroxynaphthalene, or from the corresponding amidohydroxynaphthalene. February 19.

3612. La Société Anonyme des Matières Colorantes et Produits Chimiques de Saint Denis and R. Vidal. Improvements relating to the manufacture of compounds designed for dyeing and printing. February 19.

3854. J. Imray.—From J. Bierer and La Société L. Durand, Huguenin, and Cie., Switzerland. Manufacture of new blue gallocyanine colouring matters. Complete Specification. February 22.

4018. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Manufacture of direct dyeing colouring matters. February 25.

4448. A. G. Green and R. Jansen. The manufacture and production of a new amido base and of colouring matters therefrom. March 1.

4594. A. G. Green. *See* Class XIII.

4880. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. March 7.

4961. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of derivatives of hydroxy-anthraquinone. March 8.

4962. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of alpha$_1$-beta$_2$-dihydroxynaphthalene, a new alpha$_1$-beta$_2$-dihydroxynaphthalene sulphonic acid, and of colouring matters derived from alpha$_1$-beta$_2$-dihydroxynaphthalene sulphonic acids. March 8.

4985. H. Imray.—From The Basle Chemical Works, Bindschedler, Switzerland. Manufacture of colouring matters of the group of the phthaleines. Complete Specification. March 8.

5,042. H. E. Newton.—From the Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of new basic azine dyestuffs, and of new derivatives thereof. March 9.

5114. O. Imray.—From The Society of Chemical Industry in Basle, Switzerland. Manufacture of orange to brown colouring matters. March 11.

5153. A. Bang.—From G. A. Dahl, Germany. Mordant-dyeing dyestuffs. March 12.

### Complete Specifications Accepted.

1894.

4870. J. Altschul. Improvements in the manufacture and application of a new diazo compound for use in dyeing and printing. March 13.

7786. H. H. Lake.—From Wirth and Co., agents for A. Leonhardt and Co. Improvements in the manufacture of nitroso compounds. February 27.

7859. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture or production of colouring matters and materials therefor. February 27.

9291. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Improvements in the manufacture of artificial indigo white and of bodies related to the indigo group. March 20.

9411. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of dyestuffs. March 20.

9443. J. Imray.—From R. Vidal and La Société Anonyme des Matières Colorantes et Produits Chimiques. Manufacture of colouring matters applicable to unmordanted fibres or fabrics. March 13.

9529. S. Pitt.—From L. Cassella and Co. The production of polyazo dyestuffs from gamma-amidonaphtholsulpho acid. March 20.

9856. C. D. Abel.—From The Actien Gesellschaft fur Anilin Fabrikation. Improvements in the manufacture of colouring matters dyeing blue with mordants. March 13.

10,194. J. Y. Johnson.—From the Badische Anilin and Soda Fabrik. The manufacture and production of new dyes of the rhodamine series. March 20.

10,333. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters varying from blue-violet to blue-green. March 20.

13,156. C. D. Abel. — From A. Fischesser and Co. Manufacture of naphthylendiamine sulpho acids. March 20.

13,203. C. D. Abel. — From A. Fischesser and Co. Manufacture of a new 1.8-amidonaphtholdisulpho acid from 1.8-naphthylendiaminetrisulpho acid. March 20.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

3502. W. Wells and S. Murgatroyd. *See* Class XIX.

3590. E. Lasbordes. A process for chemically cleansing wool and woollen fabrics and rags. February 19.

4082. T. H. K. Lees, E. T. Lees, and A. E. Lees. A new or improved prepared canvas for decorative purposes. February 26.

4999. J. Williams. Improvements in and connected with waterproofing paper, textile, and analogous fabrics. March 8.

5089. T. Pickles. Improvements in the treatment of cotton warps or warp yarns for weaving or other like purposes. March 11.

5108. A. Pickstone and C. Pickstone. *See* Class XIV.

5450. W. K. Greenway. *See* Class VII.

### Complete Specifications Accepted.

1894.

7975. O. Reichenbach. New or improved apparatus for use in degreasing or otherwise cleansing wool or other fibres. March 20.

8893. E. Cadoret and A. Jost. An improved process for treating vegetable substances suitable for the manufacture of woven fabrics, by converting them into soft and silky fibres adapted for spinning and dyeing. March 13.

1895.

941. K. H. E. Balatsch and A. Rayer. Improved process for removing pitch, tar, and other coloured impurities from finished or partially finished fabrics. March 13.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

3752. T. Lye and W. T. Lye. Improvements in the dyeing or colouring of "chip," "chip plait," and other like materials. February 21.

3905. L. Rivett and R. H. Scott. Improvements in printing calico and other woven fabrics of cotton and cotton warps. February 23.

4108. J. Tait. *See* Class IX.

4284. J. A. O'Loughlin. Improvements in apparatus for indigo dyeing. February 28.

4573. G. R. Hildyard. Improvements in the process of and apparatus for producing printed designs upon paper or other surfaces. March 4.

4671. J. G. Haslam. Improvements in dyeing apparatus. March 5.

5075. G. Keighley. An improved means or method of dyeing and bleaching warp upon a warp beam. Complete Specification. March 11.

### Complete Specifications Accepted.

1894.

8558. E. Cadoret and A. Jost. Improvements in the process of and apparatus for bleaching and treating fibrous materials and fabrics. March 13.

8767. F. Barraclough. Improvements in machines for scouring and dyeing textile warp or other yarns. February 27.

8969. G. N. Midwood and C. Edmeston. Improvements in dyeing and otherwise treating cotton and other piece goods, and in machinery or apparatus to be used for that purpose. March 13.

12,762. M. Kalisch, W. A. Rosenberg, and J. Entwistle. Improvements in the manufacture or production of cloths in variegated colours. February 27.

23,741. S. H. Sharp. Improved method and machinery or apparatus for producing designs on textile and felted fabrics and the like. March 6.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

3477. W. P. Thompson.—From C. von Der Linde, Germany. An improved process for obtaining acetic acid from pyrolignate of lime. Complete Specification. February 18.

3485. O. Imray.—From The Chemische Fabrik Rhenania, Germany. Process for the production of caustic lyes of the alkalis. February 18.

3489. T. H. Bell.—From T. Schloesing, France. Improvements in the manufacture of chlorine by means of magnesium chloride. February 18.

3509. J. W. Swan and J. A. Kendall. Improvements in means to be employed in the manufacture or production of cyanides. February 18.

3588. H. W. Crowther and D. J. Playfair. Apparatus for the manufacture of sulpho-cyanides. February 19.

3960. W. A. Barlow.—From F. Beltzer, France. Improvements in and in means for the manufacture of alkaline bichromates by corresponding alkaline sulphates. February 23.

4242. J. J. Alsberge. New process for the manufacture of chlorine. February 27.

4267. J. Y. Johnson.—From The Verein Chemischer Fabriken, Germany. Improvements in the manufacture or production of chlorine. February 27.

4147. A. E. Hetherington, W. M. Sowerby, and J. Brock. Improvements in the manufacture or purification of bicarbonate of soda. March 1.

4556. C. W. Watts. Improvements in the manufacture of ferro-cyanides from sulpho-cyanides. March 4.

4856. N. P. Pratt. Improvements in or relating to the manufacture of sulphuric acid. Complete Specification. March 7.

5064. B. Bagshawe.—From T. L. Willson, United States. Calcium carbide process and product. March 9.

5299. O. Alius and M. Treitel. Improved apparatus for producing carbonic acid. Complete Specification. March 13.

5354. H. J. Dartnell. Utilising the drainage and bilge water collecting in the bilge and limbers of ships used for the transportation of nitrate of soda. Complete Specification. March 13.

5450. W. K. Greenway. A non-inflammable solution for wood, paper, fabrics, and the like. March 15.

### Complete Specifications Accepted.

1894.

5300. W. Mills. Improvements in utilising spent iron pyrites and apparatus therefor. March 13.

6925. W. McD. Mackey and J. F. Hutcheson. Improvements in making potassic cyanide and apparatus therefor. March 13.

9979. T. Craney. Improvements relating to the manufacture of sodium bicarbonate and to apparatus therefor. March 13.

10,604. J. Y. Johnson.—From The Verein Chemischer Fabriken. A process of manufacture of chlorine from hydrochloric acid gas and nitric acid by the employment of sulphuric acid. March 20.

22,569. B. Peitzsch. Improvements in the manufacture of sulphides of the alkalis. March 20.

1895.

1967. C. H. Huntley. Improvements in recovering salts or salines from solutions. March 6.

## VIII.—GLASS, POTTERY, and ENAMELS.

### Applications.

3486. A. Eisenberg and H. Byk. An improved process for gilding glassware by means of gold lustre. February 18.

3560. V. F. L. Smidth. Improvements in the construction of drying chambers for bricks, pottery, or other objects to utilise waste heat. Complete Specification. February 19.

3606. J. D. Brown. Improvements in the manufacture of imitation stained glass. February 19.

3932. G. F. Chance and Chance Brothers and Co., Lim. Improvements in or substitutes for the flattening stones employed in the flattening of sheet glass and in treating or preparing the surfaces of other articles or appliances used in the manufacture of sheets of glass. February 23.

3990. A. Roberts. Improvement in the manufacture of ceramic tiles. February 25.

4753. T. Heptinstall. Improvements in or connected with glass furnaces. March 6.

4776. F. Griffin. Improved means for producing the appearance of embossed glass. March 6.

4855. E. Jones. Improvements in or relating to kilns for burning or otherwise treating bricks, terra-cotta ware, or articles formed of clay. March 7.

4881. G. F. Rose. Improvements in apparatus for drying china clay, china stone, and similar substances. March 7.

5008. T. H. Stubbs. Improved method or methods of decorating tiles or the like. Complete Specification. March 9.

5333. J. Anley. Improvements in the manufacture of glass bottles. March 13.

### Complete Specifications Accepted.

1894.

8076. D. Jones, W. W. Wardle, and A. W. Beech. Improvements in ornamenting china, earthenware, and other fictile articles. March 6.

22,028. C. D. d'Enghien, A. D. d'Enghien, and S. D. d'Enghien. Improvements in kilns or ovens for firing terra-cotta and other like materials. March 13.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

### Applications.

3467. W. Stevenson. Improved continuous-firing kiln for burning clay material. February 18.

3561. J. F. Kleine. Improvements in fire- and damp-proof ceilings and walls. Complete Specification. February 19.

3604. J. Worthington. Improvements relating to the manufacture of bricks and tiles. February 19.

3608. F. Young. Improvements in or relating to the manufacture of fire-clay refractory and non-conducting bricks and blocks, building bricks, or the like. February 19.

4048. G. von Breymann-Schwertenberg. Improved portable solid structures or blocks for building purposes. Complete Specification. February 25.

4491. J. F. de Navarro. Improvements in apparatus relating to the burning of materials used in the manufacture of cement, hydraulic limes, and similar substances, and for obtaining waste products therefrom. Complete Specification. March 2.

4973. L. Jones. Improvements in the manufacture of fire-clay. March 8.

### Complete Specification Accepted.

1894.

6890. G. S. Cory and J. R. Casbay. Improvements in paving for roads and streets. March 6.

## X.—METALLURGY, MINING, Etc.

### Applications.

3491. J. B. Torres. Improvements in extracting gold and silver from ores, and the like. February 18.

3492. J. B. Torres. Improvements in extracting gold and silver from ores, and the like. February 18.

3499. E. de Frey. An improved manufacture of gold foil for use in dentistry. Complete Specification. February 18.

3879. J. B. Torres. Improvements in and connected with the reduction and extracting of gold, silver, and precious metals from ores and the like. February 23.

3933. F. W. Scott, jun. A method of and apparatus for the preparation of zinc for use in the precipitation or recovery of gold by cyanide of potassium. February 23.

3934. J. Mactear. Improvements in the obtainment of precious metals. February 23.

3959. H. H. Lake.—From P. Manhes, France. An improved process of desulphuration of castings and alloys of nickel and cobalt. February 23.

4004. J. Mactear. Improvements in the extraction of precious metals from their ores or from compounds containing the same. February 25.

4027. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. A process of and means for protecting iron, steel, and the like materials from rust. February 25.

4595. A. de C. Scott. Improved process and apparatus for treating ores or liquors containing gold or silver, or both. March 4.

4808. J. Armstrong. Method of abstracting gold and silver from the matrix or ores in which they are found, and apparatus therefor. March 7.

4817. B. H. Thwaite and T. J. Denny. Improvements in solvent methods of extracting gold and silver from auriferous and argentiferous ores, and in plant therefor. March 7.

5000. J. B. Torres. Improvements in and connected with the reduction and extraction of metals from their oxides and other compounds, and forming of alloys therefrom. March 9.

5201. J. B. Torres. Improvements in extracting and reducing metals from ores and other metallic compounds and the like. March 12.

5295. R. C. Smith and A. B. Brown. Improvements in making chilled castings. March 13.

5512. H. Potter.—From C. Dormoy, France. An improved composition for anti-friction metal. March 15.

5513. L. Rousseau. Improvements in furnaces for smelting metals. March 15.

5539. H. Potter.—From C. Dormoy, France. An improved composition for anti-friction metal. March 15.

### Complete Specifications Accepted.

1894.

6743. E. Bonehill. Improvements in and apparatus for, or connected with, puddling raw, cast, or pig iron. February 27.

8184. J. S. MacArthur. Improvements in precipitating precious metals from cyanide or similar solutions. March 6.

8401. H. Ramage. Improvements in or connected with the preparation or coating of aluminium surfaces, and in alloys or metallic mixtures therefor, and for soldering. March 13.

8712. J. Brock and J. F. Allen. Improvements in the manufacture and production of alloys of copper and manganese. February 27.

24,278. C. D. Abel. — From Electricitats-Gesellschaft Gelnhausen mit beschrankter Haftung. Method and apparatus for the production of metals and other fusible materials in pulverulent form. February 27.

1895.

469. B. Moebius. Improvements in method of and apparatus for separating metals. February 27.

1889. S. Taylor. *See* Class I.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

3625. C. Oppermann and E. Bailey. An improved process for coating or plating metals with aluminium or aluminium alloys by electrolysis. February 19.

3791. H. Boas. Improved process for the manufacture of glass mirrors or metallic surfaces by metallic deposition. February 21.

3809. J. B. Torres. Improvements in electric and galvanic batteries and accumulators. February 22.

4154. The Cowper-Coles Galvanising Syndicate, Lim., and S. O. Cowper-Coles. Improvements in apparatus for use in electro-deposition. February 26.

4245. G. Laura. Improvements in electrical galvanic batteries. Complete Specification. February 27.

4610. W. A. Boese. Improvements in or relating to secondary batteries or electric accumulators. Complete Specification. March 4.

4660. A. Hiorns. Improvements relating to the electro-deposition of iron on copper or other metallic surfaces. March 5.

4939. E. Andreoli. Indirect electrolysis. Complete Specification. March 8.

### Complete Specifications Accepted.

1893.

22,053. V. C. Doubleday.—From M. Sussmann. Improvements in or connected with so-called dry electrolytes for secondary batteries. February 27.

1894.

6497. E. Hermite, E. J. Paterson, and C. F. Cooper. Improvements in apparatus for electrolysing chloride solutions employed for disinfecting. March 20.

6975. A. J. Smith and H. J. Wright. Improvements relating to the manufacture of plates or electrodes for electric accumulators or secondary batteries, and to machinery or apparatus therefor. March 13.

7801. C. Kellner. Improvements in or relating to electrolytical apparatus. February 27.

7994. E. de Pass.—From H. Thofehrn. An improved electrolytic trough or cell. February 27.

8350. H. H. Leigh.—From Vohwinkel. Improvements in electric batteries. March 20.

8480. T. H. Rushton. Improvements in and relating to galvanic batteries. March 6.

8972. F. Griffin. Improvements in or relating to secondary batteries. March 20.

21,323. W. P. Thompson.—From C. L. Coffin. Improvements in apparatus for welding electrically. March 6.

1895.

563. I. Klein. Process for compressing and moulding electrolytically obtained metallic precipitates. February 27.

1446. C. B. Schoenmehl and C. M. Platt. Improvements in galvanic batteries. March 20.

3183. L. Wacker. Process for the production of concentrated sulphuric acid by means of electrolysis. March 20.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

3466. J. T. A. Walker. An improved detergent or washing powder. February 18.

3615. E. Fahrig. Process of extracting fat from wool and other fibrous materials. Complete Specification. February 19.

4222. D. W. Nightingale and H. H. Perkes. Improvements in the manufacture of dry soap. February 27.

5197. J. H. Filbert. Apparatus for deodorising fats and oils. Complete Specification. March 12.

5226. A. J. Boult.—From G. W. Washburn, United States. Improvements in or relating to the treatment of cotton-seed. Complete Specification. March 12.

5301. J. S. Taylor and C. Davies. Improvements in the manufacture of soap. March 13.

### Complete Specification Accepted.

1894.

8022. J. H. Iredale and J. W. W. Huddleston. Improvements in soap. February 27.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

4409. J. Altschul. The manufacture and production of new india-rubber substitutes. March 1.

4594. A. G. Green. Improvements in the manufacture or production of solutions of aniline colours, and the employment of the same for colouring paints or varnishes, india-rubber, and for other like purposes. March 4.

4882. V. J. Kuess. *See* Class I.

5254. A. Imschenetzky. Manufacture of fireproof and insulating compounds. March 12.

### Complete Specifications Accepted.

1894.

4505. J. S. Macarthur. New or improved composition for varnishing or polishing. March 6.

5414. A. R. von Pischof. An improved process for manufacturing a plastic substance. March 20.

24,199. J. A. Fisher. *See* Class I.

1895.

1372. D. Marcus. An improved material for lacquering surfaces. March 20.

2636. R. Alberti. An improved paint, specially applicable as a substitute for white lead, zinc white, and the like, and process of manufacturing the same. March 20.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Application.

5108. A. Pickstone and C. Pickstone. An improved mixture for use in combination with sizing and finishing compounds or dressings for application to yarns, warps, and woven fabrics. March 11.

### Complete Specifications Accepted.

1894.

24,735. O. Finsen. The preparation of a new product from blood. March 13.

1895.

615. G. Seeligmann. A new or improved method and apparatus for testing the adhesiveness of glue and such like. March 13.

## XV.—AGRICULTURE and MANURES, Etc.

### Application.

4893. S. Mikovinyi. Improvements in the manufacture of artificial manure. March 7.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Application.

4803. J. Soltau. An improved process for removing the gum or glutinous matter from textile fibres. Complete Specification. March 6.

### Complete Specification Accepted.

1894.

1953. E. Shaw. Improved apparatus for boiling sugar and glucose, either separately or mixed. March 6.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

3480. A. Ravinet. Improvements in apparatus or machinery for the manufacture or production of malt. February 18.

3640. R. Cunliffe and E. W. Adamson. Improvements in machines for drying brewers' refuse and other substances and materials. February 20.

3956. F. Calmant. Purifying and ageing brandies, cognac, whisky, and gin, and in apparatus therefor. Complete Specification. February 23.

4598. H. H. Lake.—From J. Effront, Belgium. Improvements in and relating to the production of yeast. March 4.

4627. A. Fraser. Improvements in or relating to the manufacture of oat malt stout, that is to say, porter. Complete Specification. March 5.

4741. L. Egyedi, J. Weiss, J. Popelka, and A. Mlady. Improvements in and connected with the treatment of brewers' grains and similar materials. Complete Specification. March 6.

5329. F. Colley. Improvements in or connected with the manufacture of malt, and in malt houses for treating same. March 13.

### Complete Specifications Accepted.

1894.

8212. F. W. M. Karsten.—From E. Kasten. Improved means or method of treating barley and other grain for its conversion to malt for brewing, distilling, or other purpose, and in the construction of apparatus connected therewith. March 13.

1895.

803. G. Morris and H. L. Wethered. Improvements in stills or apparatus for distilling spirits and other liquids. March 6.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

*A.—Chemistry of Foods.*

3513. E. Markham. An improved process of preserving eggs. February 18.

4489. A. Dubuisson. Improvements in the manufacture of margarines and natural butters and apparatus therefor, March 2.

4386. W. H. Thew and J. H. Hooker. An improved preparation of peptonised milk and cocoa. March 7.

5122. A. J. Boult.—From A. Delcroix, Belgium. New or improved preparation of coffee. Complete Specification. March 11.

5121. J. Steiskal. Improved animal food and method of manufacturing same. March 11.

5241. H. Powers. A new food. March 12.

### *B.—Sanitary Chemistry.*

4514. P. Boisserand. Improvements in sterilising and purifying liquids. March 2.

4799. J. E. Campbell. *See* Class 11.

5257. S. Pitt.—From The Drainage Construction Co., United States. Improvements in the treatment of sewage and in apparatus therefor. Complete Specification. March 12.

### *C.—Disinfectants.*

5258. J. B. McArthur. Improved disinfecting materials. March 12.

### Complete Specifications Accepted.

### *A.—Chemistry of Foods.*

1894.

8744. F. Goracci and A. Anselmi. A new or improved compound for use as an ingredient for soup or other food, and method of manufacturing the same. March 27.

10,105. A. Bernstein. Improvements in the production of a peptonised alcoholic beverage from milk. March 13.

25,123. W. P. Thompson.—From G. B. R. von Poschinger. An improved process and apparatus for preparing or producing a fodder material. February 27.

### *B.—Sanitary Chemistry.*

1895.

370. A. Hanlon. An apparatus for the destruction by burning of the germs of disease contained in sewer gas. March 13.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

3502. W. Wells and S. Murgatroyd. Improvements in the process of and apparatus for rendering paper and fabrics antiseptic, waterproof, and airproof. February 18.

4108. J. Tait. Improvements in bleaching paper pulp. February 26.

4573. G. R. Hildyard. Improvements in the process of and apparatus for producing printed designs upon paper or other surfaces. March 4.

5450. W. K. Greenway. *See* Class VII.

### Complete Specifications Accepted.

1894.

8766. J. P. Cornett. Improvements in or relating to the manufacture of paper. March 13.

24,614. G. K. Littlefield. Improvements relating to the moulding of articles from vegetable fibrous material. March 13.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

3930. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of chemical compounds. February 23.

4866. J. F. Duke. Improvements in the manufacture of liquid extracts of coffee or other substances and in apparatus for the purpose. March 7.

5135. H. E. Newton.—From The Farb. vorm. F. Bayer and Co., Germany. The manufacture or production of a sweet compound and of certain intermediate products therefor. March 11.

5255. O. Porsch. Improvements in processes of and apparatus for making pure aceton. March 12.

### Complete Specification Accepted.

1895.

1254. J. Y. Johnson.—From F. von Heyden. The manufacture and production of mono- and di-phenetidin-citric acids. February 27.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Applications.

3613. B. J. Edwards. Improvements in colour photographs and apparatus for producing and viewing the same. February 19.

4276. A. Zimmermann.—From The Chemische Fabrik auf Actien vormals E. Schering. Improvements in the manufacture of photographic printing plates. March 6.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

3867. A. Viebig. Improvements in safety matches. Complete Specification. February 22.

4769. A. Luck and A. H. Durnford. Improvements in the manufacture of nitrocellulose and compounds thereof. March 6.

5235. J. Graham. Improvements in pyrotechnic compounds. Complete Specification. March 12.

5386. G. W. Thomas. Improvements in matches, fusees, and the like. Complete Specification. March 14.

### Complete Specification Accepted.

1894.

1755. F. J. Smith. Improvements in detonators. January 30.

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*Assisted by the following Staff of Abstractors:*

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| Prof. Jas. Walker, D.Sc., Ph.D. | Gen. Chem. |
| C. Otto Weber, Ph.D. | IV., XIII. |
| J. G. Wells | XVII., XX. |
| A. Wingham | X. |

## NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Thos. Tyrer has been nominated to the office of President; and Prof. T. E. Thorpe, F.R.S., has been nominated Vice-President under Rule 11.

Mr. T. Fairley, Mr. Boverton Redwood, and Sir H. E. Roscoe, M.P., F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. C. C. Hutchinson has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. Thos. Tyrer, nominated to the office of President.

Mr. Ivan Levinstein has been nominated an Ordinary Member of Council under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election to their respective offices.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

*Extract from Rule* 18:—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

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The Annual General Meeting will be held in Leeds on the 17th, 18th, and 19th of July next. An outline of the programme appears below. Tickets of Membership will be issued in time for the meeting, and will form, as heretofore, vouchers for visits to works and excursions.

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### *Draft Programme.*

#### Wednesday, July 17th.

10.30 a.m.—Council Meeting.

11 a.m.—Annual General Meeting and President's Address at Yorkshire College.

1 p.m.—Lunch, followed by inspection of College Buildings.

3 p.m. to 6 p.m.—Visits to works in Leeds; Electric Cars; Adel, Kirkstall, and Roundhay.

8.30 p.m.—Conversazione.

#### Thursday, July 18th.

Visits to works in Leeds, Bradford, Halifax, and district (Tetley's Brewery, Steel Works, Ice Works, &c.).

7.30 p.m.—Dinner at Queen's Hotel.

#### Friday, July 19th.

Excursions:—

1. Bolton Abbey, Grassington, and Skipton.
2. Harrogate and Ripon.

9 p.m.—Smoking Concert given by the Priestley Club.

The above is subject to modification.

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Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

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### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10*s.* |
| To Subscribers | 12*s.* 6*d.* |
| To others | 15*s.* |

### Bankers' Orders.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

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Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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## LIST OF MEMBERS ELECTED 22nd MARCH 1895.

Bardwell, Fred. L., Mass. Inst. of Technology, Boston, Mass., U.S.A., Assistant Professor of Chemistry.

Barrington, Edw. C., 18, Earlsfort Terrace, Dublin, Merchant.

Bird, Wm. R., 73, Albion Street, New Swindon, Wilts, Analytical Chemist.

Cochrane, Jno., Spring Field, New Mills, near Stockport, Printworks Manager.

Ekenberg, Dr. Martin, 3, Agnegatan, Stockholm, Sweden, Technical Chemist.

Gray, E. B., New Brighton, Richmond co., New York, U.S.A., Oil Inspector.

Hesketh, Everard, Dartford Ironworks, Dartford, Kent, Civil Engineer.

Hyde, Ellis, Birch Polygon, Rusholme, Manchester, Chemist, B.Sc.

Kveeht, Victor, 79, Murray Street, New York, U.S.A., Dyestuff Merchant.

Landin, Jno., 40, Drottninggatan, Stockholm, Sweden, Public Analyst.

Lord, Alf. B., Atlantic White Lead Works, Marshall Street, Brooklyn, N.Y., U.S.A., Chemist.

Maxim, Hudson, P.O. Box 2488, New York, U.S.A., Explosives Manufacturer.

Mistovski, L., Broadfield Rubber Works, Heywood, Manchester, Manager.

Raper, Arthur E., Alston House, Thornton Road, Bradford, Yorks, Works Chemist.

Robins, Walter, 9, Northbrook Road, Lee, S.E., Analytical Chemist, B.Sc.

Saarbach, Dr. Ludwig, 12, Old Slip, New York, U.S.A., Consulting Chemist.

Schriever, Jno., Greenpoint Chemical Works, Brooklyn, N.Y., U.S.A., President.

Slocum, Frank L., Linden Avenue, E.C., Pittsburg, Pa., U.S.A., Chemist.

Summers, Bertrand S., Western Electric Co., Chicago, Ill., U.S.A., Chemist.

Waldstein, Dr. Martin E., c/o Dr. H. Schweitzer, 159, Front Street, New York, U.S.A., Manufacturing Chemist.

## CHANGES OF ADDRESS.

Barrie, D. McL., l/o Glasgow; retain Journals until further notice.

Cooke, A. W., l/o Wakefield; c/o Goodlet and Smith, Lim., Granville, near Sydney, N.S.W.

Crossley, Dr. A. W., l/o Manchester; Chemical Laboratory, St. Thomas' Hospital, London, S.E.

Fletcher, E. Morley, l/o London; Delmore, Caterham, Surrey.

Greenwood, H., l/o Church; 411, Blackburn Road, Accrington.

Hall, Edgar, l/o New South Wales; Rivertree, *viâ* Stanthorpe, Queensland.

Harmon, L. E.; Journals to 46—54, Fulton Street, Buffalo, N.Y., U.S.A.

Hodgson, Wm., l/o Barton House; 66, Deansgate, Manchester.

Hosie, G. H., l/o Torquay; retain Journals until further notice.

Jenkins, Thos., l/o Rio Tinto; Bella Vista, Port Talbot, South Wales.

Jones, A. F. Syers, l/o Pisagua; Iquique, Chile.

Langdon, Dr. M. J., l/o Cooper Street; 15, Dickinson Street, Mount Street, Manchester.

Liepmann, Dr. H., l/o Oregon; c/o P. Shaw-Liepmann, 23, Leadenhall Street, London, E.C.

Lowe, Jas. S., l/o Mauritius; retain Journals until further notice.

Mackenzie, Dr. G. S., l/o Sydney; Sydney Smelting Works, Woolwich, New South Wales.

Mactear, Jas.; Journals to 28, Victoria Street, Westminster, S.W.

Mahon, R. W., l/o Baltimore; Monongahela Furnace Co., McKeesport, Pa., U.S.A.

Reed, Albert E., l/o Gravesend; Belgrave House, Maidstone, Kent.

Silvester, H., l/o Douglas Road; Holyhead Road, Handsworth, Birmingham.

Vasey, T. E., l/o Box 1777; P.O. Box 1449, Montreal, Canada.

Warwick, A. W., l/o London; The Ninah Mine, Wickes, Montana, U.S.A.

White, J. Freebairn, l/o Glasgow; Punjom Mining Co., Punjom, Pahang, *viâ* Singapore.

Whiteley, R. Lloyd, l/o Nottingham; The Institute, West Bromwich, Staffordshire.

Wilkins, Chas., l/o Brixton; 40, Church Lane, Hornsey Old Church, N.

### ERRATUM.

Lewkowitsch, Dr. J., Lancaster Avenue (not "House" as given in March Number), Fennel Street, Manchester.

## London Section.

THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

***Chairman:*** B. E. R. Newlands.
***Vice-Chairman:*** *C. C. Hutchinson.*
***Committee:***

*E. J. Bevan.*
W. G. Blagden.
E. Grant Hooper.
T. A. Lawson.
R. Messel.
H. de Mosenthal.
E. O'Neil.
S. Rideal.
*A. Gordon Salamon.*
A. Shearer.
Wm. Thorp.
*T. Tyrer.*
*Frank Wilson.*
Lewis T. Wright.

***Hon. Local Secretary:*** John Heron,
74, North Side, Clapham Common, S.W.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. F. Cross, B. Blount, S. Hall, F. Napier Sutton, and F. G. Adair Roberts.

May 6th:—
(1) Mr. C. C. Hutchinson. "The Use of Hot Air in Drying."
(2) Mr. A. Cameron. "The Estimation of Alkaline Salts in Fire Clays, Manures, &c."

June 17th:—
Dr. Carl Pieper, of Berlin. "The German Patent Laws and their relation to Home and Foreign Inventions."

## Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET.

***Chairman:*** *E. Carey.*
***Vice-Chairman:*** *H. Brunner.*
***Committee:***

*J. Campbell-Brown.*
*Jos. C. Gamble.*
C. L. Higgins.
C. A. Kohn.
E. K. Muspratt.
*W. Norris Jones.*
*G. Schack-Sommer.*
E. Scott.
A. Smetham.
Frank Tate.
H. Tate, jun.

***Hon. Treasurer:*** W. P. Thompson.
***Hon. Local Secretary:***
Dr. Lewis Bailey, University College, Liverpool.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman:* G. Schack-Sommer. *Vice-Chairman:* Eustace Carey. *Committee:* P. Bateson, W. D. Herman, F. Hurter, and A. Watt.

*Meeting held Wednesday, April 3rd,* 1895.

MR. EUSTACE CAREY IN THE CHAIR.

### THE ESTIMATION AND NUMERICAL EXPRESSION OF COLOUR IN TANNING MATERIALS.

BY G. WATSON GRAY, F.I.C.

MESSRS. Parker and Procter have recently described (this Journal, Feb. 1895) methods for the estimation and numerical expression of colour in tanning materials, but, so far as I can understand their paper, nothing definite is proposed to be done in the way of numerically expressing the results.

The numerical expression of the colour being the point desired, it has induced me to describe the method which I have used these last 18 months with the view of helping the establishment of some recognised method.

Many investigators have from time to time proposed methods of noting the colour as well as the strength of the tanning matter. The late Mr. Norman Tate and myself some few years ago tried tanning hide; the results, however, were not satisfactory, and we had to continue to compare samples by viewing them in Nessler's tubes and reporting our idea of the colour by such terms as: brown, light brown, dark brown, reddish-brown, yellowish-brown, darker than sample sent. To these unsatisfactory terms of expression were to be added such misfortunes as samples decomposing, sometimes resulting in the bottles bursting, others in a mould forming, and possibly other changes not so apparent; so that when a sample had to be compared with one sent some months previously we were not always in a position to do so.

I tried to arrive at an arbitrary figure to express the degree of colour by using a solution of Bismarck brown, and noting the number of c.c. required to match a solution of the sample, but while excellent matches of depth and shade of colour were possible, yet in other samples the shade was unsatisfactory. About 18 months ago, after considering the various apparatus and modes of measuring colour, I concluded that Lovibond's tintometer was the only instrument that would universally recommend itself, as not only the depth of colour could be recorded, but also the relative proportion of the three primary colours: red, yellow, and blue.

The next point to be decided was what strength of solution and thickness of cell would be most suitable. Mr. Lovibond very kindly sent me all the various-sized cells and standard glasses (numbering about 450) to make a selection from.

The method which I finally decided to follow, consists in weighing off 5 grms. of the extract, dissolving in, and making up to 500 c.c. with water at 40° C. (The difference in volume between 15° and 40° C. is about 3·0 c.c. for 500 c.c.) Most extracts dissolve to a clear solution when treated at this temperature, and even allowing them to become cold does not cause sufficient muddiness to interfere with the measurements. A ½-inch vulcanite cell is now filled with the solution and placed on one side of the binocular instrument, observing the necessary precautions to ensure equal illumination of the two openings; the colour is now matched with the standard glasses. In such extracts as oak and sumach this can generally be done with yellow and red, occasionally the introduction of a small fraction of blue is necessary to counteract slight muddiness. The figures attached to the glasses I have called degrees or tenths of a degree; thus a solution of extract made as directed, which required glasses amounting to 10·2 yellow and 2·6 red, I record as 10·2° yellow and 2·6° red. Total colour 12·8°. I then find the ratio existing between these two, and also record and report thus:—1 part of red to 3·923 parts of yellow.

Messrs. Parker and Procter, in preparing their solution for examination, dissolve the extract in boiling water, cool, and filter. This, in my opinion, is undesirable and in many cases unnecessary. It has the advantage of giving a bright and clear solution, but the colour under such treatment is sometimes altered.

When I first thought of using Lovibond's tintometer, I intended to tan hide and note the colour, hence my choice for a binocular instrument; but after considering my past experience in this direction I concluded that it would not so much represent the correct colour of two samples, but the skill of the operator in manipulating the hide and tanning material. This, I think, is borne out by Messrs. Parker and Procter's investigations, and would probably lead to analysts reporting very differently on samples, while an examination of a plain aqueous solution of the tanning material, although having some disadvantages, would be simply performed and more readily numerically expressed.

### Discussion.

Dr. Gordon Parker remarked that recently, in conjunction with Mr. Procter, he had read before the Yorkshire Section of the Society a paper in which it was proposed to use a similar method to that which Mr. Gray had just explained. He noticed that whereas they used boiling water for dissolving the tanning extract, Mr. Gray used water at 40°; he himself felt more inclined to use boiling water, for the simple reason that everything was dissolved thereby that would dissolve, whereas with water at 40° such accurate results would not be obtained. In tanning extracts, as a rule, there was a good deal of difficultly soluble colouring matter, which, with a large quantity of water, was finally dissolved in the tan-pits, so that it was taken up by the leather, and therefore it was better to measure all the colouring matter in an extract than to find how much would dissolve at 40°. He wished to ask Mr. Gray why he used 5 grms. of an extract irrespective of its strength, instead of making a solution containing exactly ½ per cent. of tanning material.

Dr. Hurter asked Mr. Gray what he meant by degrees of colour, such as 10 degrees of yellow and 2½ degrees of red. He also wished to know to what fraction of its value the result could be obtained accurate with the same solution, simply on the repetition of the determination. He would recommend Vierordt's method of quantitative spectrum analysis. He thought it would be more satisfactory to know that a particular solution had absorbed such a percentage of the red, yellow, or green, and the results would be more scientific than those arbitrary degrees.

Mr. Gray, in reply, said that most of the extracts that had passed through his hands dissolved completely at 40° without leaving any insoluble colouring matter; whereas in boiling water a large amount of material was re-precipitated, and this carried a considerable quantity of the colour with it, so that the total colour was not recorded. He did not think it mattered largely whether one used 5 grms. to the half litre, or whether one used a ½ per cent. solution; but it should certainly be decided which actually was better, so that analysts might all use the same. Dr. Hurter had asked why he attached a particular figure to the glass. The measure was perfectly arbitrary, the glass was a particular shade, and one had been taken as the unit; but if analysts would agree all to use the same method, then strictly comparative results were obtainable. Of course, if one person used a ½-in. cell, and termed his glasses degrees, and another a 1-in. cell, then the glasses would not represent degrees on the same scale as before.

## THE SEMET-SOLVAY COKE OVEN.

BY JOHN H. DARBY.

The annual production of coke in the United Kingdom is probably over 10,000,000 tons, representing at least 14,300,000 tons of coal, as shown by the annual make of pig-iron taken from the returns of the British Iron Trade Association. In making this statement I do not include coal that is carbonised in gasworks, but only coal which is carbonised for the purpose of making a hard metallurgical coke. If the products were recovered from the amount of coal named, consisting of tar, ammonia, and light oils, also taking into consideration the value of the coke wasted, as shown hereafter, there would be a net gain to the country of about 3,550,000*l*. per annum.

The annual production of ammonia as sulphate would be from this source alone over 200,000 tons, having a present net value of about 1,625,000*l*., and consuming in its manufacture about 200,000 tons of sulphuric acid. This large amount of sulphate would no doubt take the place of a similar quantity of nitrate of soda, now imported for agricultural purposes, and in addition the trade and labour required to make the sulphate would be confined to this country.

It is of the utmost importance that coke for use in high modern blast furnaces, where the driving is rapid and the temperature of the incoming blast up to 1,000° C., should be first-rate for hardness and density. Up to quite recently blast-furnace engineers have insisted on using coke which has been made in beehive ovens or their equivalent, and watered or quenched before the coke was drawn from the oven. In this way, and using first-rate coking coal, a splendid coke is obtained with a silvery metallic lustre. In the beehive class of ovens, as is well known, the fuel to be coked is charged into a fireclay chamber resembling a beehive in shape, or some other convenient form. The fuel is ignited by the hot brickwork, rendered so by preceding charges, and air is admitted above the layer of fuel when combustion takes place, destroying all the by-products of value in the gases and burning a large proportion of the coke itself, a thick layer of ash on the top of each batch when drawn clearly pointing to the waste. In this way a loss of 10—15 per cent. of the coke is incurred, amounting on the tonnage given to about 1,100,000 tons of coke per annum.

It has long been felt that if coal could be coked in a closed retort, and the same quality of coke obtained as was the case with the old beehive type of ovens, then there would be an opportunity of getting something like a theoretical yield of coke from the coal, and a considerable return in by-products from the gases.

Various types of ovens have been brought out from time to time, such as the Otto-Hoffmann, Simon-Carvès, &c., but the English ironmaster has not adopted them. Owing, however, to the extreme depression in the iron trade at the present time, and to the fact that Belgium and Germany are successfully competing for the iron trade formerly monopolised by the United Kingdom, it became necessary to inquire how they were able to do it, and foremost amongst the reasons is the fact that Belgium and Germany almost exclusively use coke manufactured in retort ovens with recovery of by-products, which gives them in the manufacture of iron an advantage of 4*s.* to 5*s.* per ton over their English competitors.

The Semet-Solvay ovens which I wish to bring before your notice are at work on the Continent in many places. In England at Messrs. Brunner, Mond, and Co.'s and the Brymbo Steel Co.'s works. The latter plant I designed and erected myself for the production of hard blast-furnace coke, after a careful examination of all the well-known systems of coke-making, my endeavour being to adopt the system that offered the greatest all-round advantages to the coke maker and iron producer. Now that the ovens under my control have been at work over a year, I can say that my anticipations have been entirely borne out. The ovens are generally erected in batteries of 25 each. They are narrow chambers about 10 metres long, 1·7 metres high, and vary in width from 350 mm. to nearly 500 mm. The chambers are built in a mass of brickwork with supporting walls between each oven covered by arches, and well protected to prevent radiation. The chambers so made are left intact as the skeleton of the ovens, and are filled in on each side of each supporting wall by channel bricks containing the heating flues. These channel bricks are rebated one into another so as to break the joints, and as they have only their own weight to support, there is no fear of cracking or bulging when they are highly heated, and when the process of coking is proceeding. (See diagram.)

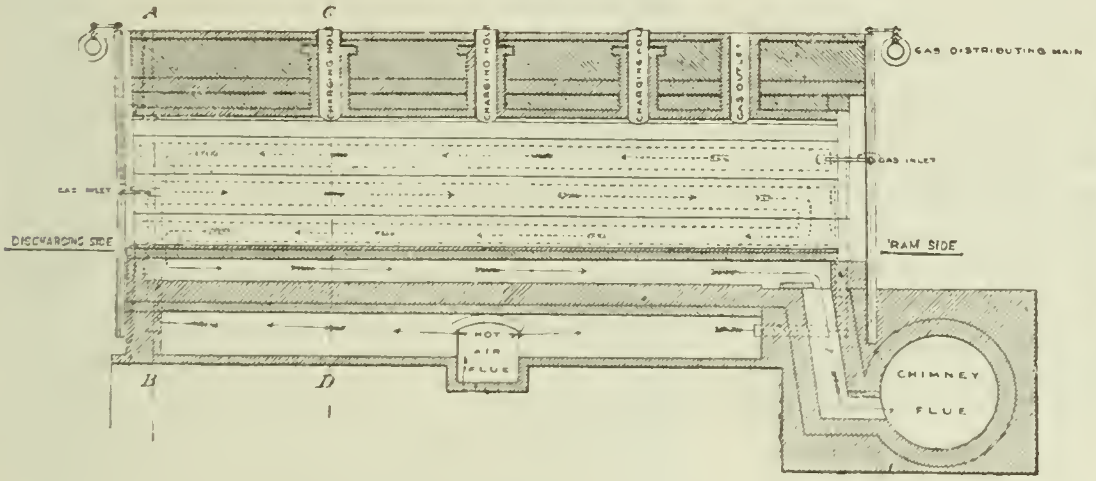


Fig 2

Section through AB

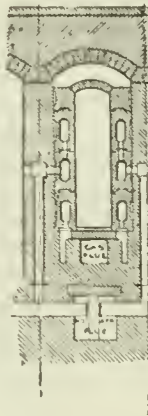
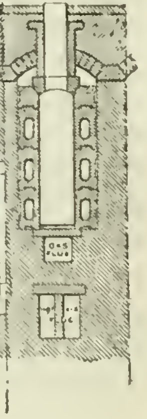


Fig. 3

Section through CD



The width of the ovens is variable, determined by the quality of coal to be treated. As a general rule, rich coals with a high percentage of volatile matter should be treated in wider ovens, lean coals with a small percentage of volatile matter should be treated in narrow ovens. The fuel to be coked is charged into each oven through three openings in the top and the gases are drawn away through a fourth opening into the hydraulic main. The openings are closed by lids when the coking operation is proceeding. (See diagram.)

After the process of coking has been completed (which usually occupies about 22 hours for a 4-ton charge of fuel) the doors at each end of the oven are raised and the coke is pushed out on to the hearth by means of a ram. The coke usually comes out in a solid block, which stands up as a core the exact shape of the inside of the oven. This is beautifully bright and contains more than the theoretical weight of fixed carbon in the coal, probably owing to the partial decomposition of the gases in their passage through the heated coke and a deposit of pure hard carbon which takes place.

Up to the time the coke is watered it is bright and silvery in appearance, but after watering outside the oven it becomes somewhat dull, and on this ground has been objected to by metallurgists. It is, however, hard and dense, and will produce a ton of pig iron with rather less consumption of coke than the old-fashioned silvery beehive coke.

I can give two instances of blast furnaces working on Semet-Solvay coke, not comparative in any way, but simply to show what two furnaces working with a very different class of material can do when they are fed with Semet-Solvay coke:—

| No. | Ore used Per Ton Pig. | Limestone Per Ton Pig. | Coke, dry, used Per Ton Pig. |
|---|---|---|---|
| | Cwts. | Cwts. | Cwts. |
| 1 | 36·40 | 7·30 | 16·70 |
| 2 | 46·0 | 13·32 | 20·34 |

In one case which came under my notice, Durham coal containing 23·3 per cent. of volatile matter yielded 80·5 per cent. of dry coke. This would seem a greater yield of coke than the coal was capable of giving, but the weights were accurately taken, and I can only attribute this large yield to the deposited carbon previously spoken of.

Beehive coke ovens usually produce about 6 to 7 tons of coke per week = 325 to 350 tons per annum; the Semet-Solvay oven produces from 1,200 to 1,400 tons per annum, and a production of as much as 1,140 tons has been obtained at Drocourt.

I attribute the great speed of coking, large yield of coke and by-products, and ease with which repairs can be made:

(1) to the considerable mass of the supporting walls; (2) to the thin sides of the channel bricks in the heating flues on the side nearest to the oven; (3) to the adoption of horizontal side-flues; (4) to the arrangement of heating flues on each side of one supporting wall; (5) to the fact that the coking process is carried on in closed retorts, so designed that leakage is reduced to a minimum, and in this way the by-products, ammonia, tar, light oils, &c., are not lost but are carried forward into the escaping gas and fully recovered in the by-product apparatus; the yield of coke is also at its maximum; (6) to the facility for changing all parts of the ovens subject to wear and tear without disturbing the supporting walls or main structure of the oven.

In most types of retort ovens the heating flues, which may be either vertical or horizontal, are built in the main or supporting wall of the ovens; therefore if any repairs are required the whole structure has to be taken down in order to make such repairs. By the construction of the Semet-Solvay ovens this is avoided, and the channel bricks can be taken out without disturbing the main structure of the oven.

As the heating flues are arranged they only carry their own weight, and therefore the side walls are made thin, through which the heat is conducted for coking the coal. 2½ ins. is the usual thickness. By increasing the thickness ½ in. 30 per cent. less heat is conducted in a unit of time.

After the gas has been deprived of the by-products it is conducted back to the ovens and distributed into the channel flues, where it is burned with heated air. There are three side flues to each oven; gas and heated air enter the top flue on the ram side of the ovens, passing the whole length of the oven, where the products of combustion turn down; then meeting a second supply of gas and heated air the current is reversed towards the back of the oven, where it again descends and travels towards the front, where the waste gases from each side of the oven unite and pass in one common flue under the hearth of the oven and into the chimney flue. In this way a uniform heat is maintained throughout the oven. The waste gases are still highly heated, but these can be utilised in generating steam before they are allowed to escape into the chimney. With rich coal, and where all the surplus gas is used for generating steam as well as the waste heat, about 1·25 lbs. of water are evaporated per lb, of coke made. Sufficient steam is produced for all the requirements of the plant from the waste heat, and when coking fairly rich coals a large surplus of gas is at disposal for gas engines, illuminating purposes, generating steam, or any other purpose for which it may be suitable. The oven gas has the following composition:—

| | Per Cent. by Vol. |
|---|---|
| Carbonic acid | 3·27 |
| „ oxide | 7·95 |
| Oxygen | 0·23 |
| Hydrogen | 52·77 |
| Nitrogen | 1·99 |
| Light carburetted hydrogen | 31·22 |
| Olefines | 2·57 |

By adopting the method of construction I have described, and working the ovens so that a very small pressure of gas is always kept on the oven side, the admission of air into the ovens is prevented, very little gas is lost by leakage into the heating flues, and when working with washed fuel a gas is produced of about 12 to 14 candle power, while clean coal from the same seam treated in gas retorts would yield gas of 16½ candle power.

The gaseous products of distillation leave the ovens by the openings into the ascension pipes and pass thence into the hydraulic main, where the gases from the various ovens unite. The gas then bubbles through the water and liquor from one side of the hydraulic main to the other, past the baffle-plate; the temperature is quickly reduced, preventing the deposit of hard tar in the pipes and recovery apparatus. Each oven can be shut off by a valve from the hydraulic main when being charged.

From the hydraulic main, the gas containing most of the tar, the ammonia, and the light oils passes through the condensing apparatus. It is important, however, not to cool the gas too rapidly or trouble will ensue by reason of deposits of naphthalene obstructing the pipes and recovery apparatus and necessitating constant attention. If, however, the gas is slowly cooled this drawback is avoided.

During the cooling of the gas, portions of the tar and ammonia liquor are condensed and run into the receiver, where they are separated by their difference of specific gravity. The tar is then pumped to the reservoir and the liquor to the ammonia-washer, as in the first instance it is too weak for treatment.

The gas is drawn through the condensers by a rotary exhauster, such as Gwynne's, and forced towards the washers and absorbers, where the remaining ammonia and light oils are extracted. The ammonia liquor leaving the washer should contain 2·25 per cent. of ammonia, equal to 9—10 oz. liquor.

The yield of by-products from the Semet-Solvay oven with a fairly rich coal is about 5 per cent. = 112 lb. of tar, 1·3 per cent. = 30 lb. of sulphate of ammonia and 3 galls. of light oil, sp. gr. 0·89, per ton of coal, having together a net value to-day of over 6*s.* per ton of coke made.

### Discussion.

Mr. White said it was certainly quite time that they did away with the old beehive oven with its waste, as pointed out. He desired to know how, by adopting that process, the percentage of sulphur compared with the sulphur from the beehive oven, and how the hardness of the coke was affected. For instance, in an iron-founder's cupola they required a very hard coke, and free from sulphur. That freedom from sulphur was so essential that a large quantity of the coke used in Lancashire came from Durham, with 6*s.* or 7*s.* per ton railway carriage. If that process limited the sulphur, it would be a great improvement.

Mr. Saniter said there was no question the manufacture of cheap coke was becoming of great importance to the iron manufacturers of this country. If the Semet-Solvay ovens were going to take five or six shillings off the price of coke, the sooner they had them the better. The quality of the coke was an important point. He asked Mr. Darby if he could give them any comparative figures of crushing tests of beehive coke and Semet-Solvay coke. He, to a certain extent, could confirm what Mr. Darby had said. In the east of France a small 50-foot blast furnace was making 110 tons a day of white iron from ores containing about 35 per cent. of iron and using only 22 cwt. of coke, and that coke was made in a patent oven. He would be glad if Mr. Darby could give them the amount of surplus gas when using a coal containing 35 per cent. of volatile matter. The question raised by Mr. White was an important one; in the case of the same coal coked in a beehive oven or in a patent oven, was there any difference in the percentage of sulphur found?

Dr. Dreyfus said he had given the question of coke ovens some attention, and some years ago, after having investigated the matter, not from the point of view of the ironmaker, but as user of by-products, he read a paper before the Manchester Section of the Society calling the attention of the people interested to the coking of coal in closed ovens. He was sorry that, notwithstanding what he did in 1892, the figures he gave, and which would have tempted anyone, had only perhaps brought about the result that Mr. Darby had put up some of those ovens. He fully expected that instead of 25 being put up, after the information had been collected, there would be so many hundred put up. That was a disappointment; simply because, he supposed, in the iron and coal industry, manufacturers generally preferred to wait until everyone else had finished his experiments, and when the thing was quite ready, then they would come in and take it up. He was telling the manufacturers that it was quite necessary at times to experiment and spend money before they knew that success followed their experiments. He would sooner belong to the category of those who experimented and failed than to those who never experimented at all. With regard to many questions that had been asked, he believed that practical results were better sometimes than theory. He had seen lately a paper, or rather a report, which had been sent by Mr. Mason, the American Consul-General at Frankfort-on-the-Maine, to his Government, and this report took up that question—the production of coke in closed ovens in Germany. From this report he found that in 1894 there were in operation on the continent 1,759 ovens of the Otto-Hoffmann system with recovery of by-products. There were 6,309 ovens of the Otto-Coppée system without the recovery of by-products, the coal used being probably too poor in volatile matter for erecting the recovery plant. There were 492 Semet-Solvay ovens with recovery of by-products, principally in Belgium; over 400 Simon-Carvès ovens, some of them in England; 100 ovens of the Carvès-Hüssener type, all with recovery of by-products; and 160 ovens of the Carvès-Seibel type in France. They had there a total of over 9,000 ovens. When he stated that there were in existence only 16,000 coke ovens in 1893 in the whole of Germany, and when, as shown above, there were nearly 8,000 of the closed retort ovens in existence now in that country—that, in his opinion, went far to show that the Germans, theorists though they liked to be, had found practically that the coke made in the closed ovens would do the same work in their smelting furnaces as the former beehive coke did, and he considered that if the Germans, the Belgians, and the French had adopted or were continuing to replace most of their old ovens (beehive ovens) by the modern closed ovens, that it would be high time that they in England should follow their example. They might depend upon it that the test of that coke for sulphur, that the tests for hardness, had all been made, and that coke had not been found wanting, and the best proof of it was they could make a ton of pig-iron by using from 16 to 20 cwt. of that closed oven coke, where formerly they had to use not far from the same quantity of the coke made from the beehive ovens. Figures sometimes went a long way in proving a thing. Mr. Darby had said that the saving in England, if the 15 million tons of coal used annually for making coke for metallurgical purposes only were treated in closed ovens, would be 3,500,000*l*. sterling per annum. He had omitted to state that there was a saving of probably not far short of another million pounds if he would take into account the surplus gas that they got from those closed coke ovens. The average coal used for coking in this country would produce about 9,000 cub. ft. of gas, and of that gas a half nearly would be available for other purposes than for coking, and that would mean a saving of about 2½ to 3 cwt. of coal on the ton of coal originally put in the ovens for coking. He would say that unless ironmasters of this country adopted the more scientific and economical way of coking than the crude methods they employed at the present time, unless they tried to use the by-products and save 4*s*. to 5*s*. per ton, in face of the enormous competition which existed in the iron industry at present, he feared that they were running a chance of losing the ground which they had kept until now, and that they would have to look out for their laurels, which he was afraid they would be on the point of losing, and he hoped the ironmasters and the colliery owners of this country would not wait until it was too late.

Mr. MUSPRATT said he thought they would all be of opinion that the adoption of those closed ovens was of immense importance, and that they should also be satisfied that the quality of the coke was equal, or practically equal, to the coke produced from the beehive ovens; but they had had no information as to the cost of the erection of those Semet-Solvay ovens, and no information at all as to the relative merits of the Semet-Solvay ovens as compared with those other numerous closed ovens that Dr. Dreyfus had spoken about. There was no doubt that in time, in a manufactory where coke was required, they would produce the coke in that way for the recovery of the by-products, as it was clear that would be more economical than producing coke without the recovery of by-products. He would like information as to the cost and what royalties were charged for the Semet-Solvay ovens. He noticed that the patent must have been in existence 14 years, because there was a renewal of it the other day for another five years. Of course the royalties asked might stand in the way of the more general adoption of the Semet-Solvay ovens as compared with the other ovens which Dr. Darby had mentioned, as also the relative prices of fuel in the various countries. Reference had been made to the escaping gases. If they were of the quality Mr. Darby had spoken of, many uses could be found for them. He meant the excess over those utilised in the oven itself.

Mr. ARTHUR CAREY asked as to the constitution of the tar and light oils, *i.e.*, the proportion of paraffins and benzol and its derivatives; he further asked for information regarding repairs required on the ovens.

Mr. STEPHEN J. LETT asked at what temperature was the carbonising carried on, and what was the quality of the coke in the centre of the charge. He had frequently noticed in carbonising coal for gas-making—in an experimental apparatus carrying 2-lb. charges—that if by any chance the temperature was allowed to drop, the resultant coke was very black in the centre, and as gas-making was usually referred to as the quick-carbonising, and coke-making as the slow process, he supposed it meant that the latter was carried on at a lower temperature; but in his own experience the lower temperature had yielded very bad coke.

Mr. BAIRSTOW remarked it was obvious that to carry on the work profitably they ought to be very close to a pit, and be sure that they would have a constant supply of coal, because if they had a long carriage to pay on the coal to the coke ovens, it would take a great deal of profit out of it. Mr. Darby was happy in being able to use the coke, and also in being close to coal. Respecting the tar, he could speak with some confidence, for he had had the distilling of Mr. Darby's tar. It contained the usual products of coal-tar—benzol, light oil, creosote, anthracene, &c.,—and the percentage of paraffin was no higher than in tar from gas-works. The quantity of these products, however, varied very much in different localities and according to the quality of the coal carbonised in the ovens. One element seemed to be lost sight of, and that was the increase of tar and sulphate of ammonia from the extension of coke ovens. Mr. Darby had based his profits on present prices, but it should be taken into account that if they increased the quantity of these articles they would reduce the price. This has already taken place in the case of benzol.

Mr. DARBY, in replying, said the first question raised was with reference to the percentage of sulphur. He had had experience with coal from the same seam both in the beehive and also in the patent ovens, and he did not find very much difference in the sulphur. He thought it was about the same; the sulphur in the coke was rather under 1 per cent. with the beehive ovens and still under 1 per cent. with the new ovens. With regard to the hardness and density of the coke, that was a very important point from a blast-furnace point of view. He found that the Semet-Solvay coke went further in the blast furnace than the old beehive coke; he had used both kinds in the same furnace at different times, working under the same conditions as to iron ores, and he found that when using Semet-Solvay coke nearly 2 cwt. less was used per ton of iron made than with the beehive coke. With regard to the surplus of gas, it varied very much with the quality of the coal. As Dr. Dreyfus had mentioned, in Germany the coal was very dry, and there was little gas to spare as surplus. In England, where there were rich coals, containing more than 25 per cent. of volatile matter, there were two-fifths of the gas at least to spare for any purpose to which it could be conveniently applied. Although Dr. Dreyfus expressed his surprise that there were few of these ovens in England, one Semet-Solvay oven was equal in point of production to four beehive ovens, and nearly double that of any other retort oven.

In reply to Mr. Muspratt's question as to the cost of the ovens, it was necessarily high. There was a somewhat complicated piece of apparatus in the oven itself, compared with the old beehive, and the recovery apparatus, together with the sulphate and light oil plants, were expensive, but he thought they might be safe in saying they paid for their cost in less than three years in by-products alone. With regard to the relative merits of other retort ovens, he did not know that he could say anything. He believed that in Germany the Otto-Hoffmann oven, which was largely used, was promoted by a firm who went to the colliery proprietors or the iron producers and offered to put up those ovens free of cost, if a proportion of the by-products were handed over to them for a term of years. That no doubt had led to their adoption very largely. The royalty charged he believed was 4*d.* a ton on the coal coked in the Semet-Solvay oven. One of the features was the question of repairs, and working at the high temperature required it was a very important fact that the channel bricks were independent of the oven, and should they require to be changed, one or two could easily be taken out and replaced in the oven requiring attention; the whole battery need not be put off for repairs, which was the case in other systems. He had seen those ovens at work after eight years' continuous working with the same channel bricks that were originally placed there, so that he did not think the question of repairs was a heavy one. As regarded the temperature of the coking, the temperature was carried on as high as they could safely carry it, the refractory nature of the channel bricks being the limit of the temperature. The coking took place from each side of the oven, and there was a division where the coking met. There was no waste coke. In all retort ovens the coke was always darker than beehive coke, due to the fact that it was watered or quenched outside the oven.

## Manchester Section.

Rooms of the Chemical Club, Victoria Hotel.

***Chairman:*** R. Forbes Carpenter.
***Vice-Chairman:*** *Edw. Schunck.*
***Committee:***

G. H. Bailey.
*F. H. Bowman.*
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
*P. Hart.*
J. M. Irving.
*E. Knecht.*
I. Levinstein.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
W. Thomson.

***Hon. Local Secretary:***
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman:* P. Hart. *Committee:* R. S. Dale, M. J. Langdon, and E. Schunck.

*Meeting held Friday, April 5th, 1895.*

MR. R. FORBES CARPENTER IN THE CHAIR.

## UTILISATION OF TOWN REFUSE AT ROCHDALE.

BY F. W. BROOKMAN.

### Part I.—The Manufacture of Manure.

### *The Rochdale System.*

About the year 1831 England was visited by Asiatic cholera, and, owing to the alarming number of deaths caused by it, much discussion arose as to the cause of its prevalence. Royal Commissions were appointed to enquire into the state of the public health, and to find out the cause of the excessive number of deaths which occurred. The conclusion arrived at was that bad drainage, overcrowding, foul middensteads, and the storing of refuse in the proximity of dwellings were chiefly responsible for the sad state of affairs.

In Rochdale the death rate in 1848 was 32 per 1,000, or a total of 856 deaths in a population of 24,755, of which 192, or over 7 per 1,000, were from zymotic and preventable diseases, so that there was plenty of room for improvement.

At that time the utilisation of nightsoil was neither understood nor practised, and the adoption of the water-closet meant that the whole of the sewage would be turned into the rivers or streams. It was, however, thought that if the old midden system could be abolished, and the fæcal matter at the same time kept out of the local streams, it would be a decided advantage in many respects.

The new system (and which is at present in use practically throughout the whole of the town) may be thus described. A tub or pail of the capacity of about 10 galls. is provided for each closet, and a tub of any dimensions for the ashes. When the washed excreta pail is sent out from the manure depôt there is about half a pint of deodorising and disinfecting fluid put into it, so as to keep it sweet for some little time.

The town is divided into six sections, A, B, C, D, E, and F, and every closet is numbered. A printed list is handed to the carter before going to change the pails, and on his return the excreta brought in is weighed, and a list of the pails collected is handed into the office. The collection is weekly. The decision to make the excreta into a dry manure was mainly brought about by the increasing difficulty in disposing of the excreta in its crude or half-manufactured state, particularly during the summer time, when the crops were on the ground and no manure was required; and when to this was added the expense of cartage when the nightsoil was taken even comparatively short distances, it became apparent that any scheme which would reduce the weight of the manure without decreasing its value must be a step in the right direction.

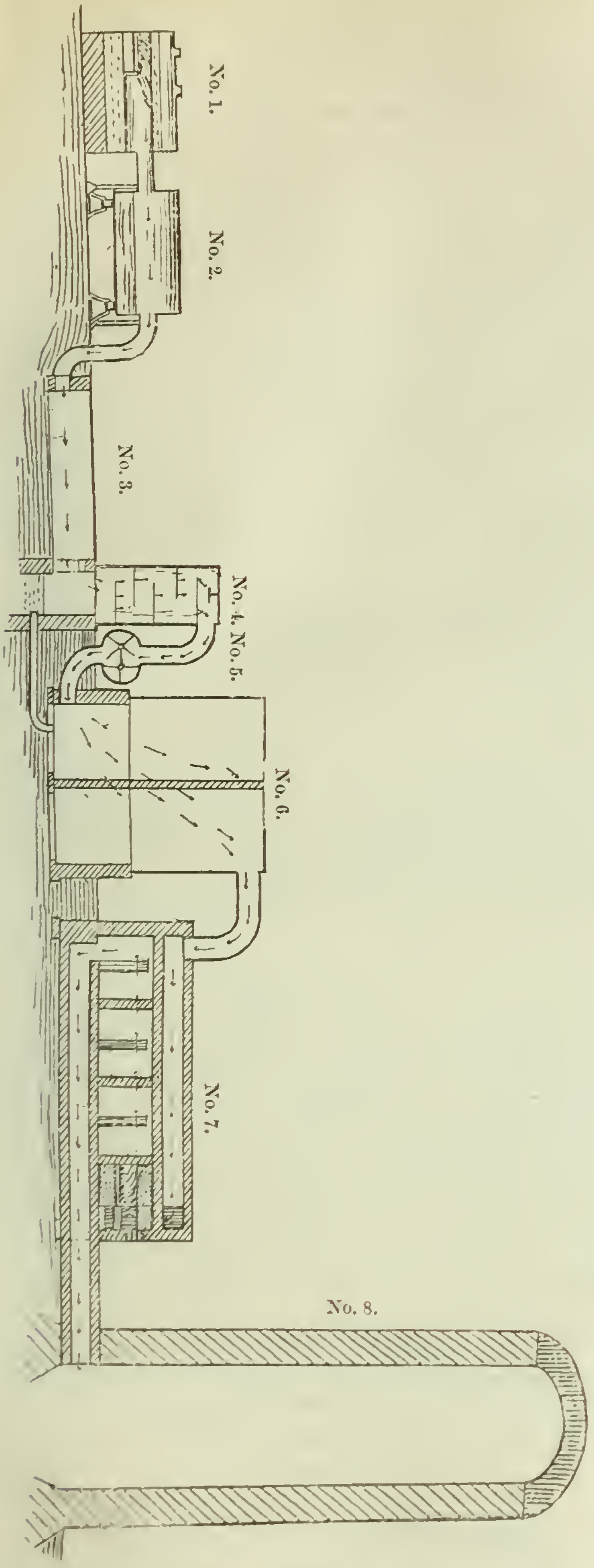
### *Collection of Refuse.*

During the past 12 months there have been employed in the collection and disposal of the refuse 110 men and 39 horses. The amount of material collected being about 10,000 tons of excreta, and 16,000 tons of ashes, &c. The quantity of excreta just mentioned will produce about 750 tons of finished manure in two qualities, viz.: the ordinary Rochdale manure, containing about 8 per cent. of ammonia, and selling at 6*l.* per ton; and the ammoniated Rochdale manure, containing 12 to 13 per cent. of ammonia, and fetching 8*l.* per ton.

A portion of the refuse when burned generates all the steam required in the manufacture of the manure, and also the heat necessary to drive off the moisture from the excreta in the drying machines. The remainder of the refuse is at present burned, but the steam produced is not utilised.

### *Manufacture of Manure.*

In this part of the works Cornish boilers fitted with Meldrum's forced-blast grates (which are 5 ft. long and 4 ft. wide) are used to generate the necessary steam and produce the hot gases required for the drying machines, which latter are placed immediately behind the boilers. The drying machines are all of the same type, and six in number. The last and most improved machine is 18 ft. long and 6 ft. in diameter, and is mounted on rollers so as to revolve easily. This machine is 6 ft. longer than those worked by the Cornish boilers, and a small furnace supplies the hot gases necessary to dry the charge of excreta. The advantages of this machine are that it is no more trouble to work than the others, while it holds two-thirds more; the lid-holes for charging, &c., are 50 per cent. larger, and the machine is easier to drive, the gear being better arranged. There is a baffle plate placed inside the machine, against



No. 1, Cornish boiler for generating steam, the hot products of combustion from which pass into No. 2, an excreta-drying machine, which revolves on rollers, and carries away the moisture. No. 3, drying machine for finally drying the manure before grinding. No. 4, washer tower with tank below, used to cool and wash the foul gases. No. 5, exhauster to draw gases from the machine through the washer and force them through Nos. 6 and 7. No. 6, depositing chamber, where water and solid matter mechanically carried over from the washer are caught. No. 7, cremator furnace, in which the gases are raised to a high temperature before passing into the chimney, No. 8, which is 250 ft. high.

which the hot gases impinge, thus tending to get the heat more uniformly distributed. This plate is placed about two-thirds the distance along the machine, and its diameter is nearly three-fourths the internal diameter of the machine. The drying machine is filled about one-third full of excreta, and, being set in motion, a fresh surface of the material is continually being exposed to the hot gases which stream in at one end of the machine and out at the other, passing over the excreta in so doing. The waste gases are further utilised after leaving the machine, to heat up a drying floor for the purpose of further and finally drying the manure.

In these machines it is very rare indeed that the excreta reaches a higher temperature than 200° F., so that the material does not foam or get charred by the hot gases. A certain percentage of acid is added to the excreta previous to charging the machine, in order to fix the ammonia. After remaining in the machine some 9 or 10 hours, the manure is just damp and sticky; it is then taken out and put on the drying floor, and remains there until sufficiently dry to be readily ground, after which it is ready for the farmers.

Now we will follow the gases and foul vapours from the machines on their way to the chimney.

When they leave the machine they are very foul and smell strongly, and means must be adopted to destroy their offensiveness.

These gases, &c., are drawn under the drying floor and through the washer by two exhausters, and are afterwards driven forward through the depositing chamber into the cremator furnace, and thence to the chimney.

A large quantity of urine obtained from the pails is run down into the washer tank, and this, together with the water which is obtained from the depositing chamber, is used as the washing medium until it becomes considerably concentrated, when it is pumped back into one of the machines and is there evaporated down, producing the ammoniated manure. Nothing whatever is added to fortify or improve the quality of either manure.

The depositing chamber consists of a blue brick tank, over which is built an iron chamber, the whole being about 32 ft. long, 17 ft. wide, and 16 ft. high, with a partition wall running down the centre about nine-tenths of its length. The object of this chamber is to bring the gases to a comparative state of rest, and allow them to deposit moisture and solid matter mechanically carried over from the washer.

The cremator furnace, through which the foul gases pass on their way to the chimney, measures outside 43 ft. long, 13 ft. 6 ins. wide, and 11 ft. 6 ins. high. The grate is 9 ft. by 6 ft., and the fuel used in this case is coke from the gasworks. The interior of the furnace behind the grate is filled up with cross baffle walls, with spaces through and between them, so as to detain the gases somewhat while passing through the furnace, and thus ensure their being heated up to the requisite temperature, which is, in this case, from 1,000° to 1,400° F. With this temperature and an excess of oxygen in the gases the organic matters present are thoroughly consumed.

Returning for a moment to the Cornish boilers and the machines, it may be interesting to note that the analysis of the gases and products of combustion, as they leave the drying machine, taking an average of three tests, give the following results :—

14·47 per cent. of carbonic acid gas. These are fairly good results, considering the material burned, as it is important that surplus air should be kept out of the flues as far as possible.

Owing to inward leakage of air, the percentage of carbonic acid in the gases is considerably reduced before the cremator furnace is reached, but an average of three tests taken on various dates give the following :—

| | Per Cent. |
|---|---|
| Carbonic acid gas | 7·56 |
| Free oxygen | 11·63 |

With reference to the manures themselves, the analysis of the ordinary Rochdale manure is :—

| | Per Cent. |
|---|---|
| Moisture | 15·73 |
| *Organic matter and salts of ammonia | 59·00 |
| †Anhydrous phosphoric acid | 3·75 |
| Magnesia | 0·70 |
| Lime | 2·66 |
| Alkaline salts | 12·43 |
| Oxides of iron and alumina | 2·44 |
| Insoluble siliceous matter | 3·29 |
| | 100·00 |

This manure sells readily at 6*l*. per ton, less a small discount, and when it is remembered that the manure has now been before the public about 13 years, the result must be considered satisfactory.

The analysis of the ammoniated Rochdale manure is :—

| | Per Cent. |
|---|---|
| Moisture | 12·82 |
| ‡Organic matter and salts of ammonia | 67·18 |
| §Anhydrous phosphoric acid | 3·05 |
| Magnesia | 0·53 |
| Lime | 2·13 |
| Alkaline salts | 10·06 |
| Oxides of iron and alumina | 1·95 |
| Insoluble siliceous matter | 2·28 |
| | 100·00 |

This manure sells at 8*l*. per ton, less a small discount. This is the fourth season for this manure, and it has been extremely well received and highly appreciated by practical farmers. There is no trouble in selling the manure at these prices, and, in fact, the demand has been greater than the supply during the past three years.

## PART II.

### *Destructor Furnaces and Steam Production.*

Much has been written and said during the last few years about destructors, or furnaces for burning refuse. A large number of the destructors at present in use seem to be worked simply for the purpose of destroying refuse to get it out of the way, and this is usually done at the rate of 6 to 8 tons per cell per 24 hours. In most cases the heat obtained is either not used at all or used in a half-hearted manner, and the whole cost of burning the refuse must be paid for on the score of a benefit to the public health and a saving in the cost of cartage. This is certainly hard lines on the public health account, more especially as the refuse will pay for its treatment if properly taken in hand.

With the majority of destructor cells such as are in regular use at the present time, having grates 5 ft. by 5 ft., I do not suppose that the steam generated will average more than 6 indicated horse-power per cell. This is in regular work, when there is no pressure put on in the shape of extra labour, &c., to produce a result, as in the case of a test made with some given object. Still the figure is a very low one, but on the other hand there is all the more room for improvement. In most of the cells just referred to chimney draught is entirely depended upon, and as a consequence the cell is very much cooled down during the period of clinkering and fresh charging, by reason of the inrush of cold air through the furnace ; of course this means that if a steam boiler is part of the plant, then for the time being little or no steam is being produced.

A few results like this would certainly cool the ardour of any but an enthusiast, and I am not surprised at an engineer, pointing to some refuse, saying : "This is what these people call fuel." It will also help to account for the fact that the utilisation of refuse has fallen flat in many places, as well as the fact that the material is far from clean ; and the results having been thought anything but encouraging, it has been easier not to bother with it, but to call refuse utilisation a fraud, and turn round to drive the electric light or other works with coal or gas.

About three fairly good attempts have, however, been made with a view to improve matters. In the one case steam jets were used, and the dampers were so set that a good high temperature could be obtained in the main flue behind the destructors ; the advantages claimed, of course, were that no cremator was required, and also more steam could be produced by reason of the high temperature.

In each of the other two cases a fan blast was used to hasten the combustion, and the temperatures obtained in these were also high. If now we draw a lesson from these cases we come to this—build your furnace cell and arrange your blast so as to burn a certain weight per hour per cell, no matter whether it be 5 cwt., 1 ton, or more, and having done this, arrange your dampers so as to prevent an inrush of cold air when the doors are opened, and you will be able to attain decidedly high temperatures, which will not only thoroughly cremate any gases distilled over at the periods of fresh charging the cell, but also at the same time generate a very large quantity of steam at a high pressure. The fact that thorough cremation of the gases and the high steam production are obtained without a cremator furnace is very important, for almost everyone knows that if you do not get complete combustion of the refuse either in the furnace or in a cremator a very unpleasant odour leaves the chimney.

Having a considerable surplus of refuse over and above what was necessary for the manufacture of the manure, the Health Committee of Rochdale decided to build two large destructor cells on the best possible lines. These furnaces were arranged to be worked by forced blast, Meldrum's steam-jet blowers being used for the purpose. In these destructors the grates are 9 ft. wide and 5 ft. long, and the object of this is that while one side of the fire is at a high temperature the other may be clinkered or fresh charged with fuel, the result being that the gases given off are to a great extent cremated in the furnace itself. This method, combined with the combustion chamber immediately behind the furnace cell (which is 21 ft. long, 7 ft. high, and 5 ft. wide), is found to be sufficiently effective, along with the high temperature maintained, in cremating the gases.

The rate of combustion during the test herein mentioned was 47 lb. per sq. foot of grate per hour, but when necessary the quantity can be greatly exceeded. Two Lancashire boilers, 30 ft. by 8 ft. diameter, were also fixed (one to each cell), and the working steam pressure is 120 lb. per sq. inch. The fuel to be burned is refuse as brought in by the carts, without any preliminary treatment. A very high temperature can be maintained, and in making tests with Siemens' pyrometer at the combustion chamber behind the cells the copper cylinders have on several occasions been melted. No cremator is used with this arrangement, and none is necessary with such a temperature in the main-flue.

A large number of tests have been made at various times, and I will now give you a recent test as witnessed by an eminent London engineer, which will serve to illustrate what can be done with this class of material.

*Evaporative Test of Ashpit Refuse burned in two Cells fitted with Meldrum Grates and Blowers, the Boilers being of the Lancashire Type, and Combustion Chambers between the Cells and the Boilers.*

*Date of Test, March* 1st, 1895. *Duration of Test, Six Hours.*

| | |
|---|---|
| Total refuse weighed | 11 tons 16 cwt. |
| Bricks, &c., not burned | 8 cwt. |
| Total refuse burned | 11 tons 8 cwt. |
| Refuse burned per hour | 1 ton 18 cwt. |
| " " per cell | 19 cwt. |
| Total water evaporated | 4,207 galls. |
| Water evaporated per hour | 701 galls. |
| Temperature of feed water | 53° F. |
| Steam-pressure, average pounds per square inch | 113 |
| Water evaporated per pound of refuse | 1·64 lb. actual. |
| Water evaporated per pound of refuse from and at 212° F. | 1·97 lb. |
| Weight of clinker produced | 4 tons 3 cwt. |
| Percentage of clinker | 36 |
| Temperature of combustion chamber | 1,988° F. |
| Temperature of combustion chamber after clinkering and fresh charging | 1,290° F. |

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* Containing nitrogen equal to 8·07 per cent. of ammonia.
† Equal to 8·19 per cent. of phosphate of lime.
‡ Containing nitrogen equal to 13 per cent. of ammonia.
§ Equal to 6·65 per cent. of phosphate of lime.

The steam-pressure was taken half-hourly, and all the water was measured through tanks into the boilers. The steam required for the steam jets was taken from the other boilers with a pressure of 55 lb. per square inch.

Now, comparing the Rochdale results with the best previously obtained, we find that at Oldham about 1 lb. of water was evaporated per lb. of refuse, to a steam-pressure of 70 lb. per square inch.

At Warrington with feed-water at 104° F. and steam pressure at 68 lb. per square inch, the result was 1·14 lb. of water to one of refuse. Now, not only do we get a higher evaporation in our test just described, but it is from water at a lower temperature to steam at over 50 per cent. higher pressure. There is therefore no doubt about the excellence of the results obtained by a combination of furnaces and boilers, as arranged at the Rochdale Sanitary Works, for the complete destruction of ordinary household refuse and the production of high-pressure steam.

These results, in my opinion, are chiefly due to the use of suitable steam-jet blowers for supplying air to the fuel, and not depending merely on the chimney with its sleepy action.

The entire works and stables have been lighted electrically for nearly two years, and it gives every satisfaction. In this case also the power required to drive the dynamo is obtained from refuse, as in the case of the other machinery.

Near the commencement of my paper I mentioned the Rochdale death-rate some years ago as being 32 per thousand, of which nearly one-fourth were zymotic cases. During the last 10 years the death-rate has averaged 18·7 per thousand, and the zymotic cases 1·39 per thousand. All the difference certainly is not due to the pail system, but the fact remains that a town can be kept healthy on that system.

As in chemical works, so in other industrial undertakings, refuse and waste substances are continually being produced, and whether it is for the good of the public health (as in our case) or for the purpose of providing some dividend for the shareholders (as in the case of a number of the gentlemen present this evening), we all agree to have as little waste as possible; and I have attempted briefly to tell you what we are doing at Rochdale in the *utilisation of refuse*.

### DISCUSSION.

Mr. **HARRY GRIMSHAW** thought the thanks of the community generally were due to the Rochdale Corporation for working out this particular method of utilising towns' refuse. He should like to know if any statistics had been published showing the comparative purity of the sewers in towns where the dry-closet system was in vogue with those in water-closet towns. If it could be shown that there was 50 per cent. less impurity in the Rochdale sewers than in towns where the water-closet system was adopted there would be a distinct gain.

Mr. **BRADBURY** (Manchester Corporation Works) said they might possibly take the amount of ashes and excreta as about equal in quantity, so that half would have to be carted, even in the case of a water-closet town. He believed Mr. Brookman stated that Rochdale was making 740 tons of manure a year—about two tons per day. Manchester had 10 boilers making about the same quantity per boiler per day of 24 hours. With respect to steam-raising, he estimated that they evaporated a pound of water for every $1\frac{1}{2}$ pounds of refuse burnt.

Dr. **GERLAND** said he believed the financial success at Rochdale was due to the farmers paying such high prices for the manure. In farmyard dung there was only from 10 to 15 per cent. that was valuable to the land, the remainder passing off into the air. Whether this was so with regard to the manure referred to by Mr. Brookman he could not say, but if it was so the farmers were paying for more than they really got. Several towns on the Continent had adopted the Liermur system of suction through pipes, and their balance sheets showed a profit.

Dr. **WEBER** disputed this statement.

Mr. **STENHOUSE** (Borough Analyst, Rochdale) said, in the case of water-closet towns a much larger water supply was necessary, and there was no doubt that in a town of 70,000 inhabitants where the pail-closet system was in vogue the sewage must be purer and less difficult to treat. Todmorden was an instance where the sewage was much purer than the average, owing to the large quantity of spring water which passed into the sewers. Supposing Rochdale sewers carried all the excreta, there would be in one year above 800 tons of solid decomposable matter, containing only 15 per cent. of moisture, passing down the sewers, and the sewage would certainly be far worse than it was. Speaking of the manufacture as distinct from the collection, it had been found that the price obtained for the manure just paid for its treatment, and, moreover, it returned to the land a valuable product that otherwise would be lost. The value of the manure was not entirely represented by the ammonia and the phosphates alone, as there was also potash, soda, and magnesia present.

Mr. **CORBETT** (Borough Engineer of Salford) thought the question of destructors was well worth the close attention of all engineers, as being a very important one which was just now ripening. He thought a very great mistake was made in coupling steam from destructors with electric lighting. He was afraid the electric light would kill the destructors. For an electrical system they required something that could rise in power very rapidly from a moderate to an extreme output, as required. This could not be done by refuse destructors, unless by using good fuel in them. In Salford they had a most convenient opportunity for using steam from refuse destructors for pumping the sewage, as it was moderately constant, which was the right sort of thing to apply destructors to, and he thought they would get even better results than Mr. Brookman had given them. They evaporated nearly 2 lb. of water per pound of fuel from feed-water at a low temperature, in ordinary Lancashire boilers, and he believed they might get better results if the fire were enclosed in a brick furnace. He was convinced that a furnace built of firebricks would give the best results in burning refuse.

Mr. **BROOKMAN**, in reply to Mr. Corbett as to raising steam by burning refuse, said, with reference to the figures given in the test, as 701 galls. of water evaporated per hour after allowing for the blowers, they would still have 600 galls., and this amount as steam would be quite sufficient for 300 indicated h.p., which from two boilers was no small matter with ordinary unscreened refuse. In cases where the refuse was burnt inside the boiler, high evaporation might be expected, but no attempt could be made at cremation. With respect to comparing the quality of sewage of various towns, in his opinion, if the whole of the excreta was taken to the sewage farm at Rochdale, it would be sufficient to cover the whole of the farm area to a thickness of about $1\frac{1}{2}$ ins. in one year, and this would certainly tend to clog the soil and render it unfit for filtration purposes. In reply to Mr. Bradbury's statement that Manchester obtained 1 lb. of water from $1\frac{1}{2}$ lb. of refuse burnt, in the case of Rochdale it was the reverse, and 1·65 lb. of water were evaporated per pound of refuse at a much higher pressure than at Manchester. With respect to the drying machines, four were usually worked at Rochdale, and dividing the 15 tons of manure produced in the week by this number would give the weight per machine per week. In reply to the question raised as to the washer and depositing chamber, the latter was not a condenser, but merely collected the water and solid matter mechanically carried over. So far from the quantity being an ever-increasing one, there was a very considerable evaporation going on in the washer. With reference to the chimney draughts, it was a matter of the utmost importance to balance the chimney draughts and the forced blast under the grate.

# Newcastle Section.

*Chairman:* G. T. France.
*Vice-Chairman:* Alf. Allhusen.
*Committee:*

P. P. Bedson.
T. W. Hogg.
T. W. Lovibond.
W. Martyn.
John Morrison.
John Pattinson.
*B. S. Proctor.*
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
T. W. Stuart.
John Watson.

*Hon. Local Secretary and Treasurer:*
Saville Shaw, Durham College of Science, Newcastle-on-Tyne.

The name in italics is that of a Member of Committee that retires at the end of the current session.

The following has been elected to fill the vacancy, and will take office in July next:—N. H. Martin.

*Meeting held in the Chemical Theatre of the Durham College of Science, Thursday, February 21st, 1895.*

MR. GEO. T. FRANCE IN THE CHAIR.

## IMMUNITY OF SOME LOW FORMS OF LIFE FROM LEAD POISONING.

BY T. W. HOGG.

(*Abstract.*)

The waste bark heap of the Elswick Lead Works was found to contain a considerable variety of living organisms, the largest of which is a small kind of earthworm. This heap consists principally of the old bark from the white lead stacks, with a small proportion of sweepings from the yards, and now amounts to over 20,000 tons, the accumulations of more than 50 years. Away from the surface it is in a damp, pulpy condition, and has been, to a great extent, converted into a kind of vegetable mould. An average sample contained 50 per cent. of water, and the dried matter included 1·5 to 2·5 per cent. of lead calculated as PbO. It would be supposed that so much lead present would render it uninhabitable for animal life, but the presence of many forms shows that it is not so. The intestines of the worms are always filled with the finely-divided bark, and if the entire organism is dried, the dry matter contains from 1·75 per cent. to 2·6 per cent. of lead calculated as PbO. But little of this is, however, absorbed in the tissues of the animal; for, on three separate occasions, worms were opened and the contents of the intestine washed away, when from 0·009 to 0·015 per cent. of lead, calculated as PbO, was found in the animal tissues. This small proportion is, however, enormous when compared with that found in any organs of the human adult in cases of death from lead poisoning, the largest proportion then found being 0·00053 per cent.

When various organs of the earthworms were treated with ammonium sulphide, blackening was only observed in the intestinal walls.

As the califerous glands were considered by Darwin to excrete lime, it was thought that they might perhaps eliminate lead, but, on squeezing out their white pulpy contents on to a glass slide and adding ammonium sulphide, there was no evidence of the presence of lead.

It would seem therefore that these worms can continue to live while large quantities of lead are passing through them, either from an immunity natural to this form of life or acquired by successive generations in this particular habitat. An experiment was made with fresh, healthy worms which had never been subjected to the action of lead, by placing them in trays filled with good soil mixed with 1, 3, 4, and 5 per cent. of white lead respectively, and kept moist. All lived about two months, but near the end of that time several disappeared and the remainder became very inactive, but this was thought to be rather from lack of food than from the injurious action of lead.

These earthworms are an interesting case of apparent immunity from the effects of a substance intensely poisonous to higher forms of life. We are now, besides, acquainted with organisms which will live in solutions of potassium permanganate; which are affected but little, if at all, by dilute solution of corrosive sublimate; with algæ which not only live, but are reproduced, and assimilate arsenic from solution; with a bird (*Buceros Rhinoceros*) which is said to eat nux vomica with impunity.

The author also refers to some observations he has made with regard to the life and growth of moulds and bacteria in Carey Lea's silver solutions.

* * *

*Meeting held Thursday, March 21st, 1895.*

MR. JOHN PATTINSON IN THE CHAIR.

## ON TWO INTERESTING CASES OF ABNORMAL CONDITION IN PIG IRON.

BY T. W. HOGG.

(For the Paper itself, see Journal, 1895, 245.)

### Discussion.

Mr. John Pattinson suggested that in the second specimen exhibited by Mr. Hogg, where a pig of grey iron had a nucleus of white iron in it, that this condition might be brought about by the state in which the silicon existed in the two varieties. As would be seen from Mr. Hogg's analyses there was very little difference in the total *amount* of the silicon present in each case, 0·85 per cent. in the grey, as against 0·65 per cent. in the white iron. But there existed a very considerable difference as regards the *condition* in which that silicon was present. In the white iron the proportion between the silicon soluble and insoluble in hydrochloric acid was about equal; in the grey portion the amount of the silicon soluble in hydrochloric acid was four times as great as that of the insoluble portion. It seemed therefore likely that the presence of silicon in this peculiar condition had an influence in accelerating the formation of graphite in the grey portion, and it would be of interest if Mr. Hogg could find time to investigate the matter further in order to study this effect of silicon.

Mr. Saville Shaw offered a suggestion towards an explanation of the occurrence of white iron in the central portion of the pig of grey iron. Both grey and white iron *expand* on cooling through a short range of temperature whilst in the pasty state just below their actual melting point. (*Wrightson, Journ. Iron and Steel Inst. No. I.* 1880.) In the case of other bodies which exhibit similar abnormal behaviour (*e.g.*, water between 0° and 4° C.), the effect of pressure upon them at this particular temperature is to cool them. Hence, in the solidifying of the pig, the external solid shell contracting rapidly on the yet pasty interior should cool it rapidly through a few degrees of temperature. The effect of rapid cooling is of course to convert an easily-chilled grey iron into white. The only difficulty in accepting this explanation would lie in the fact that the occurrences described by Mr. Hogg ought to be the rule and not the exception, and all ingots of a "critical" grey iron should have white centres, which is not the case.

He (Mr. Shaw) wondered whether Mr. Hogg had ever noticed any cavities between the grey and white portions. White iron contracts on cooling after solidification twice as much as grey, and one might almost expect to find the white central portion torn away from the surrounding grey iron.

Mr. T. W. Hogg, in reply, thought it scarcely likely that the difference in the state in which the silicon was present in the grey and in the white portions would, as suggested by Mr. Pattinson, account for the occurrences he had described. He thought rather that it was only a coincident phenomenon, and that the cause which gave rise to the differences in the character of the iron was also the cause of the variation in the condition of the silicon. He could not think Mr. Shaw's explanation satisfactory, because if it were a good one it would follow that every pig of this kind of iron should have a similar structure to the one he had exhibited. Also the white portion should extend throughout the entire length of the pig, whereas it terminated some distance from the end. He had never found any vacant space between the grey and white portions, the boundary line between the two being quite distinct, though the white iron seemed to throw out ramifications into the surrounding grey.

Mr. Hogg also writes as follows:—Since writing the paper, a section of this pig has been polished and etched, with the result that the shooting out of the white into the grey is, with great distinctness, shown to extend much further than it appeared upon the ordinary fracture. The etching also reveals a large number of isolated lamellar spots irregularly distributed nearer the top portion of the pig; it is also noticeable that the lamellæ of the different spots appear to diverge in various directions.

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Professor P. P. Bedson exhibited a form of apparatus for estimating small percentages of marsh-gas in air. By a slight addition to the apparatus of Pettersson and Palmquist, for the estimation of carbon dioxide in air, it was, as he showed, possible to utilise it for this purpose. The apparatus referred to allows of the delicate measurement of very small variations in the volume of a gas, and estimates the amount of carbon dioxide present by measuring the contraction brought about by bringing the sample of air into contact with potash solution.

Dr. Bedson's addition to the apparatus consisted of a tube standing over mercury and containing a spiral of platinum wire, which could be heated to redness by means of an electric current. The measured quantity of the air to be tested, after being deprived of its carbon dioxide, is transferred to this tube and left in contact with the hot platinum wire for one or two minutes. It is then placed over caustic potash and re-measured, the contraction serving as an indication of the quantity of marsh-gas present.

Mr. Saville Shaw gave a short demonstration on methods of quantitative blow-pipe assaying, and exhibited the portable collection of apparatus first designed by Plattner for this purpose.

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## Scottish Section.

*Chairman: Robt. Irvine.*
*Vice-Chairman: J. Clark.*
*Committee:*

G. Beilby.
*R. Cox.*
*C. J. Ellis.*
*C. A. Fawsitt.*
D. Harris.
G. G. Henderson.
*R. A. Inglis.*
W. I. Macadam.
J. S. Macarthur.
E. Ostlere.
T. L. Patterson.
R. Pullar.
*J. B. Readman.*
H. Rose.
E. C. C. Stanford.
D. R. Steuart.

*Hon. Secretary and Treasurer:*
J. Stanley Muir, Chemical Laboratory, University of Glasgow.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman*:—John Clark. *Vice-Chairman*:—J. B. Readman. *Committee*:—J. Fyfe, Robt. Irvine, A. Macdonald, P. Rottenburg, and W. Young.

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## Nottingham Section.

University College, Nottingham.

*Chairman: J. M. C. Paton.*
*Vice-Chairman: C. Spackman.*
*Committee:*

L. Archbutt.
*F. J. R. Carulla.*
F. Clowes.
J. B. Coleman.
H. Forth.
J. F. Kempson.
T. Mason.
J. O'Sullivan.
*S. J. Pentecost.*
C. Taylor.
G. J. Ward.

*Treasurer: J. T. Wood.*
*Hon. Local Secretary:*
*R. L. Whiteley*, University College, Nottingham.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman*:—F. J. R. Carulla. *Vice-Chairman*:—J. M. C. Paton. *Treasurer*:—S. J. Pentecost. *Secretary*:—J. T. Wood. *Committee*:—W. G. Johnston, and R. Lloyd Whiteley.

### SESSION 1895.

Wednesday, May 22nd:—
Dr. Herfeldt, of Bonn, "The Bacteria of Dung and their Action" (communicated by Mr. J. T. Wood).

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*Meeting held at University College, Nottingham, on Wednesday, March 27th, 1895.*

MR. J. M. C. PATON IN THE CHAIR.

## THE EXTINCTIVE ATMOSPHERES PRODUCED BY FLAMES.

BY PROF. CLOWES, D.SC., AND M. E. FEILMANN, B.SC.

In a former paper (this Journal, December 31, 1894), we described experiments which were undertaken to determine the percentages of carbon dioxide and of nitrogen, which must be mixed with air in order to extinguish the flames of different combustible substances when immersed in the mixture.

It seemed desirable to supplement this inquiry by investigating the composition of the residual atmospheres produced by the flames themselves when they were allowed to extinguish themselves in a confined volume of air. This latter investigation is treated of in this paper.

It was necessary in order to ensure accuracy in the results that the combustion of the materials and the storage of the residual atmospheres should not take place over water, as exposure to a large surface of this liquid would cause absorption of carbon dioxide and would thus vitiate the results.

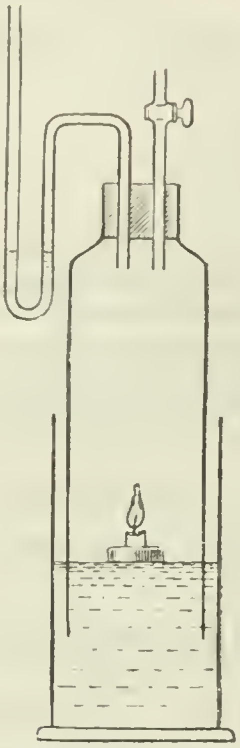
Preliminary experiments showed that sudden fluctuations of pressure, caused by the heat of the flame and the condensation of the steam produced, tended to extinguish the flame. It was therefore necessary to so arrange matters that the volume of the enclosed space could be varied rapidly, in order to keep the pressure constant.

The actual arrangement consisted of a bell-jar, the bottom of which was closed by being immersed in a vessel of mercury. Through a stopper in the top of the jar passed (1) a pressure-gauge containing coloured water, and (2) a stop-cock tube communicating with the outside air.

The gases were burnt from a platinum jet which was fed by a tube passing through the mercury.

The liquids were burnt from wicks in little lamps floating upon the surface of the mercury. These consisted of an inverted porcelain crucible lid holding the liquid and provided with a cover of sheet copper; through the centre of this passed a short glass tube holding the wick. The object in every case was to have the flame as near to the surface of the mercury as possible in order to cause circulation of the whole of the confined air.

In performing an experiment the flame was first lighted, then the bell-jar was placed over it and pressed down for some distance into the mercury, leaving the stop-cock at the top open, so as to keep the contents at atmospheric pressure. The stop-cock was then closed and the pressure inside was maintained equal to that of the atmosphere by raising or lowering the jar by hand according to the indications of the gauge.



As soon as the flame was extinguished the outside end of the pressure-gauge was closed to prevent atmospheric air from being sucked in through it, and the contents of the jar were allowed to stand half-an-hour to mix and cool. They were then forced out through the stop-cock tube into a Hempel's gas burette in which they were analysed in the usual way by absorption.

The gases were burnt in a dark room in order to be able to observe the exact moment when the flame was extinguished, as it generally became very pale at the finish. As soon as the flame went out an assistant stopped the gas-supply which had been feeding the flame at the jet, so as to prevent the unburnt gas from entering the bell-jar. The amount of unburnt gas in the feed tube was negligable, since millimetre tubing was used. In the case of ethylene, it was found impossible to maintain a satisfactory flame, and some difficulty was experienced in the case of methane also.

Percentage Composition of the Residual Atmospheres from the Flames, and of the Artificial Mixtures of Oxygen and Nitrogen in which Flames are just extinguished.

| Substances Burnt. | Percentage Composition of the Residual Atmosphere in which the Flame was extinguished. | | | Proportions Per Cent. of $O_2$ and $N_2$ in which Flame is extinguished when introduced. | |
|---|---|---|---|---|---|
| | $O_2$ | $N_2$ | $CO_2$ | $O_2$ | $N_2$ |
| Alcohol, absolute... | 14·9 | 80·75 | 4·35 | 16·6 | 83·4 |
| Alcohol, methylated | 15·6 | 80·25 | 4·15 | 17·2 | 82·8 |
| Paraffin, lamp oil .. | 16·6 | 80·4 | 3·0 | 16·2 | 83·8 |
| Colza and paraffin . | 16·4 | 80·5 | 3·1 | 16·4 | 83·6 |
| Candle ............ | 15·7 | 81·1 | 3·2 | 16·4 | 83·6 |
| Hydrogen ......... | 5·5 | 94·5 | .. | 6·3 | 93·7 |
| Carbon monoxide .. | 13·35 | 74·4 | 12·25 | 15·1 | 84·9 |
| Methane........... | 15·6 | 82·1 | 2·3 | 17·4 | 82·6 |
| Ethylene (failed) .. | .. | .. | .. | [13·2 | 86·8] |
| Coal gas ........... | 11·35 | 83·75 | 4·9 | 11·3 | 88·7 |

It will be noticed that while the proportions of oxygen in the residual and in the artificially mixed atmospheres are very similar, yet in most cases the percentage of oxygen in the residual atmosphere from the flame is slightly less than it is in the artificial mixture which just extinguishes the same flame when immersed in it. This occurs in spite of the fact that a large amount of steam must have condensed in the former case, thus making the apparent percentage of oxygen higher than would really be the case during the combustion. This is very possibly due to the fact that in the case of a flame forming its own extinctive atmosphere in a confined space, the temperature of the surrounding atmosphere is finally raised considerably, and this would undoubtedly tend to keep the flame alight.

On comparison it will be seen that the extinctive atmospheres produced by ordinary flames approximate closely in composition to the composition of the air expired from the lungs. Thus air expired after the breath has been held for 40 seconds contains—

14·9 per cent. $O_2$; 81·4 per cent. $N_2$; 3·7 per cent. $CO_2$; whilst that produced by an alcohol flame contains—

14·9 per cent. $O_2$; 80·7 per cent. $N_2$; 4·3 per cent. $CO_2$; and from a candle—

15·7 per cent. $O_2$; 81·1 per cent. $N_2$; 3·2 per cent. $CO_2$.

Atmospheres of the above composition would not, according to a research published recently by Dr. J. Haldane, produce any noticeable inconvenience when breathed. It therefore follows that atmospheres which extinguish any flame ordinarily used may yet be perfectly safe to breathe. This statement does not apply to the flame of hydrogen, which is only extinguished by an atmosphere which is quite incapable of supporting life.

## Discussion.

Dr. F. Clowes said that the results just brought forward by Mr. Feilmann were a natural sequel to those already published. In the former research, air was mixed with extinctive gas to a proportion just sufficient to extinguish flames, and the composition of this extinctive atmosphere was ascertained for each flame. In the present research the flame was allowed to produce its own extinctive atmosphere by burning in an inclosed volume of air, and the composition of the atmosphere produced by the flame, and which just extinguished the flame was ascertained. If in the two researches the similar results were compared the percentages of oxygen and the percentages of gases other than oxygen showed a close agreement. The composition of the extinctive atmosphere produced by a candle flame or by an oil or spirit flame was strikingly similar to that of the air expired from the lungs themselves. According to Dr. Haldane both these atmospheres are respirable not only with safety and without inconvenience, but he maintains that an ordinary healthy person would not be in any way affected by breathing such air. Hence it cannot be maintained that an atmosphere which causes the extinction of a candle flame cannot safely be entered by a human being. Dr. Haldane shows that a very considerable diminution in the percentage of oxygen present in air may take place without producing distressing effects. Apparently the quickening of the rate of respiration makes up for the defect of oxygen in each inspiration. If, on the other hand, the proportion of carbon dioxide is increased beyond a certain limit it begins to retard the rate and depth of the inspirations, and therefore leads to serious results in the presence of a deficiency of oxygen. It seems clear that the organic products emitted by the breath and by flame have little immediate effect upon the health when air which contains them is breathed. This is not the case, however, with carbon monoxide, which is prejudicial even when present in small quantity only.

# Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
*J. Cohen.*
T. Fairley.
W. Leach.

W. Mc'D. Mackey.
A. G. Perkin.
C. Rawson.
*F. W. Richardson.*
*G. W. Slatter.*
Thorp Whitaker.

*Hon. Local Secretary and Treasurer:*
H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* N. Farrant, A. Hess, and Geo. Ward.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

SESSION 1894-95.

May 6th:—
Prof. Hummel and Mr. W. M. Gardner, F.C.S. "The Chroming of Wool." Part IV.
Mr. A. G. Perkin, F.R.S.E., and Prof. Hummel. "The Tinctorial Properties of some Indian Dyestuffs."
Mr. A. G. Perkin, F.R.S.E. "Notes on the Purification of some Congo and Acid-Red Colours."

*Meeting held Monday, March 4th, 1895.*

MR. T. FAIRLEY IN THE CHAIR.

## THE ANALYSIS OF LIQUORS USED IN CHROME TANNAGE.

BY CARLTON B. HEAL AND H. R. PROCTER.

(This Journal, 1895, 248—252.)

### Discussion.

The Chairman remarked that the chrome-tanning process first attracted attention some 10—11 years ago, when it was taken up by a Leeds company, which was, however, unsuccessful. He took it that the process essentially consisted of two parts: first, the action of the chromic acid on the substances which, when boiled with water, formed gelatine, with or without the action of light; and, secondly, the action of the chromic oxide, which would be similar to that of alumina in the alum process. The action of chromic acid on gelatine in the light was applied industrially some 30—40 years ago to the engraving of steel plates from photographs. During the Franco-German war it was proposed to use sausages of pea-flour or other material containing much nourishment, for the German army. A difficulty was to find suitable skins, and it was proposed to dip the sausages in gelatine and then in a solution containing chromic acid. He also asked whether the action of light was favourable to the changes which occur in chrome tanning or otherwise.

Mr. C. Rawson asked whether the tanning took place in the cold. He also pointed out that if the hides contained lime, this would diminish the amount of free chromic acid in the solution, and therefore the determination of the amount of chromic acid in the tanning-liquors before and after the skins had been submitted to their action would not show how much chromic acid had been taken up by the hide. He also suggested that sodium bisulphite might be used as a reducing agent.

Mr. H. R. Procter, replying to the last speaker, said that the principal object of the determinations of chromic acid was to ascertain how much acid must be added to the used liquors in order to bring them back to their original strength. With regard to the use of sodium bisulphite, his impression was, from the experiments already made, that sulphurous acid could not be used advantageously as a reducing agent, while satisfactory leather could be made by using thiosulphuric acid or an acidulated solution of alkaline polysulphides.

By the action of light on leather still containing free chromic acid, a hard and horny substance was produced. In the old Heinzerling process, which was used by the Leeds company, the tanning was done mainly by means of alum and salt, some chromic acid being added in order to harden the fibre. No reducing agent was used, and the chromic acid was simply left to be reduced, under the influence of light, by the leather and fatty materials, such as paraffin and rosin, which were subsequently added to render the leather waterproof. He believed that Dr. T. E. Thorpe, when asked by the Leeds company how they could avoid the yellowish colour of their leather, suggested reduction by sulphurous acid. If Thorpe had published this suggestion he would have anticipated the American patent. In answer to a question by Dr. Ewan, Mr. Procter said that pelts absorbed acids such as $H_2SO_4$ or HCl quite as vigorously as chromic acid, owing to which all the bichromate was not decomposed, even when theoretically sufficient acid is added to the solution.

Chrome-leather resisted heating to an extraordinary extent. It might be boiled with water for half an hour without any great injury. Ordinary chromic salts, however, gave a leather which would not stand boiling with water, the chromic salts being washed out and the leather converted into a pulp. Basic chromic salts had been used in America with some success. Though a patent had been previously taken out in England by Bertram Hunt for tanning by means of basic salts—those of chromium being included—the American patent office decided that the special modes of preparation of the basic chromium salts were sufficiently novel to allow of the process being patented as a new one in America.

Owing to its resistance to heat and moisture, the chrome-leather would probably be very suitable for belting which had to stand heat in a moist atmosphere. The leather was also very elastic, though it did not permanently stretch.

# New York Section.

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*Meeting held at the College of Pharmacy, Monday, March 4th, 1895.*

MR. A. H. MASON IN THE CHAIR.

## NOTE UPON THE IDENTIFICATION OF A CERTAIN RED AZO COLOURING MATTER.

BY JAMES H. STEBBINS, JR., PH.D.

Ten years ago the identification of azo colours was a comparatively easy matter, but of late the number of this class of dyes has so enormously increased that the tests formerly relied upon by chemists are no longer adequate, and at times it will happen, after all the usual tests have failed to establish the nature of the product under examination, that the chemist will, so to say, find himself completely at sea. The only way then open to properly cope with the problem is to make a complete and thorough chemical examination.

What I have just prefaced occurred to me a few months since, at which time I received a sample of a red dye, with the request that I should determine its nature and composition.

At first sight this seemed to be an easy matter, but, after applying all the usual tests with acids, alkalis, dye-test, &c., I found that I was unable to say with certainty what particular dyestuff I had in hand, though of course these tests narrowed the possible combinations down to three or four. To gain therefore a thorough insight into the constitution of the product under examination, the following investigation was undertaken :—

### *General Characteristics.*

The dyestuff was a fiery red powder easily soluble in hot or cold water with a scarlet-red colour.

Hydrochloric acid added to its aqueous solution produced practically no change of colour. It dissolved in concentrated sulphuric acid with a cherry-red colour, which, upon dilution with water, changed to a yellowish-scarlet. Caustic soda added to its aqueous solution produced only a very slight change of colour, merely imparting a slightly browner shade to the solution.

Reducing agents, as stannous chloride and hydrochloric acid, decolorise the solution, with the separation of a crystalline reduction product.

It dyed wool in an acid bath, of a brilliant yellowish-scarlet colour.

From the foregoing it was easy to infer that the dyestuff was a plain azo compound, and therefore all diazo and tetrazo compounds were excluded from consideration.

### *Barium Salt.*

Since considerable information as to the nature of the dyestuff can be obtained by an examination of its barium salt, an attempt was made to prepare this body, but, owing to its impurity and great solubility in water, much difficulty was encountered in obtaining a product of sufficient purity for analysis; but, finally, after several trials, the following process was adopted :—25 grms. of dyestuff were dissolved in 150 c.c. of boiling water, and to the solution was added 120 c.c. of 95 per cent. alcohol.

The mixture was now filtered hot, and the filtrate set aside overnight to crystallise. The next morning the beaker was found filled with a mass of indistinct microscopic reddish-brown needles, which constitute the soda salt of the body under examination.

The crystalline mass was collected upon a filter, and then placed upon a porous plate to drain and dry. The yield of once-purified soda salt from 25 grms. of dyestuff was rather small, much colour remaining dissolved in the mother-liquor. The soda salt thus obtained was of a bright red colour by reflected light, and under the microscope by transmitted light appeared as little reddish-brown needles.

It would have been better to recrystallise the soda salt once or twice more, to ensure an absolutely pure product, before proceeding any further, but, as I had only a small amount of material at hand, it was feared that an attempt to purify the product further would be fraught with too great a loss. Hence I was obliged to prepare the barium salt with only a partially pure soda salt, and consequently the latter was not obtained in a sufficient state of purity for accurate analytical work, yet the results obtained were sufficiently close to theory to enable me to determine the constitution of the dyestuff in question.

The soda salt was now dissolved in hot water, acidified with hydrochloric acid, heated to boiling, and treated with an excess of barium chloride. A brilliant red precipitate of the barium salt was thus obtained. It was collected upon a filter, and washed with cold water, until a drop of the filtrate no longer reacted for chlorine with argentic nitrate. It was then spread upon a porous plate till air-dry, and finally dried over sulphuric acid to constant weight.

### *Water of Crystallisation.*

| | |
|---|---|
| Substance taken ($H_2SO_4$ dry) | 1·0279 grms. |
| Water lost at 155° C. | 0·0281 „ |
| Equivalent to water | 2·74 per cent. |

### *Barium Estimation.*

| | |
|---|---|
| Substance taken | 0·2633 grm. |
| $BaSO_4$ found | 0·099 „ |
| Equivalent to barium | 22·26 per cent. |

A duplicate Ba estimation gave absolutely the same result.

On now calculating a molecular weight from the quantity of $BaSO_4$ found, we obtained :—

$$0\cdot099 : BaSO_4 :: 0\cdot2633 : x$$
$$x = 616\cdot3.$$

Therefore the least molecular weight possible is 616·3.

### *Number of Sulpho-Groups present.*

The percentage of barium found was 22·26 per cent., hence $22\cdot26 \div 137 = 0\cdot16$ atom barium. Now, as 100 parts of barium salt contain 0·16 atom Ba, therefore 616·3 parts will contain 0·98 part barium, or, in round numbers, 1 atom; but, as 1 atom of barium calls for two sulpho-groups, therefore it is evident that the barium salt, as well as the soda salt, must contain two sulpho-groups.

The compound coming nearest to these requirements and to others which will be enumerated later on, is one of the empirical formula $C_{17}H_{12}N_2S_2O_7$, and of which three isomeric forms or modifications are possible, viz. :—

1. $C_6H_2(CH_3)_2(HSO_3){-}N{=}N{-}\beta{-}C_{10}H_5(HSO_3)OH$,
2. $C_6H(CH_3)_2(HSO_3)_2{-}N{=}N{-}\beta{-}C_{10}H_6OH$,
3. $C_6H_3(CH_3)_2{-}N{=}N{-}\beta C_{10}H_4(HSO_3)_2OH$,

either of which would yield a water-free barium salt requiring 23·93 per cent. of barium.

It therefore follows, that in the body under examination, the sulpho-groups may be either equally distributed between the benzene and naphthalene nuclei, as in example 1; or be both contained in the benzene nucleus, as in example 2; or, lastly, may be both contained in the naphthalene nucleus, as in example 3; and the general characteristics of the producs would point to a body of the latter composition.

To therefore determine the exact location of the two sulpho-groups, an examination of its reduction products is necessary. This was accomplished as follows :—

Two grms. of dyestuff were dissolved in 20 c.c. of boiling water, filtered, and the filtrate treated with 12 c.c. of a solution of stannous chloride dissolved in hydrochloric acid of

1·2 sp. gr. ($40SnCl_2$ + 100 c.c. HCl). The mixture effervesced at first, and on continuing the heating for a few minutes, the red colour of the solution was completely destroyed, giving place to a solution of amber colour. Before the solution has had time to become thoroughly cool, a white crystalline body begins to separate.

The whole mixture was now placed in an ice-box until well cooled, and the crystalline mass which separated was collected upon a filter and washed with cold water till free from tin and hydrochloric acid. It was then dissolved in sodium acetate solution, filtered, and re-precipitated with hydrochloric acid in the shape of fine white needles, which, however, turned reddish after a very short exposure to the air. It is therefore very difficult to obtain the compound in a perfectly pure condition.

The crystalline mass was filtered as rapidly as possible by means of a suction pump, washed with alcohol and ether, and finally dried under the air-pump. I thus obtained a body crystallising in pretty needles, as may be seen by an inspection of the accompanying micro-photograph, and possessing only a faint reddish colour.

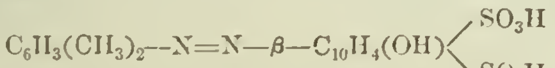
This body in aqueous solution is quickly oxidised by contact with the air. Alkalis and oxidising agents behave similarly. It does not unite with nitroso compounds to form colouring matters, and reduces silver nitrate to metallic silver very rapidly. Hence the body agrees in all points with the amido-β-naphthol-α-disulphonic acid (from β-naphtholdisulphonic acid R) described by O. N. Witt, Ber. d. chem. Ges. 1888, 3479 (this Journal, 1889, 276—277).

The acid filtrate remaining after removing the above-described reduction product was treated with zinc, and allowed to stand until the tin was all precipitated.

The filtered solution was now made alkaline with caustic soda, and shaken up with ether. After the latter had been distilled off, a few drops of a brownish basic oil, strongly smelling of xylidine, were obtained.

As, however, the quantity of material was too small for identification, a larger quantity was prepared by repeating the reduction with 15 grms. of dyestuff, and the basic oil thus obtained was found upon examination to be xylidine.

Hence, as xylidine and amido-β-naphtholdisulphonic acid were found among the dyestuff reduction products, it is evident that it must be formed by the union of a salt of diazo-xylene with beta-naphtholdisulphonic acid R, and hence the free dyestuff acid must have the following constitution :—

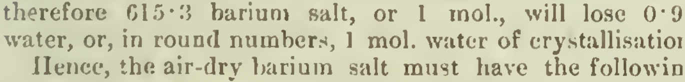


$$C_6H_3(CH_3)_2\text{—}N{=}N\text{—}\beta\text{—}C_{10}H_4(OH)\begin{cases}SO_3H\\SO_3H\end{cases}$$

We have previously shown that the barium salt on being heated to 155° C. loses 2·74 per cent. of water of crystallisation, which corresponds to 2·74 ÷ 18 = 0·15 mol. water of crystallisation.

Now, as 100 parts of barium salt lose 0·15 mol. of water, therefore 615·3 barium salt, or 1 mol., will lose 0·92 water, or, in round numbers, 1 mol. water of crystallisation.

Hence, the air-dry barium salt must have the following constitution :—



$$C_6H_3(CH_3)_2\text{—}N{=}N\text{—}\beta C_{10}H_4(OH)\left\langle\begin{matrix}SO_3\\SO_3\end{matrix}\right\rangle Ba + H_2O.$$

A body of this constitution calls for—

| | Per Cent. |
|---|---|
| Water of crystallisation | 3·05 |

Found—

| | |
|---|---|
| Water of crystallisation | 2·74 |

## COMMERCIAL METHODS FOR THE VALUATION OF IMPORTED SUGARS APPLIED TO THE ASSESSMENT OF DUTIES THEREON.

BY E. SHERER, PH.D.

The duty collected upon imported sugars has furnished a larger amount of revenue than the duty upon any other imported article of commerce under all tariffs enacted since 1861, except that of 1890, which admitted raw sugars free. Hence the importance of an equitable and practicable schedule of rates for the various grades of commercial sugars.

The tariff of 1894 is the only one enacted since that of 1846 which has provided for *ad valorem* rates of duty upon sugars. Data are therefore wanting for a full consideration of the merits of specific as compared with *ad valorem* rates. The difficulties which have attended the administration of the existing schedule of *ad valorem* rates, have, however, already been found sufficiently formidable to justify the consideration of the advantages of specific rates, and an effort to devise a scheme to provide the required amount of revenue upon sugar by specific rates of duty, which shall be relatively *ad valorem*, as applied to the different grades of sugar.

Under the tariffs enacted prior to that of 1883, the Dutch standard alone was the means prescribed for distinguishing the various qualities of sugars.

The tariff of 1883 first adopted the polariscopic test in addition to certain numbers of the Dutch standard, which were still retained as a means of distinguishing the several grades. This change was brought about by the discovery in 1878 that the method of manufacture of certain high grade centrifugal sugars had been so modified as to cause them, when graded by the Dutch standard, to be assessed at the lowest rate of duty. It was claimed on the part of the Government that such sugars were artificially coloured, and seizures of importations were made in Baltimore and New York by the Customs authorities.

The several suits which resulted were variously decided in favour of the importers and of the Government by the lower courts, but upon final appeal to the Supreme Court the decision was in favour of the importers, the opinion of the majority of the Court being that they could not be held to have attempted an evasion of the United States Customs laws by the importation of an article which, by a modification in method of manufacture, caused the Dutch standard to be no longer a measure of its value. The Court held that the Dutch standard was the only lawful measure of value for the purpose of assessment of duty that the Customs officials could apply; in other words, that they could not go behind the returns.

The Treasury Department had in 1879 directed the employment of the polariscope by Customs officials for the ascertainment of dutiable value, or true Dutch standard grade, of such sugars as were believed to have been degraded in colour to evade payment of proper rate of duty.

In 1881, upon the final decision of the Supreme Court, this use of the polariscope by Customs officials was discontinued, and the increased duties collected by this means, to the extent of some two millions of dollars, were refunded.

In the tariff of 1893, as already stated, the polariscopic test was made the chief basis for the classification of sugars, the use of certain numbers of the Dutch standard being, however, retained.

The Dutch standard is perhaps the earliest known means of grading sugars for commercial purposes. It was first adopted by the government of Holland for revenue purposes. It consists of a series of sugars, varying in colour, or rather shade, from pure white to a very dark brown, almost black. The set comprises 20 sugars, No. 1 being the darkest, and No. 20 the lightest. Applied to sugars such as are the product of the Dutch East India Islands, it furnished a most accurate measure of value, but when compared with sugars of a different colour from that of the standard, the difficulty of determining the exact shade or grade of the sugar, so compared, will be readily seen. The sugars of the Dutch standard below No. 16 are of a uniform grey colour, varying in intensity from a very light to a very dark shade. Some sugars are of a reddish colour, others of a yellow straw colour, and the Dutch standard becomes a very uncertain means for the grading of sugars which differ from it so widely in colour. The variation in shade from light to dark in the sugars which compose the Dutch standard, and in all sugars manufactured by similar processes, is caused by the greater or less amount of molasses remaining in them, and, as the impurities affecting their value are in the molasses, it will be seen that this standard becomes an approximately accurate one for their valuation.

The polariscopic test as a method for the valuation of raw sugars, became generally accepted in this country about 1870. Since that date nearly all commercial transactions in such sugars have been based on that test. It is an accurate measure of the value for refining purposes, within certain recognised limits, of all raw cane sugars testing 89 per cent. or above. In the case of low grade raw sugars it is conceded that this test alone is not an accurate measure of value. An exact estimate of the product of these sugars requires a more or less complete analysis of them; the determination of the percentage of ash, of invert sugar, the pure sugar as determined by Clerget's method, &c. Nevertheless, the polariscopic test is accepted as the best practicable basis for their commercial valuation. For the higher grades of centrifugal sugars the standard adopted by the trade is a polariscopic test of 96 per cent. Sales are made on this basis with a fixed rate of increase in value for each per cent. above 96 per cent., and a fixed rate of decrease in value for each per cent. above 96 per cent. For Muscovado sugars the commercial standard of test is 89 per cent., as also for Molasses sugars. These latter, however, are not regarded as of like value as compared with the former sugars of the same test. The unit of pure sugar in a sugar of low test has not the same value as in a sugar of high test; hence the rate of decrease in value for each per cent. below the standard is double the rate of increase in value for each per cent. above.

In the case of raw beet-root sugars the polariscopic test is not the trade basis of valuation. These sugars are sold on what is called their net analysis test. This is ascertained by deducting from the polariscopic test of such sugars an amount equal to five times the percentage of soluble ash found in them. The remainder is regarded as the net analysis test and is the basis of purchase and sale. It has been found that the average net analysis test of a beet-root sugar testing 94 per cent. by polariscope is 88 per cent., and this is the standard on which beet sugars testing 94 per cent. and above by polariscope are sold. In sugar testing below 94 per cent. the percentage of ash is extremely variable, by reason of the varying quantity and quality of the molasses contained in them, on which chiefly the percentage of ash depends. An actual determination of the percentage of ash in such sugars is therefore necessary to arrive at their value. The net analysis test of a beet-root sugar represents approximately its highest possible yield in refined sugar. It is assumed that the ash, consisting as it does chiefly of alkaline salts, will prevent the crystallisation of sugar to the extent of five times the amount of ash present. The polariscopic test of sugar represents the units of crystallisable sugar contained in the sample tested. The possible yield in refined sugar is, however, dependent upon the quantity and character of the impurities present. The ash in cane sugar is less in quantity than in beet sugars of the same test, and does not consist as largely of alkaline salts, which retard crystallisation.

It will be conceded that duties upon sugars should be so adjusted as to avoid discrimination against any specific grade of sugar. It is also evident that any scheme adopted should closely follow commercial usage in the method of distinguishing the several grades.

The difficulty in the administration of strictly *ad valorem* rates may be briefly presented as follows:—

No article of commerce is more subject to changes in value from day to day than is raw sugar. No stock upon the exchange list shows more rapid fluctuations in price, and the quantity dealt in is so great that very slight changes involve very large sums of money. Statutory provisions require that the appraising officers should assess duty upon the market value of imported merchandise at the date of shipment in the principal markets of the country from which exported. This in the case of imported sugars it is in many instances impossible to do. Much of the raw sugar imported at this port is consigned for the credit of the shipper at a nominal or *pro forma* price stated upon the invoice, against which, on consignment, the consignor draws. The price at which the sugar is actually sold and the quantity—it is often not even weighed at the place of shipment—are determined by the polariscopic test and weight after arrival here. The test is made after the sugar arrives and settlement is made on the basis of such test. The appraising officials can obtain no quotation of the market price at the date of shipment in the chief market of the country from which exported, since the real price at which the sugar is sold is the market value here, subject to test on arrival. A nominal price is stated upon the invoice but this may, and often does, differ widely from the actual value. Should the shipper of the sugar state upon the invoice a test higher than the actual test and place a value upon it higher than the true value, which he often does, that he may draw a larger amount against his shipment, the importer must, nevertheless, pay duty upon the invoice value. The customs authorities have no power to reduce declared values; they can only increase them.

In the smaller islands of the West Indies, particularly the English islands, the shipper collects the products of many small plantations at different dates, paying various prices, and ships a cargo, thus accumulated, at a nominal price, the actual price to be determined upon its arrival and test here. How is it possible for customs officials here to decide upon the correctness of such an invoice in accordance with the requirements of the statutes, which provide that they shall be governed by the market price of the chief market of the country from which exported at the time of shipment?

It may be that in process of time the difficulties that attend the administration of a tariff providing *ad valorem* rates of duty upon sugar will be overcome, but it would certainly seem that specific rates would be much easier of administration and more equitable. Specific rates would afford no opportunity for under-valuations, nor would the importer be mulcted for over-valuations.

A schedule of specific rates of duty, providing for the decreasing value of the sugar unit in sugars of low test, so that such sugars would not in any degree be discriminated against, is desirable but is impracticable, for the reason that these sugars are of a variable value, even when of the same polariscopic test.

No scheme is practicable which requires a complete analysis of a sample of every importation. Simplicity of administration must be regarded even at the cost of discrimination against some sugars.

Any schedule adopted, grading sugars by polariscopic test, should provide that from the test of beet-root sugars, there shall be deducted an amount equal to five times the percentage of soluble ash found by chemical analysis to be present, and that the remainder be regarded as the polariscopic test of such sugars, for the purposes of classification. Such a provision would place beet-root sugars upon a parity with cane sugars.

Commercial sugars rarely, if ever, test below 75 per cent. by the polariscope. Upon sugars testing not above 75 per cent. the lowest rate of duty should be assessed, and the rate of increase should be graded for each per cent. above 75 per cent. proportionately to the increased commercial valuation. Trade usage divides raw sugars in well-defined classes by polariscopic test, and the rate of duty could readily be adjusted so as to be approximately proportionate to the value. Marked increase in rates at any specific test should be avoided as far as possible, to prevent disputes between importers and customs officials. To conform to commercial usage it will be, however, necessary at certain percentages by polariscopic test to double the rate of increase in duty.

I refrain from suggesting in detail a specific schedule of duties, since there are some among the members of this association who are more familiar with the usages of the trade in the valuation of sugars than myself.

The question, too, of the desired amount of revenue to be collected by duties upon sugars must control the starting point of any schedule of rates.

The average test of imported raw sugars has been for several years about 90 per cent.

It would seem, therefore, that the desired average rate of duty per pound should be placed upon sugars testing above 89 per cent. and not above 90 per cent., and that sugars testing above or below 90 per cent. should be made dutiable according to test by polariscope with an increase or decrease in rate for each per cent. proportionate to the increase or decrease in value placed upon them by the trade in commercial transactions. The details of such a schedule, I leave to those better qualified to prepare it than myself.

Regarding a duty upon refined sugars, it is suggested that such a protection as it is desired to give the American refiner can best be attained by the imposition of a specific rate of duty upon such sugars in addition to the duty imposed upon all sugars by polariscopic test. This course would afford the desired protection in a manner that would not be open to a suspicion that it was in any way concealed or disguised in the complication of *ad valorem* rates upon raw and refined sugars.

The Dutch standard in colour is perhaps the best practicable means for distinguishing refined from raw sugars.

Refined sugars below No. 16 Dutch standard in colour, are not to any appreciable extent imported into the United States. No difficulty would attend the grading by the Dutch standard of sugars above No. 16, since they are so nearly white as to possess little or no colour.

A provision therefore that all sugars above No. 16 Dutch standard in colour be held to be refined sugars and be subjected to the desired rate of duty in addition to the rate placed upon all sugars by polariscopic test, would seem to meet the requirements in regard to refined sugars.

The foregoing suggestions relative to duties upon imported sugars are offered, not with the view of presenting anything new, but with a desire to reach a practicable and equitable solution of a purely practical and commercial question.

Having for more than 20 years been chiefly occupied in the work of testing sugars by the polariscope, I feel justified in the statement that no more difficulty attends the assessment of duties upon imported sugars by this means than attaches to their valuation for commercial purposes.

### Discussion.

Mr. Clementson asked Mr. Sherer how the moisture was determined for the valuation of imported molasses.

Mr. Sherer, in reply, said that the test was carried out in the usual manner by drying at 100° C. in a porcelain dish filled with sand.

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### Erratum.

## THE CORRECT IODINE NUMBER.

BY H. SCHWEITZER AND E. LUNGWITZ.

(This Journal, 1895, 130.)

It appears that, for a better understanding of the table on p. 132, it should be mentioned that in the heading of the 12th column, "Amount of Iodine substituted, in Per Cent., from Oil taken," the authors included in the substituted iodine, also the iodine present in the form of hydriodic acid.

It is therefore evident that the figures contained in this column must be divided by two in order to find the amount of iodine actually substituted.

For example, the references in the text, p. 133, left column, 5th and 28th lines from the top, must be understood in this way.

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# Journal and Patent* Literature.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*An Improved Method of and Apparatus for Generating Steam and Evaporating Liquids.* H. McPhail and C. H. Simpson, both of Wakefield, Yorkshire. Eng. Pat. 11,044, June 11, 1892.

The invention relates chiefly to the production of dry and superheated steam and the prevention of priming in steam boilers. The invention is shown applied to boilers of the Lancashire type, the steam being collected by an anti-priming pipe in the usual manner, and, instead of passing direct to the stop valve, it is conveyed by branch pipes to a superheater in the external flue at the rear end of the boiler, wherein it is superheated. The steam afterwards passes by means of a pipe placed below the internal flue tubes, to the front of the boiler and back again to a similar superheater similarly situated in the external brickwork flue, where it is again heated, and afterwards is carried above the internal flue, but below the water-level, finally escaping into an outlet pipe. By this arrangement the evaporation in the boiler is quickened, and the temperature throughout is rendered more uniform, the steam becoming superheated by the waste gases passing to the chimney. The method may also be used for the evaporation of liquids generally.
—E. G. C.

*Improved Apparatus for Sterilising Liquids, applicable also for Heating, Cooling, Condensing, and other similar Purposes.* P. M. F. Laurent, Paris, France. Eng. Pat. (Under International Convention), November 20, 1893.

Two thin sheets of copper, brass, or the like, held apart by suitable distance-strips, are coiled round a central tube or annulus to form two separate passages communicating at the centre, whereby water or other liquid may flow by one convoluted passage from the outside inwards to the centre, and back by the other spiral passage to the outside. The central

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[*] Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

tube or annulus is heated by a gas flame or in any other convenient manner, so that the liquid is heated at the centre, and as it flows outwards it gives up its heat to the liquid flowing inwards, thereby becoming itself cooled, the ultimate result being that the temperatures of the ingoing and outgoing liquids are not very different. The water is thus sterilised, and subsequent cooling fits it for drinking purposes. In a similar manner the apparatus may be used as a heat-exchanging apparatus for the condensation of vapours, or as a refrigerator. The heating of the central tube is regulated by a thermostat, which varies the supply of gas; and, in order to render the joints of the distance-pieces watertight, rings or bands of india-rubber are used as packing. In a modified apparatus there are two parts united by tubing, in one of which the liquid is heated, the other being used as a heat-exchanging apparatus.—E. G. C.

*An Apparatus for Drawing off known Quantities of Liquid and Registering the same.* H. Nalder, W. S. Crawley, and A. Soames, Clerkenwell, Middlesex. Eng. Pat. 6777, April 5, 1894.

Within a vertical measuring cylinder, there is a piston worked from a pivoted hand-lever by means of tappets upon a piston rod; the amount of movement of the operating handle being regulated by an endless band carrying a pair of projecting pins which engage with the said handle. As the hand lever is raised, a projection upon the endless band is guided over and lifts the arm of the three-way valve at the base of the measuring cylinder, thereby permitting the liquid to enter, while a further movement causes the piston to begin to lift, and the motion is continued until the required amount of liquid is drawn, the amount being measured by any convenient form of registering apparatus worked by the movement of the endless band. The motion of the handle is now reversed, causing the band to turn the plug of the three-way cock and cut off the supply of liquid, and likewise open a new passage for its escape by a suitable spout.—E. G. C.

*Improvements in Apparatus for Making Fresh Water from Salt Water, partly applicable also to Condensing and to Heating Feed-Water.* H. Hocking, Liverpool. Eng. Pat. 7184, April 11, 1894.

A vertical cylindrical casing is provided with a sliding door, to which is attached a battery of steam coils for heating and evaporating the salt water, while above there is an outlet for the steam to escape, consisting of a cup-shaped and perforated casting surrounding a bell-mouthed aperture in order to prevent water being carried over with the steam; a drain-pipe is fitted to the cup to allow any condensed steam to drain back into the evaporating casing. The steam is supplied to the coils by means of hollow steam-chests cast upon the door, and there are taps to regulate the supply. The door can be removed from its closed position and the tubes taken out for cleaning and repairs. In a modified apparatus for heating feed-water, the casing is horizontal and the arrangements for the removal of steam for condensation are dispensed with. —E. G. C.

*Improvements in Evaporating Apparatus.* E. G. Scott, Liverpool. Eng. Pat. 7388, April 13, 1894.

The liquid to be evaporated is made to flow in thin films down the inner surfaces of vertical tubes contained within a casing, while air is drawn upwards through the tubes by means of a fan, and discharged with the vapour formed, through the outlet above; steam at the same time circulates around the tubes in the external casing, to promote evaporation. A motor at the base of the apparatus drives the fan and also the pump for lifting the treated liquid to the reservoir above, for a further concentration. The upper ends of the tubes are notched, in order to ensure an even flow of liquid over the interior surfaces.—E. G. C.

*Improvements in or connected with Air-tight Receptacles or Cases for Chemicals and other Goods.* A. Apps, London. Eng. Pat. 8392, April 27, 1894.

The vessel or casing is constructed with one or more sides of thin corrugated sheet metal or sheet india-rubber, so that the volume will easily change under variations of temperature and pressure. The membrane is carried in a cap, which may be screwed on to the vessel, a tight joint being made by an india rubber packing-ring, whilst a guard-plate inside, prevents any injury to the membrane. In a modified arrangement, the membrane is replaced by an elastic bag, carried inside the stopper, and communicating with the interior by means of a short tube fixed in the lower wall of the stopper, so that if the interior pressure rises, the flexible membrane will expand outwards, and tend to establish equilibrium between the internal and external pressures.—E. G. C.

*Improvements in Processes and Apparatuses for Distillation.* O. Perrier, Paris, France. Eng. Pat. 20,175, October 22, 1894.

The invention relates to apparatus for the distillation and rectification of volatile products, such as resins, fatty acids, acetic acid, and the like. The liquid to be treated is first led into a series of compartments, where it is submitted to the agitation and propulsion of perforated blades, and to the heating action of vapour. The compartments have overflow notches from one to the other, so that a constant stream of liquid is kept passing through the apparatus, and the vapour so formed is led to a series of superposed analysers filled with beads of porcelain or the like, for subdividing the gases as much as possible. The gases are subjected to the action of condensing liquids in the analysers, whereby a fractional distillation of the vapours is effected.—E. G. C.

## II.—FUEL, GAS, AND LIGHT.

*Preparation of Crystallised Calcium Carbide in the Electric Furnace: its Properties and Reactions.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1002—1007.

An intimate mixture of 120 grms. of calcium oxide from marble and 70 grms. of sugar-charcoal is heated in an electric furnace for 15—20 minutes with a current of 350 ampères and 70 volts. The product forms a black mass, which, having melted, will have taken the shape of the crucible. The yield is 120—150 grms. The mass has a crystalline fracture, the crystals of the calcium carbide $C_2Ca$ having a density (taken in benzene) of 2·22 at 18°. They appear to be insoluble in all the usual reagents, and also in carbon bisulphide, petroleum naphtha, and benzene. With regard to the reactions of the substance, hydrogen and nitrogen are without action on it, whilst chlorine, iodine, and bromine react at temperatures from 245°—350° C. The reaction with chlorine may be conveniently shown by dropping fragments of the carbide into a flask containing cold water saturated with chlorine. Bubbles of acetylene are liberated, which catch fire at the surface, and at the same time a smell of the chlorides of carbon is observed. Calcium carbide burns in oxygen at a dull red heat, whilst in sulphur vapour it becomes incandescent at 500° C., forming calcium sulphide and carbon bisulphide. Phosphorus at a red heat transforms the carbide into phosphide without incandescence, whilst arsenic reacts with a great evolution of heat, producing calcium arsenide. Silicon and boron do not react with the compound. Most of the metals also are without action. Sodium and magnesium do not react at the temperature at which glass softens; whilst iron, which does not react at a red heat, forms at higher temperatures a carburetted alloy of iron and calcium. Tin does not react at a red heat, whilst antimony at the same temperature gives a crystalline alloy of calcium. The most interesting point, however, in connection with calcium carbide is its decomposition by water to form pure acetylene according to the equation $C_2Ca + H_2O = C_2H_2 + CaO$ (this Journal, 1895, 135). Dilute acids cause a similar decomposition, whilst fuming sulphuric acid, for instance, only produces a slow evolution of gas. Dry hydrochloric acid gas at a bright red heat causes a decomposition, with evolution of gas very rich in hydrogen. Anhydrous chromic acid in contact with calcium carbide becomes incandescent with evolution of $CO_2$, whilst aqueous chromic acid only liberates acetylene. The substance is not attacked by fused potassium chlorate or nitrate except at a red heat, and the same applies to lead peroxide. When ground with lead fluoride at the ordinary temperature, it becomes incandescent. By heating with alcohol in a sealed tube to 180° C., acetylene and calcium ethylate are formed according to the equation $2C_2H_5OH + C_2Ca = C_2H_2 + Ca(C_2H_5O)_2$.—T. A. L.

### *Crystalline Acetylene Compounds of Barium, Strontium, and the Alkalis.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1007—1010.

Working in a similar manner to that described in the preceding note, the author has obtained the corresponding carbides of barium and strontium by heating baryta or strontia with sugar-charcoal in a carbon crucible in the electric furnace. The densities of the compounds obtained are 3·75 and 3·19 respectively. Both are decomposed by water with the formation of acetylene, and behave towards reagents similarly to the calcium compound. The alkalis also appear to give compounds which decompose in presence of water, giving off a small quantity of acetylene, but owing probably to the too high temperature employed, the compounds obtained, contained excess of carbon, were amorphous, and had no definite composition.—T. A. L.

### *Crystallised Aluminium Carbide.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1010—1014.

About 15—20 grms. of aluminium are fused in a carbon boat in the electric furnace, and allowed to cool in a current of hydrogen. On breaking the aluminium obtained, it is found to contain brilliant yellow crystals. The same thing is observed on reducing a mixture of kaolin and carbon in the electric furnace. In order to separate the crystals, which consist of aluminium carbide, $Al_4C_3$, the excess of aluminium is dissolved away with strong hydrochloric acid. The crystals are finally washed quickly with cold water, alcohol, and ether, and dried. The yellow crystals so obtained have sometimes a diameter of 5—6 mm., and occasionally are hexagonal in form. They have a density of 2·36 and are decomposed at the highest temperature in the electric arc. The carbide undergoes an interesting decomposition in presence of water, yielding methane, $CH_4$; this decomposition is accelerated by heat, but light has no effect. The product also possesses well-marked reducing properties. The author describes in detail the methods adopted for analysing it. The aluminium was determined by two methods—either by dissolving in dilute hydrochloric acid, filtering if necessary, evaporating to dryness, igniting and weighing as alumina; or by fusing with potash, neutralising with hydrochloric acid, and precipitating the dilute solution with sodium hyposulphite, igniting the precipitate, and weighing as before. The carbon was estimated by treating the compound with chlorine, burning the residual carbon in oxygen, and weighing the carbon dioxide produced; or by measuring the quantity of methane obtained from a given weight of the compound and deducing therefrom the weight of carbon in the original substance.—T. A. L.

### *The Heating Power of Wyoming Coal and Oil, with a Description of the Bomb-Calorimeter.* E. E. Slosson and L. C. Colburn. Special Bulletin of the University of Wyoming, January 1895.

Recognising that coal is at present the most important of the mineral resources of Wyoming, Profs. Slosson and Colburn have made a chemical and thermal investigation of no less than 54 samples of coal and 8 of petroleum from various localities in Wyoming, the samples being collected by Prof. Knight, and the whole investigation conducted under the auspices of the State University.

*Wyoming Coal.*—The table on pages 354—355 gives the results obtained.

*Wyoming Petroleum.*—The following table gives the thermal efficiency of the samples examined:—

Wyoming Petroleum and Asphalt.

| — | — | Location. | Calories per Grm. | Foot-Pounds per 1 lb. of Oil. | Pounds of Water at 212° F. evaporated by 1 lb. of Oil. |
|---|---|---|---|---|---|
| 1 | Petroleum....... | No Wood .................................. | 10,927 | .. | .. |
| 2 | „ ....... | Shoshone Reservation........................ | 10,883 | 15,204,000 | 22·24 |
| 3 | „ ....... | Salt Creek. Natrona Co. .................... | 10,813 | 15,106,000 | 20·11 |
| 4 | „ ....... | Oil Mountain. „ .................... | 10,743 | .. | .. |
| 5 | „ ....... | Newcastle. Weston Co. .................... | 10,447 | 14,595,000 | 19·43 |
| 6 | „ ....... | Little Popo Agie. Fremont Co. ............ | 10,430 | 14,571,000 | 19·40 |
| 7 | Asphalt.......... | Big Horn........................................ | 9,532 | .. | .. |
| 8 | „ .......... | Wallace Creek, W. of Garfield Park.......... | 6,307 | .. | .. |

From the table it will be seen that pound for pound the Wyoming petroleums possess nearly double the heating capacity of the coals.

In Ohio, for heating furnaces, in making bolts, spikes, chain, and other small iron work, oil is considered cheaper at 2 cents per gallon than coal at 2 dols. per ton.

As to the methods in vogue for the determination of heating power, the authors admit the great value of the boiler test, where this can be carried out on a normal plant, and where all the factors can be carefully determined. For the testing of a large number of samples, however, this method is difficult and very expensive. The calculation of heating power, from the analysis of the fuel, has also many disadvantages, and the analysis is a longer and more delicate process than a direct determination by the calorimeter.

Among calorimeters, Thomson's has been discarded by the authors, on account of the impossibility of making any satisfactory correction for the loss of heat by the escape of the imperfectly cooled gases of combustion, the solution of the oxygen salts and their products in water, the imperfect combustion of the carbon, &c. This correction is stated by

TABLE SHOWING THE HEATING POWER AND PROXIMATE ANALYSES OF WYOMING COALS.

| Rank in Heating Power. | Owner's Name. | Location. | Name of Mine. | Calories per Grm. | Foot-Pounds per 1 Lb. of Coal. | Pounds of $H_2O$ at 212° F. evaporated by 1 Lb. of Coal. | Water. | Volatile Combustible Matter. | Fixed Carbon. | Ash. | Sulphur. | Total Fuel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | J. D. Curtis | Hams Fark, Uinta Co. | (Prospect sample) | 7,560 | 10,566,000 | 14·70 | 1·50 | 37·90 | 57·75 | 2·85 | 1·00 | 95·65 |
| 2 | Wm. Goodell | „ „ | (6-ft. face sample) | 7,467 | 10,435,000 | 13·90 | 2·95 | 38·00 | 54·00 | 4·05 | .. | 92·00 |
| 3 | A. Kendall | „ „ | (Prospect sample) | 7,372 | 10,303,000 | 13·72 | 3·75 | 37·25 | 55·40 | 3·60 | 0·60 | 92·65 |
| 4 | Sweetwater Coal Co. | Hopkins, Sweetwater Co. | Sweetwater | 7,358 | 10,284,000 | 13·69 | 5·55 | 36·95 | 55·70 | 1·80 | 0·86 | 92·65 |
| 5 | F. Kindt | Rankin, Carbon Co. | Kindt, No. 1 | 7,140 | 9,978,000 | 13·29 | 4·87 | 35·68 | 55·15 | 4·30 | 0·77 | 90·83 |
| 6 | Van Dyke Coal Co. | Rock Springs, Sweetwater Co. | Van Dyke, lower vein, 1893 | 7,132 | 9,967,000 | 13·27 | 6·25 | 34·50 | 56·50 | 2·75 | 0·74 | 91·00 |
| 7 | „ „ | „ „ | „ No. 1, 1894 | 7,110 | 9,937,000 | 13·24 | .. | .. | .. | .. | .. | .. |
| 8 | F. Kindt | Rankin, Carbon Co. | Kindt, No. 2 | 7,108 | 9,934,000 | 13·23 | 5·40 | 35·80 | 55·65 | 3·15 | 0·70 | 91·45 |
| 9 | Van Dyke Coal Co. | Rock Springs, Sweetwater Co. | Van Dyke, No. 2, 1894 | 6,963 | 9,730,000 | 12·96 | .. | .. | .. | .. | .. | .. |
| 10 | McCoid | Rankin, Carbon Co. | McCoid | 6,952 | 9,716,000 | 12·94 | 5·05 | 34·75 | 56·15 | 4·05 | 0·85 | 90·90 |
| 11 | Van Dyke Coal Co. | Rock Springs, Sweetwater Co. | Van Dyke, upper vein, 1893 | 6,922 | 9,675,000 | 12·89 | 5·67 | 35·73 | 56·85 | 1·75 | 0·68 | 92·58 |
| 12 | Buffalo Fork Coal Co. | Fremont Co. | (Surface coal) | 6,896 | 9,638,000 | 12·84 | .. | .. | .. | .. | .. | .. |
| 13 | Dillon Coal Co. | Rawlins, Carbon Co. | New Dillon Mine | 6,830 | 9,558,000 | 12·73 | 7·25 | 33·25 | 54·25 | 4·25 | 0·50 | 87·50 |
| 14 | Rock Springs Coal Co. | Rock Springs, Sweetwater Co. | No. 2 | 6,822 | 9,534,000 | 12·70 | 6·22 | 34·78 | 55·75 | 3·25 | 1·11 | 90·58 |
| 15 | Union Pacific Coal Co. | „ „ | Rock Springs, No. 1 | 6,812 | 9,521,000 | 12·68 | 5·38 | 36·42 | 55·60 | 2·60 | 0·63 | 92·02 |
| 16 | „ „ | „ „ | „ „ 4 | 6,728 | 9,403,000 | 12·52 | 5·95 | 34·55 | 56·10 | 3·40 | 1·00 | 90·65 |
| 17 | „ „ | „ „ | „ „ 8 | 6,705 | 9,371,000 | 12·48 | 5·95 | 35·70 | 55·75 | 2·55 | 0·65 | 91·45 |
| 18 | „ „ | „ „ | „ „ 7 | 6,704 | 9,370,000 | 12·47 | 6·37 | 35·18 | 54·85 | 3·60 | 0·86 | 90·03 |
| 19 | Dillon Coal Co. | Rawlins, Carbon Co. | Dillon, No. 2 | 6,616 | 9,246,000 | 12·31 | .. | .. | .. | .. | .. | .. |
| 20 | Cambria Coal Co. | Cambria, Weston Co. | Antelope | 6,566 | 9,177,000 | 12·22 | 6·72 | 39·38 | 44·25 | 9·65 | 3·79 | 83·63 |
| 21 | „ „ | „ „ | Jumbo | 6,557 | 9,164,000 | 12·21 | 5·72 | 40·13 | 43·65 | 10·50 | 4·57 | 83·78 |
| 22 | Rocky Mountain Coal and Iron Co. | Red Canon, Uinta Co. | Red Canon, No. 6 | 6,553 | 9,138,000 | 12·20 | 7·75 | 35·10 | 50·60 | 6·55 | 0·29 | 85·70 |
| 23 | Union Pacific Coal Co. | Carbon, Carbon Co. | Carbon, No. 2 | 6,500 | 9,084,000 | 12·10 | 7·42 | 35·43 | 48·30 | 8·85 | .. | 83·73 |
| 24 | „ „ | Rock Springs, Sweetwater Co. | Rock Springs, No. 3 (E. face) | 6,136 | 8,995,000 | 11·98 | 7·17 | 33·58 | 55·60 | 3·65 | 0·83 | 89·18 |
| 25 | „ „ | Hanna, Carbon Co. | Hanna, No. 1 (market sample) | 6,427 | 8,981,000 | 11·96 | .. | .. | .. | .. | .. | .. |
| 26 | W. M. Carter | Casper, Natrona Co. | Casper, No. 1 | 6,400 | 8,945,000 | 11·91 | 11·30 | 32·10 | 53·55 | 3·20 | 0·40 | 85·65 |
| 27 | Rocky Mountain Coal and Iron Co. | Red Canon, Uinta Co. | Red Canon, No. 5 (lower 9 ft.) | 6,340 | 8,861,000 | 11·80 | 7·42 | 36·08 | 48·50 | 8·00 | 0·44 | 84·58 |
| 28 | Terry Fee | Dutton Creek, Albany Co. | Brown (1893) | 6,164 | 8,615,000 | 11·47 | 11·85 | 34·65 | 47·30 | 6·20 | 1·25 | 81·95 |

TABLE SHOWING THE HEATING POWER AND PROXIMATE ANALYSES OF WYOMING COALS—*continued.*

| Rank in Heating Power. | Owner's Name. | Location. | Name of Mine. | Calories per Gram. | Foot-Pounds per 1 Lb. of Coal. | Pounds of $H_2O$ at 212° F. evaporated by 1 Lb. of Coal. | Water. | Volatile Combustible Matter. | Fixed Carbon. | Ash. | Sulphur. | Total Fuel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | G. L. Young | Rock Springs, Sweetwater Co. | (Sample No. 1) | 6,160 | 8,609,000 | 11·46 | 14·66 | 31·51 | 50·85 | 1·98 | 0·56 | 82·36 |
| 30 | Union Pacific Coal Co. | Almy, Uinta Co. | Almy No. 7 (sample No. 2) | 6,145 | 8,588,000 | 11·44 | 7·37 | 34·88 | 48·75 | 9·00 | .. | 83·66 |
| 31 | G. L. Young | Rock Springs, Sweetwater Co. | (Sample No. 2) | 6,116 | 8,547,000 | 11·38 | 14·64 | 36·70 | 46·45 | 2·21 | 0·48 | 83·13 |
| 32 | Dillon Coal Co. | Rawlins, Carbon Co. | Dillon | 6,046 | 8,450,000 | 11·25 | .. | .. | .. | .. | .. | .. |
| 33 | L. R. Meyer | Carbon, Carbon Co. | .. .. | 6,039 | 8,440,000 | 11·24 | 11·15 | 33·10 | 53·00 | 2·75 | 0·65 | 83·10 |
| 34 | Union Pacific Coal Co. | Almy, Uinta Co. | Almy No. 7 (lower vein) | 6,017 | 8,410,000 | 11·20 | 8·82 | 33·55 | 51·75 | 5·90 | 0·65 | 85·30 |
| 35 | L. A. Mason | Felix, Wyoming | .. .. | 5,962 | 8,332,000 | 11·10 | 10·50 | 37·02 | 48·46 | 4·42 | 0·35 | 85·48 |
| 36 | G. L. Young | Rock Springs, Sweetwater Co. | (Sample No. 3) | 5,949 | 8,314,000 | 11·07 | 14·23 | 37·48 | 46·07 | 2·22 | 0·44 | 83·55 |
| 37 | Lander Fuel Co. | Popo Agie River, Fremont Co. | .. .. | 5,938 | 8,299,000 | 11·05 | 11·40 | 36·60 | 47·60 | 4·40 | 0·50 | 84·20 |
| 38 | Rocky Mountain Coal and Iron Co. | Red Canon, Uinta Co. | Red Canon No. 5, middle 2½ feet. | 5,933 | 8,292,000 | 11·04 | 6·81 | 36·49 | 47·45 | 9·25 | .. | 83·94 |
| 39 | Black Buttes Coal Co. | Black Buttes, Sweetwater Co. | Black Buttes No. 1 | 5,926 | 8,282,000 | 11·03 | 14·45 | 30·07 | 51·98 | 3·50 | 0·61 | 82·05 |
| 40 | J. D. Woodruff | Popo Agie River, Fremont Co. | Gilmore | 5,886 | 8,226,000 | 10·96 | 13·12 | 33·13 | 50·40 | 3·35 | .. | 83·53 |
| 41 | Terry Fee | Dutton Creek, Albany Co. | Brown (1894) | 5,734 | 8,014,000 | 10·67 | 11·25 | 36·85 | 45·00 | 6·90 | 1·13 | 81·85 |
| 42 | Sheridan Fuel Co. | Sheridan, Sheridan Co. | Burgess | 5,723 | 7,998,000 | 10·65 | 13·05 | 37·55 | 44·70 | 4·70 | 0·71 | 82·25 |
| 43 | J. D. Harper | Sundance, Crook Co. | Harper | 5,700 | 7,966,000 | 10·61 | .. | .. | .. | .. | .. | .. |
| 44 | „ | „ „ | „ | 5,680 | 7,938,000 | 10·57 | 7·88 | 33·52 | 43·90 | 14·70 | 1·03 | 77·40 |
| 45 | Earl and Gillis | Popo Agie River, Fremont Co. | Gillis | 5,631 | 7,810,000 | 10·48 | 13·25 | 34·25 | 48·00 | 4·50 | 0·71 | 82·25 |
| 46 | Sheridan Fuel Co. | Sheridan, Sheridan Co. | Grinnell | 5,416 | 7,569,000 | 10·08 | 14·42 | 33·18 | 44·75 | 7·65 | 2·87 | 77·93 |
| 47 | Deer Creek Coal Co. | Glenrock, Converse Co. | Deer Creek | 5,410 | 7,560,000 | 10·07 | 13·82 | 33·03 | 47·75 | 5·40 | 0·61 | 80·78 |
| 48 | Inez Coal Co. | Inez, Converse Co. | Inez | 5,402 | 7,550,000 | 10·05 | 14·65 | 26·05 | 42·50 | 6·80 | 0·66 | 79·15 |
| 49 | Chase and Farrell | Mill Creek, Albany Co. | Chase | 5,402 | 7,550,000 | 10·05 | 14·50 | 34·50 | 44·75 | 6·25 | 1·03 | 75·25 |
| 50 | Mr. Bohack | Lost Soldier, Carbon Co. | Bohack | 5,375 | 7,512,000 | 10·00 | 13·65 | 39·25 | 42·60 | 4·50 | 0·80 | 81·85 |
| 51 | J. F. Becker | Goose Creek, Sheridan Co. | Becker | 5,345 | 7,470,000 | 9·95 | 14·10 | 35·25 | 38·75 | 11·90 | 1·04 | 74·00 |
| 52 | W. H. Holland | Buffalo, Johnson Co. | Holland | 5,293 | 7,397,000 | 9·85 | 13·55 | 35·05 | 45·30 | 6·10 | .. | 80·35 |
| 53 | Monker and Mathers | „ „ | Buffalo | 4,966 | 6,940,000 | 9·25 | 14·70 | 34·30 | 44·20 | 6·80 | 0·34 | 78·50 |
| 54 | Diamond Coal Co. | „ „ | Diamond | 4,931 | 6,891,000 | 9·18 | 14·50 | 33·35 | 44·30 | 7·85 | 0·42 | 77·65 |
|  |  |  | Average of Wyoming Coals - | 6,282 | 8,779,000 | 11·70 | .. | .. | .. | .. | .. | .. |

the manufacturers of the apparatus to be about 10 per cent., but Blake (Kansas Acad. Sciences, 1888, 42) states it as 30 per cent.

Berthelot's (platinum-lined) bomb-calorimeter costs about 1,500 dols.; whilst Mahler's modification of this apparatus, in which the platinum lining of the steel bomb is replaced by a thin coating of enamel, is found, practically, to yield equally good results, and only costs 750 francs.

It is this apparatus (see, for figures and description, this Journal, 1892, 840) which has been used throughout the present investigation by the authors, who elaborately described the structure and use of the apparatus, the corrections (for influence of temperature of environment, formation of nitric acid, combustion of the iron wire, and for sulphur) to be employed, and the method of the determination of the "water value" of the apparatus.

As to the correction for the influence of the temperature of the environment, the authors find that it is more accurately given by the application of the Regnault-Pfaundler formula (Ostwald, Lehrbuch Allgem. Chem. 1, 572) than by Mahler's own method (Bull. Soc. d'Encourag. Ind. Nat. June 1892, 335, and this Journal, 1892, 842). They state "a comparison of the two methods in some 20 cases showed an average difference of 0·0013, which on 1 grm. naphthalene would amount to about 3 calories, or 0·03 per cent.; a difference within the limit of error in technical work."

—E. R. B.

### *The Gaseous Products evolved from Wood-Charcoal when submitted to a High Temperature out of Contact with Air.* Dosmond. Comptes rend. 1894, **119**, 733—735.

In an attempt to obtain carbon monoxide gas by passing carbon dioxide from a gas-holder over red-hot charcoal, it was found that none of the dioxide could be driven through the charcoal owing to a back pressure due to gases developed from the latter. On the contrary, the disengaged gas, to the extent of 170 litres per kilo. of charcoal, passed to the receiver prepared for the carbon monoxide. In a laboratory experiment, the volume of gas amounted to 250 litres per kilo. That prepared on the large scale contained $CO_2 = 9·14$; $CO = 18·08$; $H = 49·11$; $CH_4 = 16·04$; $O = 0·26$; and $N = 7·37$ per cent.; its antiseptic properties were superior to those of carbon monoxide. The gas is probably due, for the most part, to the destructive distillation of solid, or condensed liquid, organic substances contained in the charcoal. Its formation shows that the equation $C + CO_2 = 2CO$ does not adequately express the result of the interaction aimed at; and it also shows that the carbon monoxide in the gases from burning charcoal is not due to incomplete combustion alone.—W. G. M.

## PATENTS.

### *An Improved Method of Preventing Spontaneous Ignition and Explosion of Coal.* H. H. Lake, London. From J. H. C. Behnke and The Chemische Fabrik in Billwärder, vorm. Hell and Sthamer, A. G., of Billwärder, Germany. Eng. Pat. 4636, March 5, 1894.

To prevent cargoes of coal spontaneously igniting, the atmospheric air is expelled from the mass of coal by means of smoke, preferably derived from coke burned in steam boilers or coke ovens. Before such smoke—which contains on an average from 15 to 20 per cent. of carbon dioxide and not more than 4 per cent. of oxygen—is conducted into and around the mass of coal, it is cooled, washed with water, and passed through a solution of sodium carbonate in order to free it from sulphur dioxide, which attacks wood and metals. The air and any gas between the pieces of coal are expelled upwards and then conducted away by suitable ventilators.

In the case of steamboats, the boilers may be used for producing the necessary smoke; on sailing ships a specia. coke furnace must be provided. The smoke is first passed through a scrubber, then through a cooler, and finally into the hold of the ship through a suitable system of tubes. As a further means of securing safety the contents of several bottles of compressed liquid ammonia are also introduced. The ammonia combines with the carbon dioxide, forming ammonium carbamide, which deposits on the coal and effects a cooling action. Moreover, the deleterious moisture present is absorbed, resulting in the formation of weak ammonia solution, which takes up a further quantity of carbon dioxide and forms ammonium bicarbonate. These ammonium carbonate compounds are particularly advantageous in such cases, because they become volatile at even 60° or 70° C., and the ammonia acts so as to impede oxidation, more especially that of any iron pyrites present. As the gases introduced completely prevent oxidation, spontaneous ignition is impossible.

—R. B. P.

### *An Improved Method of Using Small Coke or Breeze in the Manufacture of Coke and Coke Bricks.* F. Williams, Middlesbrough. Eng. Pat. 5092, March 12, 1894.

Small coke from coke ovens or other sources is first cleansed by washing, or other suitable means, and then either used as it is, or preferably ground to small particles. A suitable quantity—from 10 to 30 per cent.—of binding material is then added and the mass thoroughly mixed. It is then fired in an ordinary coke oven or other suitable furnace. If bricks are required, the mass is first pressed into shape and then fired. As binding material, coal or other tar, pitch, creosote, or other hydrocarbon oils, resin, vegetable or mineral oils, or the waste from paraffin or petroleum, may be used. If pitch or tar comparatively free from water be used, 10 to 12 per cent. is sufficient. The by-products in the gases from the coke ovens may be recovered.—R. B. P.

### *Improvements in Apparatus for the Manufacture of Coke.* H. Schon, Allegheny City, Penn., U.S.A. Eng. Pat. 22,034, November 14, 1894.

The essential feature of this invention is a movable hearth which can be run in or out of the coke oven on a truck. The truck is fitted with a platform that can bo elevated or lowered, on which the movable hearth rests. The truck, together with the hearth, is run in under the oven, and when in its proper position, the platform is lowered. At a certain point, the hearth as it is being lowered, comes on to suitably placed supports, whilst the truck platform is lowered still further and can be run out, leaving the hearth in position in the coke oven.

When the coal charged on to the hearth has been coked, the truck is run in again and the platform raised, thus lifting the hearth, which can then be run out on the truck.

An arrangement of bins for rapidly charging the hearth with coal, and means for "dumping" the coke formed, are also described.—R. B. P.

### *Improved Manufacture of Mantles for Incandescence Gas Burners and Apparatus therefor.* M. Arendt, Berlin, Germany. Eng. Pat. 811, January 12, 1895.

To avoid the mantle becoming deformed during the burning, after it has been dipped, it is carbonised before dipping.

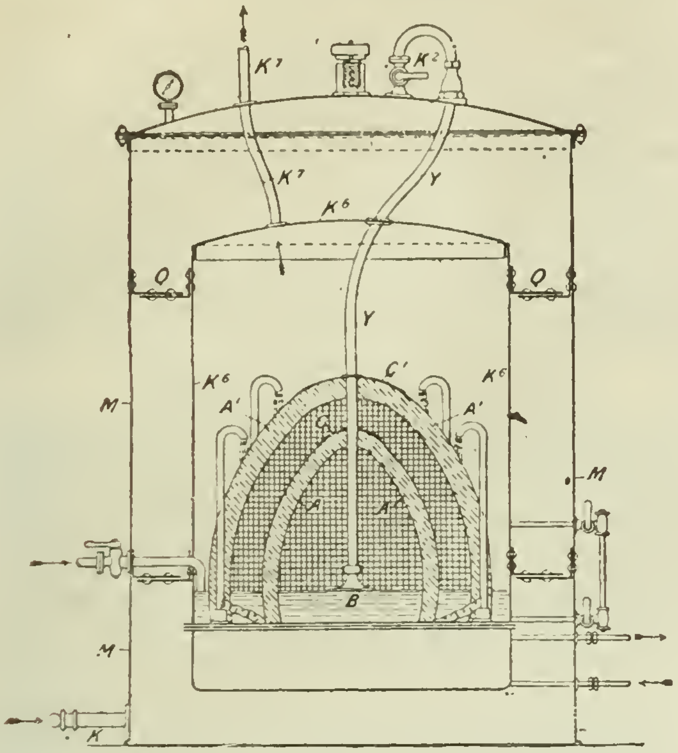
This carbonising is effected in a closed vessel, the mantle being supported on a suitably-shaped mould. This process gives the mantle greater porosity, whilst it retains the flexibility of the original fibrous material used. The carbonised mantle is then dipped in a solution of a suitable salt, and afterwards calcined in an oxidising flame.

The resulting finished mantle will not be deformed, and will be stronger than those made in the usual manner.

Apparatus for carbonising the mantles is described and illustrated.—R. B. P.

*Improvements in Carburettors.* G. Cabrié, Paris. Eng. Pat. 1961, January 28, 1895.

The apparatus consists of a closed metal cylinder M, within which is a second cylinder $K^6$, held by brackets Q.



Improved Carburettor.

A pipe Y passes from the top of the outer cylinder through the top of the inner one and thence downwards, terminating in a rose B. Within $K^6$ are the carburetting bodies A $A^1$, of which there may be two or more, arranged one within the other, whereby any desired amount of carburetting surface may be obtained.

They are composed of untwisted cotton-mesh fitted over metal caps C $C^1$, and are steeped in the carburetting liquid.

The air or gas to be carburetted is introduced through the pipe K into the outer cylinder, and passes through the cock $K^2$ to the rose B.

The bottom part of the inner cylinder contains a layer of the carburetting liquid through which the air or gas bubbles, and which at the same time seals the bottom of the carburetting bodies A $A^1$. The gas or air then passes through the walls of these and, as they are soaked with the carburetting liquid, is further enriched. The gas finally leaves the apparatus through the pipe $K^7$ for use.—R. B. P.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Contributions to the Chemistry of Lignite Tar.* F. Heusler. Ber. **28**, 488—498.

In a previous communication (this Journal, 1892, 671) the author showed that, contrary to the usual statements, the low-boiling lignite tar oils consist not merely of hydrocarbons belonging to the saturated and ethylene series, but are largely composed of hydrocarbons of the aromatic series. The present paper is devoted to a study of the nature of the substances other than those belonging to the paraffins and the hydrocarbons of the benzene series. Lignite tar oils boiling below 180° contain the following groups of substances: — (1.) Paraffins, increasing in amount as the boiling point rises. (2.) Naphthenes, present in small quantities. (3.) Aromatic hydrocarbons, the amount of which decreases with the rising of the boiling point. (4.) Hydrocarbons of the ethylene series. (5.) Thiophens. (6.) Ketones. (7.) Nitriles and presumably also small quantities of non-saturated hydrocarbons of lower hydrogen percentage.

Having established the presence of hydrocarbons of the aromatic series in lignite tar, it was thought very probable that the products of the distillation of bituminous shale would yield a similar result, but only traces of benzene and toluene were found, whilst the presence of naphthalene could not be detected. As both tars are produced at approximately identical temperatures, shale tar should contain aromatic hydrocarbons, if the statement frequently met with be correct, that their presence is a function of the temperature which prevails during the formation of tar. The author hopes to return to this subject on a future occasion. A comparison of these tars undoubtedly has an important bearing on the question of the formation of petroleum, seeing that the brown coals (lignites) are said to be of vegetable, and the bituminous shales of animal origin.

*Detection of the Naphthenes.*—It was previously shown that the oils unacted upon by nitric acid were free from naphthenes, but it has since been found that these hydrocarbons are oxidised in the process of nitrification. They were identified in the course of studying the action of sulphuric acid on lignite tar. On treating the oils with concentrated sulphuric acid at a low temperature, the hydrocarbons of the ethylene series are acted on with formation of products of polymerisation and neutral sulphuric ethers (compare next abstract), both of which are found in the residue which remains on subjecting the unattacked oils to distillation by means of steam. The distillates were fractionated in a Norton-Otto dephlegmator and washed repeatedly with concentrated sulphuric acid, first at the ordinary temperature, then with the application of heat, and finally with fuming sulphuric acid, until the unattacked oils had been entirely freed from aromatic hydrocarbons. In this manner fractions of oils boiling between 100° and 180° were obtained, having a higher specific gravity than the pure paraffins of the same boiling points. The results are given in the following table:—

| Fraction of Oils treated with fuming Sulphuric Acid. | Specific Gravity. | Temperature. | Paraffins. | Specific Gravity. | Temperature. | Naphthenes. | Specific Gravity. | Temperature. |
|---|---|---|---|---|---|---|---|---|
| 100—110 | 0·697 | 21° | $C_7H_{16}$, boiling at 98° | 0·68856 | 14·9° | $C_7H_{14}$, boiling at 95°—98° | 0·742 | 20° |
| 110—120 | 0·706 | 21° | .. .. | .. | .. | .. .. | .. | .. |
| 120—130 | 0·713 | 20° | $C_8H_{18}$, boiling at 125·5° | 0·7032 | 17° | $C_8H_{16}$, boiling at 119° | 0·7582 | 17° |
| 130—140 | 0·718 | 20·5° | .. .. | .. | .. | $C_9H_{18}$, boiling at 135°—136° | 0·7652 | 20° |
| 140—150 | 0·727 | 20·5° | $C_9H_{20}$, boiling at 149·5° | 0·7177 | 20° | .. .. | .. | .. |
| 150—160 | 0·731 | 21° | .. .. | .. | .. | .. .. | .. | .. |
| 160—170 | 0·738 | 21° | .. .. | .. | .. | $C_{10}H_{20}$, boiling at 160°—162 | 0·783 | 15° |
| 170—180 | 0·748 | 21° | $C_{10}H_{22}$, boiling at 173° | 0·7304 | 20° | .. .. | .. | .. |

The assumption that these oils contain hydrocarbons of lower hydrogen percentage was confirmed by an analysis of the fraction boiling between 160°—170°. On heating the mixed oils with fuming sulphuric acid on a water bath, sulphurous anhydride is evolved. Bromine acts at the ordinary temperature, forming oily bromo-addition products, which could not be distilled even in a vacuum without decomposition. Ordinary nitric acid is without action, fuming nitric acid acts slowly at the ordinary temperature, more rapidly on warming, forming as oxidation products oxalic acid and other acids, apparently belonging to the succinic acid series.

*Detection of Thiophen.*—Unsuccessful attempts were made to separate thiophen from the lignite tar oils by using the mercuric chloride method suggested by Volhard. It was, however, identified according to Meyer and Stadler's reaction, by preparing dinitrobenzene from lignite tar, extracting the thiophen with alcohol, and adding one drop of alcoholic potash solution, when a deep red solution, characteristic of thiophen, was obtained.

*Detection of Acetone in Coal Tar and of Homologues of Acetone in Lignite Tar.*—On shaking lignite tar oils with dilute sulphuric acid and adding water to the acid solution, an oil possessing a ketone-like odour is obtained, which yields on fractionation a low-boiling oil and a high-boiling product of polymerisation. The former unites with sodium bisulphite, forming a crystalline compound, characteristic of ketones. On shaking the first runnings of coal-tar benzene with a large quantity of water, subjecting the aqueous solution to distillation, and treating the distillate with potash, an oil is obtained consisting of a mixture of acetone and acetonitrile. On treating the first runnings of lignite tar boiling below 100° in the same manner, an oil is obtained, which combines with sodium bisulphite to form crystalline compounds. Vincent and Delachanal assert that ethyl alcohol accompanies acetonitrile in coal tar. The author failed to detect its presence, and thus confirms Krämer's view, who doubts its existence in coal tar. The author has also detected ammonia, determined as platinum double chloride, in the acid washings from lignite oils, which points to the probable occurrence of nitriles in lignite tar.

*Detection of Hydrocarbons of the Ethylene Series.*—The fraction boiling below 80° was dissolved in absolute ether and subjected to fractional bromination. The bromides thus obtained were distilled in a vacuum. On fractionation the following products were separated:—(1.) $C_6H_{12}Br_2$, boiling at 65°—75°; sp. gr. 1·600 at 20·5°. (2.) $C_7H_{14}Br_2$, boiling at 75°—80°; sp. gr. 1·585 at 21°. These fractions were found to consist of mixtures of hexylene and heptylene bromides, contaminated with sulphur compounds, presumably monobromothiophen. According to analysis, the ratio of carbon to hydrogen is as 1:2, hence it follows that the non-saturated hydrocarbons of the lowest boiling fractions of lignite tar, belong essentially to the ethylene series. The fraction boiling below 180° appears to contain from 35 to 40 per cent.

Terpene, indene, and cumarone, as previously mentioned, could not be detected. The author has recently searched for the presence of heptene in lignite tar, allowing oxygen and water to act on the fraction boiling between 100° and 110°. He did not, however, obtain the hydrate $C_7H_{14}O_2$, prepared by Morris from heptene (this Journal, 1882, 361). He also looked for hydrocarbons of the acetylene series, but owing to lack of material their identification had to be abandoned.—D. B.

### *Formation of Neutral Sulphuric Ethers in Washing Tar Oils with Sulphuric Acid and Separation of Alkyl Sulphates and Sulphonates.* F. Heusler. Ber. 28, 498—501.

The author has shown in a former paper (this Journal, 1892, 671) that by the action of concentrated sulphuric acid on lignite tar oils previously treated with dilute sulphuric acid, sulphur and oxygen compounds are obtained, which, when subjected to distillation, are decomposed, sulphurous anhydride being evolved. At first the author was inclined to regard these substances as sulphones formed by the condensation of one molecule of sulphuric acid with two hydrocarbon molecules. Subsequently it was thought more probable to connect the formation of these neutral compounds with the high percentage of hydrocarbons of the ethylene series. Bearing in mind the fact that sulphuric acid combines with these hydrocarbons to form alkylsulphuric acids, it may be supposed that under certain conditions the latter would be capable of resolution into neutral substances with elimination of water. Although this assumption proved to be groundless, it nevertheless formed the starting point of some experiments, which soon brought to light the true explanation. It was found that on boiling the products in question with aniline, large quantities of aniline sulphate were obtained. Hence it was assumed that the action of concentrated sulphuric acid on the ethylene hydrocarbons of lignite tar, is accompanied by the formation of neutral as well as acid sulphuric ethers:—

$$SO_2(OH)_2 + 2C_nH_{2n} = SO_2(OC_nH_{2n+1})_2$$

The exact proof of the correctness of this assumption was furnished by the fact that on treating an acid-washed fraction boiling between 150°—160° with aniline at the ordinary temperature, and setting the mixture aside for several weeks, a crystalline mass was obtained, which was found to contain aniline decylsulphate. The latter gave, when boiled with aniline, decylene and aniline sulphate. The fact that sulphonic acids are not decomposed by aniline may be utilised as a means of separating alkyl sulphuric and sulphonic acids. These acids are formed in large quantities in the process of purifying tar and petroleum with sulphuric acid. The acid mixture is diluted with ice-cold water, neutralised with calcium or barium hydroxide, and filtered. The calcium or barium salts are then converted into the sodium salt, and the solution is evaporated to dryness, care being taken to prevent it from reaching the boiling point. The residue is heated with aniline in a paraffin bath for four hours at 170°, the alkyl sulphate being decomposed with regeneration of ethylene hydrocarbons. The aniline and hydrocarbons are then distilled off by means of steam, and the hydrocarbons recovered from the residual solution of sodium sulphonate in the usual manner.—D. B.

### *Quinoline Bases in Brown Coal Tar.* O. Doebner. Ber. 1895, 28, 106.

In experiments made with brown coal tar taken from Riebeck's works at Webau, the higher boiling portion (220°—280° C.) was found to contain a mixture of quinoline bases and probably pyridine bases. Quinoline itself was isolated from the fraction of the oil distilling over between 235° and 245°. The other bases contained in the higher boiling oil and also in this fraction of it, have the properties of quinoline bases, but were not isolated.

The occurrence of these quinoline bases in brown coal tar, in which pyridine bases, benzene and its homologues, naphthalene, picene, chrysene, phenol, and the cresols have already been detected, affords a further proof of the analogy between the constituents of brown coal and hard coal tar.—H. M.

### *Reactions of Chelidonine with Phenols in Sulphuric Acid Solution.* Battandier. Comptes rend. 120, 270.

*See under* XXIII., *page* 398.

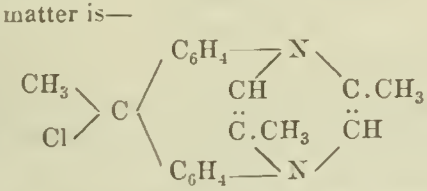
## IV.—COLOURING MATTERS AND DYES.

*A New Series of Colouring Matters.* C. Friedel. Bull. Soc. Chim. 1894, **11**, 1027—1038.

By heating together 30 grms. of methylacetanilide and 18 grms. of phosphorus oxychloride at about 120° C., as long as hydrochloric acid is given off, a fuchsine-like product is obtained, which is dissolved in water and precipitated therefrom by sodium carbonate and salt. The crude hydrochloride washed with benzene to remove methylaniline and recrystallised from alcohol, forms small reddish needles with a blue reflex. Analysis points to the empirical formula $C_{20}H_{20}N_2Cl_2$. The quantity of hydrochloric acid evolved in the reaction (5 grms.), and the observation that the benzene extract contains nothing but monomethylaniline, would seem to show that the equation representing the reaction is—

$$3C_6H_5NCH_3COCH_3 + POCl_3 =$$
$$C_{20}H_{19}N_2Cl + C_6H_5NHCH_3 + PO(OH)_3 + 2HCl,$$

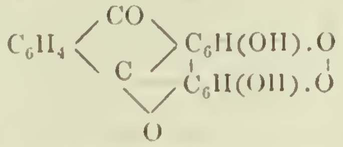
which indicates 4·89 grms. of hydrochloric acid for the quantities taken. The constitution suggested for the new colouring matter is—



which represents it as a derivative of methyldiphenylmethane. In the substance analysed 1 mol. HCl has attached itself to one of the nitrogens, and on addition of excess of hydrochloric acid to the red colouring matter, a pale yellow dihydrochloride crystallises on evaporation, having the formula $C_{20}H_{19}N_2Cl, 2HCl$, in which both nitrogens have become saturated. If the red solution of the monohydrochloride be titrated with sulphuric acid it becomes colourless when $\frac{1}{2}SO_3$ has been added to 1 mol. of the colouring matter. In these properties the new body resembles fuchsine. The dilute rose-coloured solution is likely to prove useful as an indicator, responding sharply to acids and alkalis. Carbonic acid and acetylacetone also decolorise the solution. Disodic phosphate and phenol do not affect it, but aniline restores the rose colour to the acidified liquid, which is not the case with phenolphthaleïn. The hot aqueous solution dyes wool, silk, and tannined cotton a fine magenta of a somewhat violet tint, which resists soap, but is not very fast to light and still less so to acids. Sulphites and bisulphites precipitate from a boiling solution of the colouring matter a bronzy greenish-yellow powder consisting of small rhomboidal plates, insoluble in water and cold dilute hydrochloric acid, soluble in the latter on heating, and soluble in hot alcohol with a violet colour. This substance may be reprecipitated from its colourless hydrochloric acid solution by boiling with sodium carbonate or ammonia. Analysis shows it to be the sulphite of the colouring matter, two atoms of chlorine being replaced by $SO_3$. By treating the hydrochloride in aqueous solution with potassium benzoate, silver nitrate, or silver acetate, the benzoate, nitrate, and acetate of the colouring matter have been obtained, and, like the hydrochloride, are all colouring matters. When the sulphite is boiled for several hours with dilute hydrochloric acid and the reddish-yellow solution treated with an alkali, a red, orange, or vermilion precipitate is obtained, which is a mixture of an oxide $(C_{20}H_{19}N_2)_2O.4H_2O$ with some of the original red colouring matter, which may be removed by means of its solubility in sodium bicarbonate. The same product is obtained by heating the hydrochloride with dilute hydrochloric acid to 120° C. It can also be produced in the form of sulphate, by boiling the sulphite of the red substance with dilute sulphuric acid; in this case the evaporation of the solution gives rectangular plates of the acid sulphate, nearly colourless in moist air, but acquiring a rose colour when dried. The solution of this sulphate heated in a sealed tube becomes distinctly red about 160° C., at which temperature the hydrated salt no doubt becomes anhydrous, reverting to the colourless state on cooling. The air-dried salt has the composition $(C_{20}H_{19}N_2)_2O.4H_2SO_4, 0.8H_2O$. The action of dilute acids upon the red colouring matter is therefore to replace the chlorine attached to the methane carbon by oxygen. This view is confirmed by the action of phosphorus pentachloride on a benzene solution of the orange substance; on heating for a short time the characteristic magenta colour appears, and an aqueous extract has the usual dyeing properties, showing that the orange substance has been transformed into the red by the introduction of chlorine in place of oxygen. By the prolonged action of phosphorus pentachloride a blue substance of unknown composition is found, and this is also produced when the red substance is acted on by chloride of lime or by air in presence of an alkali. As opposed to the red substance, the orange substance is not a dye. The author further has distilled the hydrochloride of the red substance, and obtained an oily product smelling of pyridine. When distilled with zinc dust a basic distillate is formed, insoluble in water, and having a similar odour. The hydrochloric acid solution of this gives a chloro-platinate, to which the author gives the formula $C_{20}H_{22}N_2, 2HClPtCl_4$, and he considers that its formation is further evidence in support of the view that the magenta red colouring matter is the hydrochloride of dimethyl-diazine-methyl-diphenyl-chloro-methane, and the orange dyestuff derived from it an oxide of dimethyl-diazine-methyl-diphenylmethyl.—T. A. L.

*Constitution of Coeruleïn.* M. Prud'homme. Bull. Soc. Chim. 1894, 1136—1138.

When heated with three to four times its weight of aniline on the water bath, and finally at 180° C. for a short time, to drive off excess of aniline, coeruleïn is converted into a new colouring matter. The increase in weight corresponds to an addition of two molecules of aniline with the elimination of two molecules of water. The product is sparingly soluble in alcohol and acetic acid, &c., but easily soluble even in cold sulphuric acid. The addition of water gives rise to a blue solution, from which alkalis precipitate the base, easily soluble in dilute acids with a blue colour. Cotton mordanted with tannin and tartar emetic is dyed greenish-blue by the acetate; wool and silk also are dyed blue, and the latter gives almost black shades. The colour is, however, not fast to soap, but is turned greenish, owing to liberation of the base. The new base will not dye iron, chromium, or aluminium mordants, which points to the non-existence of hydroxyl groups in the compound. Since coeruleïn can be condensed with two molecules of aniline, this condensation must have taken place at the expense of the hydroxyls, of which two must have been present in the original coeruleïn. Mordant-dyeing colouring matters containing a single hydroxyl group are either hydroxyquinones containing an hydroxyl group ortho to a quinonoid oxygen, or hydroxyquinolines in which the nitrogen is peri to the hydroxyl. The colouring matters of the former group are, however, only weak mordant dyestuffs, whilst those which contain the grouping (O:OH = 1:2) twice, have greater tinctorial power. This has a bearing on the constitution of coeruleïn, which, as well as galleïn, from which it is obtained by the action of sulphuric acid at 200° C., dyes mordants well, and satisfying these conditions, the following formula is proposed for coeruleïn:—

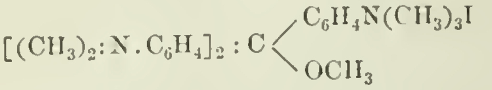


showing it also to be a derivative of phenyloxanthranol.

—T. A. L.

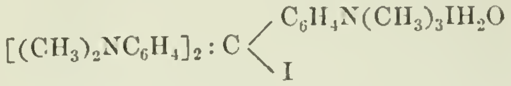
*Ammonium Iodide Derivatives of Hexamethyltriamidotriphenylmethane.* A. Rosenstiehl. Comptes rend. **120**, 264—266.

The author, in a previous communication (Comptes rend. **120**, 192), has described five compounds of the general formula $[ICH_3(CH_3)_2NC_6H_4]_3 \vdots CR$, in which R represents H, OH, $OCH_3$, $OC_2H_5$, $OC_5H_{11}$. He observed that intermediate products were formed in the preparation of these compounds, which are coloured green on heating with acetic acid, but he has only succeeded in separating one of these substances by acting with methyl iodide on the compound $[(CH_3)_2:N.C_6H_4]_3 \vdots C.OCH_3$. The two substances are digested in presence of water in the cold for several days until a sample of the mixture no longer dissolves with a violet but with a pure green colour in dilute acetic acid. Water is then added, the methyl iodide distilled off, and the mixture filtered, when the new compound remains behind, the triammonium iodide being in solution. On crystallising from methyl alcohol, it forms white crystals having the formula—



$$[(CH_3)_2:N.C_6H_4]_2:C\left\langle\begin{matrix}C_6H_4N(CH_3)_3I\\OCH_3\end{matrix}\right.$$

It dissolves in dilute acetic acid on warming, with a deep green colour, and the solution, on adding a few drops of potassium iodide solution, solidifies to a paste of shining bronzy crystals having the formula—



$$[(CH_3)_2NC_6H_4]_2:C\left\langle\begin{matrix}C_6H_4N(CH_3)_3IH_2O\\I\end{matrix}\right.$$

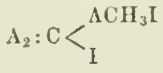
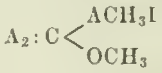
It is as unstable as Hofmann and Girard's iodine green, of which it is the lower homologue, and decomposes below 100° C., giving off water and methyl iodide, but can be obtained anhydrous by drying in a current of methyl iodide. The author concludes that bases of the general formula $[(CH_3)_2:N.C_6H_4]_3 \vdots CR$ form two series of colourless compounds with alkyl iodides. The one class contains only one pentavalent nitrogen, and in these compounds R can be replaced by acid radicals yielding colouring matters, whilst the other contains three pentavalent nitrogens, and does not give colouring matters with acids.—T. A. L.

### *Preparation of 1.4-Naphthol Sulphonic Acid.* F. Reverdin. Ber. **27**, 3458—3462.

The methods hitherto employed for the preparation of this acid are (1) the decomposition of diazotised naphthionic acid by boiling with acidulated water, and (2) heating sodium naphthionate with alkalis under pressure. Neither process gives a theoretical yield, and the diazo method requires the manipulation of a large quantity of fluid. It has been recently proposed to obtain the acid by heating 1.4-chloronaphthalene sulphonic acid under pressure with caustic soda. The present paper describes the preparation of this acid by sulphonating and hydrolysing α-naphthyl carbonate, $(C_{10}H_7.O)_2:CO$, obtained by the action of phosgene on an aqueous solution of sodium α-naphtholate. Phosgene is passed through a solution of 60 kilos. of α-naphthol, 60 kilos. of soda-lye of 48° B., and 1,000 litres of water at the ordinary temperature. About 23—24 kilos. of phosgene are required. The naphthyl carbonate separates as a sandy powder, and, after filtering off, may be purified by crystallisation from benzene, acetic acid, and petroleum spirit. It melts at 130° C. In order to sulphonate it, 50 kilos. are carefully stirred into 150 kilos. of 100 per cent. sulphuric acid between 10° and 20° C. Complete solution takes place in about 12 hours, and the melt is then poured on to 300 kilos. of ice and 60 kilos. of salt are subsequently added. The disulphonaphthyl carbonate separates out and is filtered off. In order to convert it into naphthol sulphonic acid it is dissolved in water and the solution heated to 60°—70° C. until the evolution of carbon dioxide ceases. Sodium naphthol sulphonate can then be obtained solid in the usual manner by neutralisation with lime and decomposition of the lime salt with sodium carbonate. The acid shows all the characteristic reactions of 1.4-naphthol sulphonic acid prepared by other methods.—T. A. L.

### *Comparison of the Coloured and Colourless Derivatives of Hexamethyltriamidotriphenylmethane.* A. Rosenstiehl. Comptes rend. **120**, 331—333.

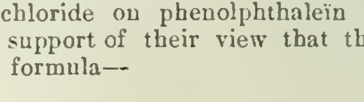
The author, in two previous papers (Comptes rend. **120**, 192 and 264; see above) has described certain compounds containing the group $[(CH_3)_2:N.C_6H_4]_3 \vdots C$, or $A_3 \vdots C$, some of which are coloured and others colourless. Certain of the latter on double decomposition are convertible into coloured compounds, whilst others are not, and the following table gives some typical cases :—

| Coloured. | Colourless. | |
|---|---|---|
| | Give Coloured Compounds by Double Decomposition. | Do not give Coloured Compounds by Double Decomposition. |
| $A_3 \vdots C.Cl$ | $A_3 \vdots C.H$ | $(ICH_3A)_3 \vdots C.H$ |
|  $A_2:C\left\langle\begin{matrix}ACH_3I\\I\end{matrix}\right.$ | $A_3 \vdots C.OH$ | $(ICH_3A)_3 \vdots C.OH$ |
| | $A_3 \vdots C.OCH_3$ | $(ICH_3A)_3 \vdots C.OCH_3$ |
| |  $A_2:C\left\langle\begin{matrix}ACH_3I\\OCH_3\end{matrix}\right.$ | |

In commenting upon this the author remarks that the compounds of the third group which are not changed by dilute acids, all contain pentavalent nitrogen, whilst each of those in the other two groups contain at least two trivalent nitrogen atoms, and in these compounds if the non-phenylated radical is positive it can be replaced by a negative radical, or if negative by a positive one. In the former case the compound is coloured, and in the latter colourless. Comparing the two tertiary aromatic alcohols $(ICH_3A)_3 \vdots C.OH$ and triphenyl carbinol, $(C_6H_5)_3 \vdots C.OH$, in neither of which compounds is the OH replaceable by Cl by treatment with hydrochloric acid, the group $(ICH_3A)$ in the former, by the complete saturation of the nitrogen, has become similar to the non-substituted phenyl residue. This function of triphenylcarbinol varies between two extremes; in $(C_6H_5) \vdots C.OH$ it is acid, since $(C_6H_5)_3 \vdots C.Cl$ is decomposed by cold water; on the other hand, $A_3 \vdots C.OH$ is more basic, for acids in the cold form coloured compounds, $A_3 \vdots C.R$, and amido carbinols in general liberate ammonia from its salts. Intermediate between these two extremes are the diamido carbinols, which react more slowly with acids, and ammonium salts, in some cases requiring heat in order to complete the reaction.—T. A. L.

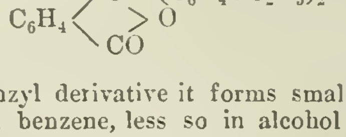
### *Some Derivatives of Phenolphthaleïn.* A. Haller and A. Guyot. Comptes rend. **120**, 296—299.

In a previous paper (Comptes rend. **116**, 479) the authors describe compounds they have obtained by acting with phenylisocyanide on phenolphthaleïn and fluoresceïn, and with benzyl chloride on phenolphthaleïn in an alkaline solution. In support of their view that this latter compound has the formula—



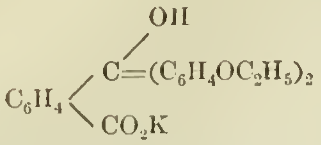
$$C_6H_4\left\langle\begin{matrix}C=(C_6H_4.OC_7H_7)_2\\>O\\CO\end{matrix}\right.$$

they have succeeded in obtaining a crystallised product by the action of phenetol on phthalyl chloride in presence of aluminium chloride, which from the mode of its formation and its reactions has the constitution—



$$C_6H_4\left\langle\begin{matrix}C=(C_6H_4OC_2H_5)_2\\>O\\CO\end{matrix}\right.$$

Like the dibenzyl derivative it forms small white crystals very soluble in benzene, less so in alcohol and ether. It melts at 122° C. The same compound is obtained by boiling under an inverted condenser one molecular proportion of phenolphthaleïn with two molecular proportions of sodium ethylate and an excess of ethyl iodide. When boiled with alcoholic potash, the ether prepared by either method is converted into the compound—



$$C_6H_4\begin{cases} C{=}(C_6H_4OC_2H_5)_2 \text{ (with } OH) \\ CO_2K \end{cases}$$

which on dissolving in water slowly dissociates, yielding the diethylated phthaleïn. With reducing agents, sodium amalgam or zinc dust and caustic potash, diethoxytriphenylmethane *o*-carboxylic acid—

$$HO_2C.C_6H_4.CH(C_6H_4OC_2H_5)_2$$

is produced, which forms colourless crystals melting at 135° C., soluble in the usual solvents and in caustic and carbonate alkalis. The same substance is obtained by acting with ethyl iodide on an alkaline solution of phenolphthaleïn and hydrolysing the triethylic ether formed. Hence it would appear that the diethylphthaleïn does not contain a quinonoid group, and indeed it has not been possible to obtain an oxime from it.—T. A. L.

*The Reduction of Aromatic Nitro Compounds in a Neutral Solution and the Formation of Aromatic Hydroxylamines, serving as Photographic Developers.* Lumière Bros. and A. Seyewetz. Bull. Soc. Chim. 1894, **11**, 1038—1045.

*See under* XXI., *page* 385.

## PATENTS.

*Improvements in the Manufacture of Nitroso-Compounds.* H. H. Lake, London. From Wirth and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 7786, April 19, 1894.

This patent relates to the production of nitroso-compounds by causing alkyl nitrites (preferably amyl nitrite) to react in alkaline solution on meta-amidophenol, meta-amido *o*-cresol, or meta-amido-*p*-cresol.

13 kilos. of meta-amido para-cresol—

$$(CH_3 : NH_2 : OH = 1 : 2 : 4)$$

are dissolved in 60 litres of spirit and 9 litres of caustic soda of 40° B.; the solution is well cooled and 13 kilos. of amyl nitrite gradually added. After standing for about 24 hours, the liquid assumes an intensely reddish-yellow colour, and is then supersaturated in the cold with acetic acid. The nitroso-amidocresol separates in the form of a red precipitate, which is filtered off and well washed with water.

Nitroso-amidophenol is prepared by dissolving 1 kilo. of meta-amidophenol in 3 litres of spirit and 0·9 litre of 30 per cent. caustic soda. This solution is well cooled with ice and 1·4 kilos. of amyl nitrite gradually added. The sodium salt of nitroso-amidophenol separates from the liquid in the crystalline form on standing some time, and is then filtered off and washed with spirit.—J. S.

*Manufacture or Production of Colouring Matters, and Materials therefor.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 7859, April 20, 1894.

The provisional specification of this patent describes the preparation of 1.1′.4.3′-amidonaphthol disulphonic acid, which the patentees believed to be a new substance. The acid, however, had already been claimed in Eng. Pat. 17,141c of 1893 (this Journal, 1894, 878), and the claims in the present patent refer to the production of colouring matters from this acid by combining it with diazo or tetrazo compounds. In the latter case either symmetrical or mixed dyestuffs can be obtained, the combinations being carried out in the usual manner.—T. A. L.

*Improvements in the Purification of Anthracene.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 7862, April 20, 1894.

Raw anthracene hitherto has been purified by means of hydrocarbons or naphtha, or aromatic bases such as aniline, pyridine, or quinoline, &c. (Eng. Pat. 5785 of 1887; this Journal, 1887, 505), or else by means of liquid sulphur dioxide (Eng. Pat, 5,539 of 1892; this Journal, 1893, 439). It has now been found that the impurities in raw anthracene may be removed by washing it with ketones of the fatty series, such as acetone, which may be used in the form of "raw acetone" or "acetone oils," anthracene itself being almost insoluble therein. The process may be carried out as follows, but the patentees do not limit themselves to the precise details given:—500 kilos. of raw anthracene are stirred together with 750 kilos. of acetone in a steam-jacketed closed vessel and heated to 60° C. for one hour. After cooling, the anthracene is filtered off and washed with 375 kilos. of fresh acetone, which is used subsequently in the first washing of the next batch. The first mother-liquors are distilled to recover the acetone, and the anthracene is pressed and dried in the usual manner. The percentage of pure anthracene by this treatment is raised from 35 to 82 per cent.—T. A. L.

*Manufacture of a New Naphthylen-diamine Mono-Sulpho Acid, and of Colouring Matters derived therefrom.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 8381, April 27, 1894.

The new acid referred to is prepared by the action of ammonia on 2.3.3′-dihydroxynaphthalene sulphonic acid according to the following method:—100 kilos. of 2.3.3′-dihydroxynaphthalene sodium sulphonate and 200 kilos. of 22 per cent. ammonia are heated for 10 hours to about 165° C., after which the temperature is raised to about 210° C. for another 10 hours; the melt is then dissolved in water, the excess of ammonia removed by boiling, and the new acid precipitated by hydrochloric acid. It is sparingly soluble in water, the sodium salt being more soluble and its solution having a slight blue fluorescence. Chloride of iron produces a blue coloration, whilst nitrous acid yields an azimido and not a diazo compound. The acid in the form of its sodium salt will combine with one or two molecules of a diazotised amine or amido-azo compound or their derivatives, giving orange to brown colouring matters for cotton or wool. It also combines with tetrazo compounds, yielding either symmetrical or mixed disazo colouring matters, all of which give similar shades on unmordanted cotton.—T. A. L.

*Improvements relating to the Manufacture of Salts of Pyrocatechin Disulpho Acid, and of Pyrocatechin therefrom.* G. Tobias, Berlin. Eng. Pat. 154, January 2, 1895.

The improvements relate to the manufacture of salts of pyrocatechin disulphonic acid by heating salts of phenol trisulphonic acid with caustic potash or soda in open or closed vessels to temperatures above 200° C. A portion of the excess of caustic soda used, may be recovered in the form of a concentrated soda-liquor by treating the above soda melt with the proper quantity of water, or it may be recovered as carbonate by treating the solution of the soda melt with carbonic acid. The caustic soda or carbonate having been washed out, the ultimate liquor, being substantially a concentrated solution of sodium pyrocatechin disulphonate, may either be evaporated to obtain the salt in the solid form, or it may be heated with water, to which acids may or may not be added, to temperatures above 140° C., when pyrocatechin itself will be formed.—J. S.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*Use of Unsaponifiable Oils for Greasing Wool.* Leipziger Monatschrift f. Textilind. and Färberzeit. Dingler's Polyt. J. **294** [2], 44—45.

Experiments were made by J. Spennrath with a view of ascertaining to what extent mineral oil, wholly or partially substituted for oil of vegetable or animal origin in the preparatory treatment of wool for spinning, can be removed again in the subsequent operation of washing. Pieces of thick woollen cloth, saturated with solutions of either pure mineral oil or mixtures of such and fatty oils in petroleum spirit, were, after the evaporation of the solvent (used with the object of spreading the oil evenly over and through the fabric), washed with pure rain-water and the usual media employed in wool-washing. The quantity of oil contained in the cloth was estimated before and after washing.

In the case of cloth, treated with mineral oil solely, the best results in washing were obtained with fulling soap, the least good with soda, 47·55 per cent. and 90·8 per cent. of the oil used remaining behind in the two respective pieces of material. Fuller's earth likewise did not work satisfactorily, leaving behind 79·61 per cent. of the oil. O. Walther, who criticises these experiments, ascribes this fact to the insufficiency of the mechanical action of the earth obtainable by the manual treatment adopted by Spennrath, he having himself found that material to answer best of any, if applied in a manner more nearly corresponding to the method employed on the large scale. Nevertheless, the results of the experiments furnish sufficient proof of the utter unsuitability of pure mineral oil for the purpose in question.

A mixture of equal parts of mineral oil and olein was used in another series of experiments. The best washing media in this case proved to be soda and soap, as one would expect. The oil residue amounted to from 1·98 to 6·98 per cent. Fuller's earth left behind 78·13 per cent. of the oil used, a fact borne out also by observations in practical working, and showing the incapacity of fuller's earth to remove oil of animal origin in appreciable quantity. Ammonium carbonate was found to be absolutely useless for washing, its employment leading to the formation of a sticky mass which firmly adhered to the fibre.

For the removal of a mixture of equal parts of olive and mineral oils, soaps were found most suitable, whilst ammonia showed but a weak action.

Mixtures of olein and mineral oil invariably gave better results in washing with a solution of soda (2 per cent.) than mixtures of olive oil and mineral oil. It must, however, be borne in mind that soda is less suitable for removing olive oil than soap.

Spennrath concludes from the above and a number of other experiments that oil used in the process of preparing wool for spinning may be mixed with mineral oil to the extent of 30 per cent.

Walther, on the other hand, considers the evident difficulty experienced in the removal of the mineral oil from the goods, sufficient reason to exclude it utterly from use for the purpose in question.—F. M.

### PATENTS.

*Improvements in or Applicable to Machinery for Scouring and Washing Wool and other Fibrous Materials.* W. McNaught, Rochdale. Eng. Pat. 7133, April 10, 1894.

The liquid used for washing or scouring, according to this patent, is contained in a wide trough having two separate compartments, viz., the washing or scouring tank, and the settling tank for the discharged liquors, which may be pumped out of this latter tank into the former. The washing tank is likewise divided into two parts by a division running longitudinally from one end of the tank to the other; the one where the material is treated is provided with a raised perforated bottom, whilst the bottom of the tank itself is inclined from the side under the perforated bottom to the other, so that the sediment from the material, falling on this floor, runs to one point. It is removed when the tank is discharged, and the inclined surface is washed with water supplied by a perforated pipe running along its highest part; mechanical agitators are sometimes used to accelerate the descent of this sediment. Under the squeezing rollers is a small tank likewise provided with perforated and inclined bottoms; from this the liquid squeezed out is led into the settling tank, from which it is afterwards raised by an elevator wheel or pump to the feeding end of the washing trough. The wool is propelled through the tank by an arrangement similar to that already described by the patentee (this Journal, 1894, 803). It consists of a framework carrying teeth or prongs, which moves downwards, forwards, upwards, and then back again, thus forcing the wool up the incline on to the squeezing rollers.
—H. I.

*A New or Improved Method of Softening Vegetable Fibres.* W. P. Thompson, Liverpool and Manchester. From J. F. Kerr, Paterson, New Jersey, U.S.A. Eng. Pat. 22,595, November 22, 1894.

The fibres are subjected to the action of a solution of soap, alkali, oil, and glycerin, until they are sufficiently softened, and are then dried. The following proportions gave good results:—Water, 85 per cent.; alkali, 1 per cent.; oil, 7 per cent.; soap, 5 per cent.; glycerin, 2 per cent. After washing, the material is placed in a tank containing the above mixture, heated to just below boiling, or is allowed to remain in this solution until it becomes saturated and softened.—H. I.

*An Improved Starch or Linen Gloss for Laundry Purposes.* J. Hilton, Blackpool. Eng. Pat. 25,242, December 29, 1894.

*See under* XVI., *page* 376.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Aluminium Compounds in relation to their Application as Mordants.* E. Schlumberger. Bull. Soc. Chim. 1895, **13** [2], 41–65.

The author endeavours to determine more exactly the composition and nature of certain aluminium compounds, viz., the basic sulphate, the carbonate, and the various hydrates.

*I. The Basic Sulphate.*—The first product of the precipitation of a solution of aluminium sulphate or alum, by a base, is a compound containing aluminium and sulphuric acid in the ratio $2Al_2 : SO_4$, which compound the author names sulpho-di-aluminium hydrate. This same substance constitutes the precipitate, which is formed when a solution of basic aluminium sulphate, basic alum, or of "red liquor" (*i.e.*, basic aluminium acetate) is heated to boiling. It is, in fact, the acetic acid compound of sulpho-di-aluminium hydrate that forms the essential part of "red liquor."

*II. The Carbonates.*—The author's experiments confirm the already known fact that the precipitation in the cold of aluminium salts by means of alkaline carbonate, as well as that of alkaline aluminates by $CO_2$, always gives a precipitate containing $CO_2$, and never the normal hydrate of aluminium.

*III. The Hydrates.*—Normal hydrate of aluminium has as yet not been prepared. Where its formation would be expected, one of three results was obtained. Either the product, while having some of the properties expected from the normal hydrate—as, for instance, dissolving easily in acids to form the normal salts of aluminium—retains some of the acid from the bodies used in the preparation; or the product, whilst retaining no acid, is not entirely soluble in acids, and gives on calcination a weight of aluminium higher than that calculated for $Al_2(OH)_6$; or thirdly, the resulting substance, although retaining acid, is neither entirely soluble in acids nor contains aluminium corresponding with the formula $Al_2(OH)_6$.

*IV. Colloidal Hydrates.*—Whenever it is attempted to isolate the normal aluminium hydrates, there is found at the same time one or more hydrates containing less water, and characterised by the property of giving colloidal solutions with dilute hydrochloric acid. Of these, the most nearly related to the normal hydrate is that obtained by adding alum solution to sodium aluminate and boiling the product with sodium carbonate. It may be considered as produced by the condensation of three molecules of the normal hydrate, and has the formula $Al_6(OH)_{10}O_4$. This condensation product dissolves in dilute acid, giving a colloidal solution from which all the acid cannot be separated by dialysis. It contains in fact salts of this tri-aluminium hydrate.

Closely related to this body, if not absolutely identical with it, is the *soluble hydrate of Walter Crum*, which the author prepares by heating aluminium acetate solution in sealed tubes to 150° C., or by boiling a more dilute solution (not stronger than 0·5 per cent.) exposed to air. On precipitating the resulting opalescent solution with KOH, a substance having all the properties of tri-aluminium hydrate is obtained.

It seems probable that all these soluble hydrates are maintained in solution by the trace of acid from which it is impossible to free them. The colloidal solution obtained by heating aluminium acetate in sealed tubes to 150° C. is completely precipitated by caustic potash as well as by sulphuric acid.

*Behaviour towards Textile Fibres and Colouring Matters.*—The various colloidal hydrates do not seem to be able to act as mordants. A sample of cotton impregnated with tri-aluminium acetate and treated by the methods usually adopted in Turkey-red dyeing only appears to fix aluminium very imperfectly. With alizarin the resulting colour is pale rose, dull in shade, and not at all like alizarin red. With logwood merely a dirty greyish violet is obtained on cotton mordanted in this way. The solutions themselves with a decoction of logwood give the following reactions:—

(1.) Normal aluminium acetate—violet-red colour, brilliant and warm in shade, the liquid remaining clear.

(2.) Tri-aluminium acetate—dirty reddish-grey, the liquid becoming turbid.

(3.) The acetate obtained by heating the normal acetate to 150° C. after the acetic acid had been removed by boiling—rose-brown in colour.

The last facts probably explain the pernicious action which alkaline baths, even when incapable of dissolving alumina (*e.g.*, milk of lime), exert on the aluminium mordant already fixed but not dyed, and also that of the prolonged action of steam at 100° C. The conditions destructive of the aluminium mordant are precisely those favourable to the formation of the tri-aluminium hydrate and its related hydrates. It is thus probable that the lowering of the mordanting power in the above cases is due to the formation of these hydrates.—H. I.

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*Detection of Artificial and Natural Colouring Matters on the Fibre.* A. Lehne and A. Rusterholz. Färber Zeit. 1891 *et seq.*

*See under* XXIII., *page* 391.

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## PATENTS.

*A New or Improved Means or Method of Dyeing Warp on the Beam.* G. Keighley, Burnley. Eng. Pat. 5186, March 13, 1894.

The warps are wound on a perforated metal beam, which is fixed in an upright position in the dye vessel. Hot water is caused to flow from a cistern into this vessel, and by means of a pump, a vacuum is created in the interior of the beam, when the water passes through the warps and returns to the cistern. Dyeing is effected by circulating the dye-liquor in a similar way from another cistern. Finally, air is drawn through the warps to fix and, if necessary, oxidise the dye upon the fibre.—R. B. B.

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*An Improved Process for Printing Indigo on Fabric and Yarn.* A. Blanchon and A. Allegret, Paris, France. Eng. Pat. 7135, April 10, 1894.

Instead of printing with reduced indigo, the indigo is made into a paste with starch and water previously boiled together. This mixture is printed on to the material, which then passes through a reducing bath, such as a lukewarm solution of calcium hydrosulphite. The indigo is re-oxidised, and the thickening removed by the usual methods.—R. B. B.

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*Improvements in Machines for Scouring and Dyeing Textile Warp or other Yarns.* F. Barraclough, Yeadon. Eng. Pat. 8767, May 3, 1894.

This invention relates particularly to a former patent of the inventors (this Journal, 1893, 826).

The same framework and mechanism as already described is used, only the trough is replaced by an arrangement consisting of two series of short-flanged horizontal rollers, which are just wide enough to allow the warp to pass once round, set across the front of the machine frame at right angles to the principal rollers, and at heights corresponding to the top and bottom rollers respectively. The first short bottom roller is placed in front of the last "draft" of the machine described in Eng. Pat. 22,893 (*loc. cit.*), and the first short top roller in front of the last "draft" but one, and so on. These new rollers are driven by the principal gearing; they run loose in bushes, and since they can slide in perpendicular slots, they are adjustable to suit any lengths of yarn.

The yarn, after it leaves the top front roller of the machine in the last "draft," passes down to the first bottom short roller, and then up to the first top short roller, and so on until it passes over the last top short roller, whence it goes to the front bottom roller in the first division of the same.

With shorter lengths of yarn, modifications in the winding may be made.—H. I.

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*Improvements in the Manufacture or Production of Cloths in Variegated Colours.* M. Kalisch, W. A. Rosenberg, and J. Entwisle, Manchester. Eng. Pat. 12,762, July 2, 1894.

The object of these improvements is the imitation of hand-treated native cloths, which are produced by tying or stitching up parts of the cloth to prevent penetration of the dye.

The cloth is woven in the first instance with a pattern in two or more colours. A resist for indigo is printed on the fabric, which is subsequently dyed with indigo. The outline of the original woven pattern is practically obliterated, but the different colours of the original cloth show up into and variegate the portions untouched by the indigo, *i.e.*, where the resist has been printed. The colours of the woven pattern may also be modified by the action of the resist.

—R. B. B.

*An Improved Apparatus for Treating Spun or Woven Fibrous Materials with Dyeing, Washing, Bleaching, Mordanting, or other Liquids.* L. Frotscher, Zittau, Germany. Eng. Pat. 119, January 2, 1895.

The goods are wound on a perforated cylinder, which is connected at each end by hinged pipes with a central tube, which is itself joined to a large vessel. This latter can, at will, by suitable valves, be placed in communication with a vacuum, steam, or compressed air generating apparatus, or, by means of a pipe at its base, with a tank containing a concentrated liquor. The roller, with its covering of fabric, is placed in the dye- or wash-trough. By turning on the vacuum, the liquid can be drawn through the material into this above-named vessel; here it may be replenished, by means of the pipe, with a concentrated liquor from below, and again be forced through the material either by steam or, if the process takes place in the cold, by compressed air. In this way, by passing the liquid to and fro, the goods receive a very thorough impregnation with the solution. Two processes may also be carried on, one after the other, without removing the roller from the trough.—H. I.

## VII.—ACIDS, ALKALIS, AND SALTS.

*The Compounds of Hydrofluoric Acid with Water.* R. Metzner. Comptes rend. 1894, **119**, 682—684.

The author has investigated the behaviour of aqueous hydrofluoric acid of various strengths when strongly refrigerated, and concludes from his results that under such conditions the acid forms only one hydrate of the formula $HF + H_2O$.—H. T. P.

*The Manufacture of Alumina from Clay.* J. Heibling. Comptes rend. 1894, **119**, 609—610.

The following process is stated to yield excellent results. The clay is thoroughly incorporated with a mixture, in equal parts, of ammonium and potassium sulphates, in such proportion that three molecules of ammonium sulphate may be present to every molecule of alumina. The mixture is made into hollow bricks, which are then heated in an oven to 270°—280° C. At this temperature gaseous ammonia is given off, and acid ammonium sulphate produced, which immediately reacts with the potash salt present, acid potassium sulphate being formed. The latter, at the above temperature, combines with the alumina of the clay to form alum. The alum is finally extracted from the bricks by means of water, and freed from iron by recrystallisation. The insoluble silica remaining behind may be employed in cements. Granular alumina is prepared as follows:—The powdered alum is spread out in a thin layer on shelves arranged in a vertical tower, which is traversed by the warm, moist, ammoniacal fumes derived from the brick oven above mentioned. Under these conditions the alum is transformed *in situ* into alumina—retaining the form of the original powder—and potassium and ammonium sulphates. The latter may be subsequently removed by washing, and used over again. The alumina thus obtained is absolutely free from silica, and is readily convertible into sulphate, &c.
—H. T. P.

### PATENTS.

*Improvements in and relating to the Treatment of Marine Plants for obtaining Materials designed for Various Industrial Purposes.* G. Laureau, jun., Quiberon, France. Eng. Pat. 6988, April 7, 1894.

Marine plants, washed by sea-water, are sprinkled with acidulated water, drained, and heaped, and sometimes sorted, to separate mixtures of "potassic or sodic plants." The seaweed is then passed through a series of vessels containing water acidulated with 5 per cent. of sulphuric acid, or with 10 per cent. of hydrochloric acid, draining between the immersions, the operation lasting a week. The next treatment consists in washing with sea-water or with soft water, after which the wrack, thus deprived of salts, is drained and put in heaps. The acid-water used is filtered through ashes of marine plants, and concentrated, to obtain potassium and sodium salts, and iodine and bromine, by ordinary processes.

The acid-washed seaweed is heated with solution of an alkali, carbonated or otherwise, provision being made for recovery of ammonia by distillation, if that alkali be used. The resulting pasty mass is filtered in linen bags or in a filter-press, and the liquid is treated with an acid in a wooden vessel, to precipitate "gelatinous material," which may be moulded into plates or otherwise, and dried, and applied as a substitute for horn, waxed leather, shell, and gutta-percha, in the manufacture of various articles. The fibrous material remaining on the filters is washed and treated with bleaching-powder and sulphuric acid; the fibres are then separated from an amylaceous portion by sifting, and the latter is used in the manufacture of pasteboard and cellulose mouldings, and the former in making packing-paper. Or the fibre is pressed into plates, dipped into linseed oil or a resin, and then exposed to nitrous vapours or dipped into strong sulphuric acid, to obtain a waterproof material.

When seaweed but little attacked by acidulated water is treated with cold, concentrated alkaline solutions, a material of horny appearance is obtained, which swells in contact with water, and may be used in pharmacy as a cataplasm. Seaweed may be directly treated with an alkali solution, and then with bleaching-liquor, to obtain a material applicable "in the drug trade" and in finishing fabrics. The processes may be modified in some respects, and many applications for the products obtained are mentioned in the claims.

The total products obtained by the described processes from 5,000 kilos. of dry marine plants, "which correspond to a ton of soda obtained by the burning of sea-wrack," are stated to be, approximately, 3,200 kilos. of fibre, 1,000 kilos. of horn or horny material, and 705 kilos. of salts, inclusive of 4½ kilos. of iodine and ½ kilo. of bromine.—E. S.

*Improvements in Recovering Salts or Salines from Solutions.* C. H. Huntley, London. Eng. Pat. 1967, January 28, 1895.

The solution containing salts or salines is passed through a filter composed of coarsely-crushed animal charcoal and magnetic iron ore, in alternate layers with asbestos cloth. The filtered solution is received in a non-metallic vessel, and compressed air, previously passed through a 2½ per cent. solution of potassium permanganate, is forced through. The solution is then placed in a vessel enclosed in another larger and air-tight vessel, the lateral space being filled by a condensible gas, like ammonia or sulphurous acid, under strong pressure, say 250 lb. to the inch or thereabouts. The salts that separate on further cooling from the remaining solution are collected and dried in suitable apparatus.—E. S.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*Chromates of Iron.* C. Lepierre. Bull. Soc. Chim. 1894, 1115—1128.

*See under* XIII., *page* 372.

### PATENT.

*An Improvement or Improvements in or Substitutes for the Flattening Stones employed in the Flattening of Sheet Glass.* Chance Brothers and Co., West Smethwick, and J. E. Scott, West Bromwich. Eng. Pat. 5899, March 21, 1894.

In place of the flattening stone ordinarily employed, which needs to be used with a sheet of coated glass upon its surface, a metal slab is cast with ribs on its under side to prevent warping; the surface is planed and finely grooved, then heated to low redness, and allowed to cool very slowly. The upper surface of the slab is then coated with dark purimachos worked up with water to the consistence of molasses. Before the coating is quite dry, another coating is applied of a mixture, in stated proportions, of purimachos with bone ash, similarly worked up with water; a third and fourth coating are afterwards given, but the number of coatings may be varied; preferably, however, the thickness of the combined coatings is made equal to about one-thirty-second of an inch. When the surface is quite dry, it is made true by rubbing with an iron rubber, and with coarse and afterwards fine sand. The coated slab is then heated to dull redness, and is finished when cold, if necessary, by rubbing the surface with fine sand. Instead of having radiating tapering ribs, the slab may be made thicker in the middle, and tapering towards its marginal flange. Directions are given as to the manner of using the slabs in flattening glass.—E. S.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Hydraulic Cement.* Dingler's Polyt. J. 1894, **294**, 89—95, 114—119, 137—144, and 163—167.

The bulk of the article consists of a recapitulation of the experimental work, deductions and opinions that have been published within the last few years concerning cement. The major part of this has already appeared in this Journal, but a few excerpts of matter which has not been hitherto recorded may be given.

The various views entertained concerning the action of water sprayed upon hot clinker, a practice sometimes resorted to to prevent "dusting," may be summarised as follows: Kosmann attributes the action of this quenching process to the formation of hydrated products, an opinion which is contrary to the observation of Erdmenger that cement quenched in this manner contains no combined water. The last-named writer considers that the sudden lowering of temperature caused by quenching is the true reason of the alteration in properties. Should the quenching result in the actual granulation of the clinker, such as occurs when the hot clinker falls into a large volume of water, a certain amount of hydration may take place, but even then the product instead of being deteriorated by this partial slaking gives high tensile tests. Adopting Le Chatelier's view that the dusting of clinker is due to the presence of the silicate, $2CaO\,SiO_2$, it may be supposed that the change of crystalline form of this body is prevented by the rapid cooling of the mass of silicates with which it is associated in the clinker of which it forms part. The molecular transformation that obtains is probably analogous to changes of constitution such as are exhibited by blast furnace slag on granulation, and by glass on slow solidification. The behaviour of glass supersaturated with cadmium sulphide may also be quoted. Such glass at first solidifies in a perfectly normal manner, but at a relatively low temperature becomes devitrified and disintegrated consequent on the separation of the cadmium sulphide from the mass of the glass, which is a poor solvent for this substance at moderately low temperatures. The energy relations of quenched and unquenched clinker may profitably be studied by determining their heat of dissolution in a manner similar to that already adopted for blast furnace slag. It is to be expected that the quenched clinker would give the more exothermic reaction of the two.

The well known investigations of Michaëlis on the behaviour of cement prepared by actual fusion, instead of mere sintering (semi-fusion), as in the usual clinkering process, have proved that under these conditions the usual limit for the percentage of lime may be much surpassed, a cement having the composition—silica, 20·7; alumina, 5·8; ferric oxide, 2·7; lime, 69·4; magnesia, 0·9; sulphuric anhydride, 0·5—being of unexceptional quality. This fact disposes finally of all speculations based on the alleged difference in quality of calcium silicates prepared by sintering from that formed by complete fusion.

Höglom has examined a specimen of material accidentally formed by the fusion of a portion of a charge of a cement furnace. He found it to consist of a vitreous matrix, through which abundance of crystals of melilite, a mineral having the composition $(CaMgNa_2)_{12}(Al_2Fe_2)_2(Si_9O_{36})$ were disseminated to the extent of 40—50 per cent.

The following observations may be set down with regard to the action of calcium sulphate upon cement. Lightly burnt cement is much more strongly influenced than heavily burnt cement. With the latter a large addition of gypsum is necessary to cause an equal retardation of the setting.

It is noteworthy that cement, the setting time of which has been increased by the addition of gypsum, will after aeration again become quick setting; a similar return to the original setting time is alleged to take place after 6 or 12 months, even when access of air to the cement is prevented. Candlot's work on the action of calcium sulphate upon cement has been noticed in this Journal, 1891, 140, but certain portions of it may be here stated for comparison with the results of other investigators.

He has found that when cement containing gypsum is gauged with an equal weight of water, test samples of the water in which the cement is placed contain at first a considerable quantity of gypsum, but that after some time the gypsum disappears from the solution, and inversely the proportion of free lime increases. Thus water in contact with cement containing gypsum, contained after five minutes 1·82 grms. of CaO and 7·80 grms. $CaSO_4$; after three hours the amount of CaO has increased to 2·88 grms., while the gypsum had dropped to zero. From these observations, Candlot deduced that there must be a substance in cement capable of forming an insoluble compound with calcium sulphate. He further proved that calcium aluminate having a composition indicated by the formula $Al_2O_3\,1{\cdot}5\,CaO$ behaved towards gypsum in the same way as did cement. Finally, he succeeded in isolating a crystalline compound of calcium aluminate and calcium sulphate, the composition of which corresponds with the formula $Al_2O_3, 3CaO\,2{\cdot}5\,CaSO_4, 69H_2O$. This substance may be obtained in crystals 2—3 mm. in length, and is difficultly soluble in water and insoluble in lime water. The existence of this substance throws light upon the fact that cements containing gypsum become quicker setting on aeration. All cement contains a certain small amount of free lime; a minimum quantity of this suffices to render the aluminate insoluble, and thus to decrease the rate of setting considerably. The calcium sulphate on the other hand goes into solution tending to decrease the solubility of the calcium aluminate; the sulphate remains thus in solution without action on the aluminate, on account of the insolubility of the latter under the conditions quoted. When, on the other hand, by the action of the carbon dioxide of the air, the free lime of the cement is carbonated, calcium sulphate dissolves concomitantly with the aluminate, causing the ultimate precipitation of the latter and rendering it inoperative. Thus, if the free lime in a cement containing no calcium sulphate be removed by gauging with a solution of sodium carbonate (0·2 per cent.) a large diminution of the setting time takes place, *e.g.*, a cement originally setting in two hours sets in as short a time as three minutes. Conversely cement containing gypsum which has become quick setting by aeration, is restored to its former condition of slow setting by treatment with a small quantity of free lime. In the case of cements that are but lightly burnt, the formation of the double compound of calcium aluminate and calcium sulphate becomes complete during the setting. With true Portland cement, on the other hand the hydration of all the calcium aluminate takes place slowly, thus delaying the formation of the double compound, the ultimate recurrence of which produces the "blowing" frequently observed with cements containing much gypsum.

A similar double compound of calcium sulphate and calcium aluminate has been described by Michaëlis under the title of "the cement bacillus." To this body he assigns the formula $Al_2O_3$, $3CaO.3CaSO_4.30H_2O$. This substance occupies a much larger volume than do the aluminate and sulphate from which it is formed, and consequently causes "blowing." Its existence also explains the observation that a certain limited percentage of calcium sulphate in Portland cement increases the closeness of texture and tensile strength of test pieces. Michaëlis considers that the permissible limit for the addition of gypsum to cement may be set at 4 per cent., although the standard recognised in Germany is 2 per cent.

Erdmenger has investigated the gypsum question from a somewhat different standpoint. He considers that although 4 per cent. is a liberal maximum for gypsum added after burning, yet that considerably more may be present in the raw materials before burning without injurious influence. Gypsum added to the raw materials in such amount as to cause the lime which it contains to replace a portion of the lime from the chalk or other calcareous material, does not interfere with the production of unexceptionable cement. If on the contrary the gypsum be added without replacing a portion of the lime in other forms, the formation of calcium sulphide will occur, and the cement will have the properties characteristic of products containing this substance.

Schott has studied the influence of gypsum on cement in the following way:—He prepared two cements from pure raw materials, the one consisting solely of silica and lime, corresponding with the formula $2CaOSiO_2$, and the other containing alumina in amount similar to that in an ordinary commercial cement, and having the percentage composition silica, 18·09; alumina, 12·53; ferric oxide, 0·90; lime, 63·30; magnesia, 0·96; sulphuric anhydride, 0·71. Loss on ignition, 3·73. These cements were gauged with water with and without gypsum, in quantity calculated to form a double salt with the whole of the calcium aluminate, reckoning their relations on the formula of Michaëlis; their expansion was determined by the use of the Bauschinger apparatus. As a result, the cement containing silica as its only acid oxide was nearly perfectly constant in volume, while the cement containing alumina expanded *per se* in the manner usual with Portland cements, and when dosed with gypsum expanded violently and broke up. The constancy of volume of the purely siliceous cement is noteworthy, inasmuch as the celebrated Theil hydraulic lime, which is know to resist the action of sea water particularly well, is similarly free from alumina. From these facts it is to be supposed that 'a cement containing only lime and alumina would blow even more badly than did the cement already quoted. A cement prepared to correspond in composition with the formulæ $2CaO.Al_2O_3$ expanded considerably when tested in the Bauschinger apparatus when used without gypsum, and showed a still stronger expansion when an equivalent of gypsum was added. The result of this expansion was, however, different from that taking place in the aluminous cement mentioned above. The test pieces cracked but did not disintegrate. A cement richer in lime and having a composition represented by $3CaOAl_2O_3$, showed indications of blowing before gypsum was added. A cement having the composition silica, 26·1 per cent.; ferric oxide, 12·2 per cent.; lime, 61·6 per cent., the ferric oxide replacing alumina, hardened perfectly without blowing when tested alone, but on the addition of gypsum exhibited strong expansion.

Klinkenburg has prepared mixtures of the semi-fused (sintered) compound $2CaO\ Al_2O_3$ with one, two, and three equivalents of $CaSO_4.2H_2O$, and has treated weighed portions with excess of water for a period of six months, after which the contents of the flasks containing the mixtures were dried over sulphuric acid and caustic potash, the increase of weight corresponding with the amount of water which had entered into combination. Evidence of the existence of the following substances was thus obtained:—

(1.) $Al_2O_3.2CaO.5H_2O$.
(2.) $Al_2O_3.2CaO.3CaSO_4.19{\cdot}55H_2O$.
(3.) $Al_2O_3.2CaO.2CaSO_4.18{\cdot}25H_2O$.
(4.) $Al_2O_3.2CaO.CaSO_4.12{\cdot}49H_2O$.

Inspection of these formulæ shows that the presence of calcium sulphate greatly increases the capability of the particular calcium aluminate experimented with, of combining with water to form probably a double salt of the type described by Candlot and Michaëlis. The reconciliation of the rival views of Schott on the one side, and Candlot and Michaëlis on the other, in respect of the existence of the aluminate, $3CaO.Al_2O_3$, in normal cement (Schott considering that it causes blowing) can only be effected by further work.

With regard to the so-called magnesia question which has been copiously debated and concerning which various contributions have appeared in this Journal, it may be said that two views at present prevail, namely, that of Le Chatelier who regards the magnesia as functioning similarly to lime, and that of Erdmenger who considers it inert. The latter states that cement having the composition lime 46 per cent., magnesia 23 per cent., silica 21 per cent., alumina and ferric oxide 9 per cent., behaves as if it were over-clayed and not over-limed as would be the case if the magnesia were capable of replacing lime equivalent for equivalent. Voluminous tables have been compiled showing the tensile strength and expansion of cements containing percentages of magnesia varying from 0·8 to 23·3 per cent. Their general tenour may be gathered from the fact that the neat cement exhibits a noteworthy tendency to blow when the percentage of magnesia reaches 11·5 per cent., but that mixtures of cement and sand are, as is to be expected, less easily affected, maintaining their coherence until as high a percentage as 15·4 per cent. MgO has been reached.

The article concludes with a list of recent works treating of cement. These are:—Tarmin, "Cement and Lime" (a new edition of Gerstenbergk's "Cemente," 1892); Zwick, "Hydraulic Lime and Portland Cement," new edition, 1892; Heusinger and Waldegg, "Lime and Cement-making," part 2, second division, 1892; "Portland Cement and its Use in Building," issued by the Association of German Cement Makers.—B. B.

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## X.—METALLURGY.

*Temperatures of Transformation of Iron and Steel.* G. Charpy. Comptes rend. 1894, **119**, 735—737.

By experiments on the heating and cooling of five samples of extra mild steel, by heating in an electrically-heated furnace, and by measuring with an autographic Le Chatelier pyrometer, Osmond's three points $a_1$, $a_2$, and $a_3$, were found to have the following values, of which each number is the mean of several experiments differing among themselves only by a few units:—

| Sample. | Percentage of Carbon. | Other Ingredients. | $a_1$ |  | $a_2$ |  | $a_3$ |  |
|---|---|---|---|---|---|---|---|---|
|  |  |  | Heating. | Cooling. | Heating. | Cooling. | Heating. | Cooling. |
|  |  | Per Cent. |  |  |  |  |  |  |
| 1 | 0·07 | .. | .. | .. | 710° | 730° | 865° | 840° |
| 2 | 0·09 | .. | 722° | 664° | 744° | 731° | 903° | 860° |
| 3 | 0·07 | Ni.1·15 | 710° | 698° | 744° | 732° | 835° | .. |
| 4 | 0·08 | Cr.0·75 | .. | 675° | 744° | 744° | 860° | 789° |
| 5 | 0·11 | W.0·60 | .. | 630° | 749° | 740° | 923° | 877° |

The point $a_1$, always more marked as the percentage of carbon increases, is here but lightly indicated; $a_3$ is well marked, but varies both with the nature of the metal and the rate of heating, while $a_2$ is fixed, and seems to indicate a reversible effect, as the point is practically constant for rising and falling temperatures. The last-named observation is in accordance with Arnold's work. Mechanical tests showed that the metal, heated to 750°—800° C. and quenched, exhibited no rectilinear notch in the tenacity curve (see this Journal, 1894, 40). On reheating cold-drawn or hardened steel, the curves generally agree with those given by annealed metal, showing that the change produced by cold-hammering is reversed at a temperature lower than that of formation. But on rapidly heating such samples, the point $a_2$ either failed to appear, or was replaced by a hump-shaped rise spreading over the whole space between 720° and 740°. It would seem, therefore, that the critical point $a_2$ corresponds to the change in the iron produced by cold hammering or by quenching at temperatures between 750° and 800°, and characterised by the notch in the tenacity curve. Curie has observed that the magnetic properties of iron are normal up to 800° C., so that the transformation of the iron appears to influence the magnetic, as well as the mechanical, properties of the metal. The alteration in volume accompanying this change may develop considerable strains in large masses of metal. The point $a_1$ corresponds to the carbon transformation marked by the Eggertz test (see this Journal, 1894, 1066), whilst $a_3$ corresponds to a second change in the iron, which appears to have most influence upon its magnetic properties.—W. G. M.

### *Displacement of Carbon by Boron and Silicon in Melted Cast Iron.* H. Moissan. Comptes rend. 1894, **119**, 1172—1175.

Ten grms. of grey cast-iron, containing 3·18 per cent. of total carbon and 0·5 of "cinder" (the substance left after burning the carbonaceous residue in oxygen, which was obtained by acting upon the metal with chlorine or mercuric chloride) were fused in a porcelain boat, brasqued with 2·5 grms. of boron, and contained in a porcelain tube, through which a current of hydrogen was passed continuously. The resulting button of metal was yellowish in colour, with long crystalline prisms on the surface, and was covered with a layer of graphite. It contained from 8 to 9 per cent. of boron, only 0·27 per cent. of carbon, and left no residue after ignition of the carbon precipitate. Four other experiments with a grey iron, containing 3·24 per cent. of carbon and 0·418 of cinder, gave buttons with 0·14—0·36 per cent. C and 0—0·03 per cent of cinder; and a white iron gave similar results. Thus the boron had displaced carbon, and eliminated the constituents of the cinder. 500 grms. of grey iron were next fused in a crucible, to which there were then added 50 grms. of an iron containing 10 per cent. of boron; after the stirring, which was necessary to induce solution, the crucible was covered until the end of the experiment. The resulting ingot was lamellar, had the appearance of white iron, and was so hard that a graving tool made no impression upon it. Some graphite was separated, and the total carbon was reduced from 3·75 to 2·83 per cent. Grey iron, heated in contact with crystalline silicon, gave results similar to those obtained in the first trials with boron. A carbide obtained from pure soft iron and sugar-carbon in the electric furnace was melted, and several grammes of melted silicon were projected upon the surface of the metal. On cooling, the ingot was smooth upon the upper surface, had the aspect of siliceous iron, and a white and brilliant fracture; it contained a trace of combined, but no graphitic carbon, and was divided almost into two parts by a large central cavity containing a quantity of brilliant and well-crystallised graphite. These results show that cast-iron, when fused, is subject to precipitations and replacements quite analogous to those which occur in aqueous solutions. When the displacement of carbon is not complete there exists a position of chemical equilibrium between silicide and carbide of iron, which varies with the temperature and with the impurities in the bath. All these experiments were made at a temperature below that required to obtain notable quantities of silicide or boride of carbon.—W. G. M.

### *Boron in Steel.* H. Moissan and G. Charpy. Comptes rend. 1895, **120**, 130—132.

Osmond (Comptes rend. **110**, 242 and 346; this Journal, 1890, 517) has studied the action of iron cast on to a fragment of the adamantine variety of boron, and has concluded that boron acts upon iron in the same way as does carbon, lowering, like that element, the critical points of the metal and rendering it more readily hardened by quenching. The view that boron is actually taken up under the conditions named is disputed by Arnold, who denies that the two elements are capable of uniting in the same way as iron and carbon. The authors have prepared iron containing a small proportion of boron in the following manner:—Pure amorphous boron heated in contact with reduced iron in a current of hydrogen, yielded a product which, when ultimately cast, contained about 10 per cent. of boron, and could be used to introduce boron into mild steel of known composition. Steel prepared in this way has the composition: boron, 0·58 per cent.; carbon, 0·17 per cent.; manganese, 0·03 per cent., with traces of silicon, phosphorus, and sulphur. This metal could be rolled out in the form of a cylindrical bar and could be readily forged at a dull red heat, but crumbled under the hammer when heated too strongly. Speaking generally it behaves like soft steel.

The thermal properties of the boron steel were studied by the usual pyrometric methods; it was found that there was a strongly marked critical point at 1,110° C., and other points less definite at 1,040°, 830°, 730°, and 660° C. These last three points appeared to correspond with the points $a_1$, $a_2$, $a_3$, which occur in ordinary mild steel at slightly higher temperatures; they are, however, less definite in the case of boron steel. The critical point observed at 1,140° C. is similar in intensity to that corresponding with the point of recalescence of hard steel. As the authors have already indicated on a previous occasion, boron may replace carbon, and the critical point occurring at 670° in the cast metal containing carbon, disappears almost entirely on the substitution of boron, that at 1,140° becoming prominent.

Mechanical tests of boron steel have been carried out on test pieces previously heated and quenched at various temperatures and tested without annealing :—

| — | Boron Steel. | | Steel containing 0·07 per Cent. C. | | Steel containing 0·37 per Cent. | |
|---|---|---|---|---|---|---|
| | Tensile Strength. | Extension. | Tensile Strength. | Extension. | Tensile Strength. | Extension. |
| | Kilos. per Sq. Mm. | Per Cent. | Kilos. per Sq. Mm. | Per Cent. | Kilos. per Sq. Mm. | Per Cent. |
| Rolled and annealed.................... | 46·0 | 11·0 | 33·4 | 22·7 | 55·3 | 16·1 |
| Hardened by heating to 800° C. and quenching. | 85·6 | 5·1 | 34·8 | 15·2 | 92·4 | 2·7 |
| Hardened by heating to 900° C. and quenching. | 120·0 | 2·7 | 42·5 | 13·5 | 117·4 | 1·7 |
| Hardened by heating to 1,100° C. and quenching. | 129·5 | 3·1 | .. | .. | .. | .. |
| Hardened by heating to 1,200° C. and quenching. | 92·3 | 0·9 | .. | .. | .. | .. |

From the above table it is evident that with regard to the increase of tensile strength caused by hardening (by heating to a determined temperature and quenching in water), boron steel behaves like a carbon steel of considerably harder grade, while the diminution in extension is less marked than with the latter.

It is remarkable that the hardness of boron steel—as distinct from its tensile strength—increases but little on heating and quenching. Thus, test-pieces having a tensile strength from 120—137 kilos. per sq. mm. could be filed as easily as those which have not been heated and quenched. In contradistinction to this, hardened test-pieces of steel containing 0·37 per cent. of carbon could only be shaped with an emery wheel, as they were not touched by the file. The special effect of boron therefore appears to be to communicate to the steel a high tensile strength rather than actual hardness when the metal is heated and quenched, the function of the hardening agent therefore differing sharply from that of carbon.—B. B.

### *Impurities in Commercial Aluminium.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1021—1024.

It is well known that commercial aluminium contains iron and silicon, but in addition to these impurities the author states that carbon and nitrogen are also present. A sample under examination gave the following numbers on analysis :—Al = 98·02, Fe = 0·90, Si = 0·81, C = 0·08, and traces of nitrogen. The quantity of silicon can be considerably reduced by fusing the metal under an alkaline fluoride. In the example cited the amount was reduced from 0·81 to 0·57 per cent. The presence of nitrogen gives rise to the formation of ammonia when a sample of the aluminium is boiled with 10 per cent. potash and the gas passed through Nessler's solution. By passing nitrogen through fused aluminium the gas is absorbed, forming aluminium nitride, and the physical constants (elasticity, breaking strain, and co-efficient of elongation) of the metal are thereby altered. The existence of this aluminium nitride has already been mentioned by Mallet (J. Chem. Soc. **30**, 340). Carbon is present in larger quantity than nitrogen, and may be determined by dissolving the aluminium in potash, washing the residue with water, and burning it in a current of oxygen, weighing the carbon dioxide produced. The presence of carbon has a marked effect on the physical properties of aluminium. In the case of pure aluminium, the breaking strain per sq. mm. was 11·1 kilos. with an elongation of 9 per cent., whilst carburetted aluminium broke at 6·5 to 8·6 kilos. with an elongation of 3 per cent. In conclusion, the author mentions that commercial aluminium containing alumina is devoid of crystalline character. He also states that certain samples he has examined contain small crystals of carbon boride.—T. A. L.

### *Utilisation of Blast-Furnace Gases.* M. G. Arth. Bull. Soc. Chim. 1895, **13** [3], 154—155.

The blast-furnace gases have hitherto been scarcely utilised, except as a means of heating the air-blast necessary for the working of the furnace, or for generating steam. In some works the gases are subjected to a more or less efficacious washing process, mainly for the purpose of removing the fine dust and of thus avoiding its accumulation in the Cowper's or Whitwell's apparatus. A recently patented process (French Pat. 234,431, 1893) has for its object the recovery of the soluble substances contained in the water used for washing, as well as the complete removal of the solid matters. M. Gredt, the inventor and patentee, has supplied the author with a sample of the calcined saline matter obtained by evaporation of the washing water at the works at Esch, Luxembourg, where the process is in use. This sample contained, besides, about 11 per cent. of insoluble matter ($CaCO_3$, FeS, silicates, carbon, &c.) and notable quantities of sodium salts and other soluble substances :—Iodine, 1·43 per cent. ; chlorine, 45·94 per cent. ; potassium, 13·12 per cent. ; calcium, 4·62 per cent.

The inventor calculates that about 100 kilos. of calcined salts might be recovered for every 100 tons of pig-iron produced, which would correspond to 1·869 kilos. of potassium iodide and 24·22 kilos. of potassium chloride.

—F. M.

## PATENTS.

### *Improvements in the Recovery of Tin from Old Tins and Clippings and Waste Pieces of Tinned Iron.* H. A. Martin, Paris. Eng. Pat. 7544 (under International Convention), September 19, 1893. April 16, 1894 (United Kingdom).

The clippings or other substances are treated in a bath composed of dilute sulphuric acid at 53° Beaumé, to which is sometimes added an equivalent proportion or less of hydrochloric acid, and an oxidant such as nitric acid, a nitrate, a chlorate, oxygen, or air. The tin thus dissolved in the bath is separated in the form of metal or salt by a suitable chemical or metallurgical process.—J. H. C.

### *Improvements in and Apparatus for Desilverising Lead.* J. W. Swan, Bromley. Eng. Pat. 3228, February 14, 1894.

The lead to be desilverised is made to pass through molten zinc, which is contained in vessels provided with inlets and overflows, so arranged that the lead but not the zinc passes out. The vessels are arranged in series when required.—J. H. C.

*Improvements in the Manufacture of Oxides of Lead and Apparatus therefor.* S. Z. de Ferranti, London, and J. H. Noad, East Ham. Eng. Pat. 3372, February 16, 1894.

These are improvements in the process of manufacturing litharge, whereby molten lead is "sprayed" by means of a blast of hot air into a chamber heated from the outside, and also supplied internally with hot air, the spraying being effected by an apparatus similar to an ordinary ejector. The lead is oxidised to litharge by this treatment; but if red lead be required, the monoxide is collected, and again sprayed into a second or third chamber under similar conditions.

To produce a superior quality of litharge or red lead, lead carbonate may be blown or sifted into such a chamber, fed either with highly-heated air or with oxygen.—F. H. L.

*An Improved Process for Treating Steel in the Manufacture of Files.* J. Smilie, Chapeltown, Yorkshire. Eng. Pat. 4378, March 1, 1894.

The steel to be used is heated, before cutting, in a closed vessel containing coke, charcoal, or other carbonaceous matter, alongside, but not in contact with it, so as to produce a non-oxidising atmosphere. By this means the steel (even Bessemer steel) is uniformly softened, it is stated, and, after the oven is allowed to cool, the steel withdrawn is said to require but very slight grinding to render it fit for the cutting of the teeth in the usual way.—J. H. C.

*Improvements in and Apparatus for or connected with Puddling Raw, Cast, or Pig Iron.* E. Bonehill, Marchiennes, Belgium. Eng. Pat. 6743, April 4, 1894.

The metal is tapped from the blast-furnace into a reservoir in which the temperature is maintained by the combustion of a small supply of gas. Hence it may be discharged, still liquid, into the hearth of any of four puddling furnaces, constructed around the reservoir, but at a lower level. The puddling furnaces are fired by waste gases from the blast-furnace, mixed with a small proportion of producer gas, and ignited in admixture with a controlled supply of hot air from the blast-furnace, in a combustion chamber placed at the fire-bridge end of the hearth, and separated from it by brick baffles. The waste gases from puddling are finally passed under boilers. Many economies, and the production of a higher grade of iron, are claimed for this process.

—W. G. M.

*A New or Improved Solder for Soldering Aluminium and Alloys of Aluminium.* S. Taylor, Birmingham. Eng. Pat. 7380, April 13, 1894.

The solder is composed of 12 parts of silver, 4 parts of copper, 4 parts of aluminium, 8 parts of zinc, 12 parts of lead, and 60 parts of tin. The lead may be replaced wholly or in part by cadmium. In preparing the solder, the silver is melted in a crucible, preferably of plumbago, and the copper is added and stirred for one minute with a steel rod. The remaining constituents are then added, together or separately, in the order mentioned above, and the alloy is thoroughly stirred. The melted solder is then poured into greased, or whitened ingot moulds, after which it may be sawn into sticks or granulated for use as required.

—J. H. C.

*Improvements in Precipitating Precious Metals from Cyanide or similar Solutions.* J. S. MacArthur, Pollokshields, N.B. Eng. Pat. 8181, April 25, 1894.

In precipitating gold and silver by means of zinc from cyanide solutions, which contain practically no other metal, finely-divided or shot lead, mixed with the zinc, is found to facilitate the precipitation and to economise zinc; in this case both metals receive deposits. When copper is present in the solutions a spongy deposit of lead upon the zinc, produced by a short immersion in a solution of lead salt, is found to prevent the formation of that continuous dense deposit of copper upon the zinc, which is known to impede its reducing action upon the solution. Immersion for one minute in a 1 per cent. solution of lead acetate suffices When mercury is present in the cyanide solution it should be removed by means of metallic lead (shot); some silver is thus precipitated with the mercury, but the remainder of the silver and the gold are then obtained without inconvenience.—W. G. M.

*Improvements in or relating to the Treatment of Ores for the Extraction of Metals therefrom.* H. L. Sulman, London. Eng. Pat. 8405, April 27, 1894.

The slimes produced in the process of crushing, are coagulated by means of gelatin, followed by tannic acid or a suitable metallic salt, or by the addition of a lime-soap (or its components), followed by treatment with cream of lime to act as a precipitant.—J. H. C.

*Improvements in the Manufacture and Production of Alloys of Copper and Manganese.* J. Brock, Widnes, and J. F. Allen, Manchester. Eng. Pat. 8712, May 2, 1894.

Finely-divided ferro-manganese and copper, mixed in the proportion of about three to one, are fused with about 10 per cent. of sodium carbonate and 5 per cent. of borax and common salt, and the temperature is so regulated that the manganese-copper alloy alone fuses, being practically free from iron, which remains in an unfused scoria.—W. G. M.

*Method and Apparatus for the Production of Metals and other Fusible Materials in Pulverulent Form.* C. D. Abel, London. From the Elektricitäts-Gesellschaft Gelnhausen, mit beschränkter Haftung, Gelnhausen, Prussia. Eng. Pat. 24,278, December 13, 1894.

The metal is conveyed in a fused and superheated condition from the vessel in which it is melted, to a nozzle so arranged that a jet of steam or gas from a surrounding tube, or from a set of small tubes, impinges upon the stream of metal as it issues from a narrow orifice, and by meeting it at an angle breaks it up into a fine spray. If the fusing point of the metal be low, the material may be conveniently heated by a row of gas jets below the vessel, which also serve to superheat the steam used for spraying. The nozzle may also be heated to prevent chilling of the metal.—W. G. M.

*A Process and Apparatus for separating the Metals and other Ingredients from Blendes.* M. A. J. Roux and J. M. A. Desmazures, Paris. Eng. Pat. 1322, January 19, 1895.

The pulverised blende, mixed with litharge, is heated, air being excluded, and the separated argentiferous lead is drawn off from time to time. The residue is then heated to fusion with blast-furnace slag as a flux, and steam, air, or oxidising gas is blown through the liquid to separate the zinc oxide, which collects in the upper part of the vessel and is removed at intervals. The litharge used must be in slight excess over that necessary to oxidise most of the blende, leaving sufficient lead oxide unreduced to form a fluid, separating layer between the lead and the zinc oxide. The lead oxide left in the crucible serves to treat another portion of blende, but after several operations must be partially reduced by the addition of carbonaceous matter; in course of time the residue becomes ineffective, and the lead is then completely reduced by treatment with carbonaceous matter, at a temperature below that at which zinc oxide becomes acted upon. One vessel suffices for the whole cycle of operations. It should have a tap-hole at the lowest point, and may be advantageously provided with a removable hollow cover, fitting into an annular trough which forms a sand seal. The space within the cover is connected at the upper part with a blast pipe, and at the lower with a series of narrow tubes dipping nearly to the bottom of the vessel. Through the cover pass larger tubes, which serve to convey the fumes of lead sulphate and sulphur dioxide, first to depositing chambers, and then, if desired, to lead chambers of sulphuric acid works.—W. G. M.

*Improvements in Appliances for Use with Crucibles or Melting Pots during the Melting of Metals and Metallic Alloys in the said Crucible or Pots.* S. Taylor, Birmingham. Eng. Pat. 1889, January 26, 1895.

A flanged cover with a concentric tubulure is luted on to the crucible. The tubulure, which may be several inches in diameter, is closed, while in the furnace, with a smaller cover that may be removed for purposes of inspection; or a long flanged pipe may be fitted over the tubulure and brought through a hole in the furnace-cover, and there closed with a lid. Through this tube, the progress of the fusion may be observed, or additions may be made to the charge in the pot, without opening the furnace or admitting furnace gases into the crucible. The contents of the crucible are thus melted without danger of being rendered impure. The process is especially suitable for treating aluminium and its alloys.—W. G. M.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*Reduction of Alumina by Carbon.* H. Moissan. Comptes rend. 1894, **119**, 935—937.

Alumina has hitherto been regarded as unreducible, but the author shows that when crystals of corundum are heated in a carbon tube in the electric furnace, metallic aluminium is obtained. At the high temperature of the electric furnace, produced by a current of 1,200 ampères at a pressure of 80 volts, the vapour of carbon is able to reduce the vapour of alumina. In another experiment 100 grms. of alumina were placed in a carbon tube (400 mm. long by 40 mm. internal diameter) closed at one end, and so arranged in the furnace that the closed end was raised to the highest temperature. On passing a current of 300 ampères at 65 volts for 15 minutes, vapours were given off at the open end of the tube, which condensed on cold bodies and proved, on examination, to be minute spheres of fused alumina. After cooling, the carbon tube was found to contain a white deposit of alumina together with an ingot of alumina, whilst that portion of the tube which had been raised to the highest temperature contained a skin of graphite formed by the condensation of the vapour of carbon. On the walls of the tube were found small white or yellowish globules, consisting of a mixture of aluminium and its carbide.

Starch, which supplies the carbon necessary for the reduction, may with advantage be mixed with the alumina before heating.

Alumina may be melted in a carbon crucible without any reduction taking place, and it is only when the temperature is raised sufficiently high to vaporise both the alumina and the carbon that reduction is possible.—J. S.

*A Peculiar Case of Metallic Deposition.* J. B. Senderens. Bull Soc. Chim. 1894, **11** [24], 1163—1164.

When a bar of lead is placed in a neutral solution of lead nitrate at ordinary temperatures, particles of metallic lead are deposited on the surface of the bar, and the bar also gradually becomes coated with a thin layer of basic nitrates and nitrosonitrates of lead. No similar action occurs with the acetate. This deposition is due to the different physical condition of the outer skin and main portion of the lead, and the production of a galvanic current between the crystalline lead in the interior of the bar and the smooth tempered outer layer. If a portion of a bar is used the action is much more rapid, owing to the two elements of the couple coming more freely in contact with the solution. —L. T. T.

*Preparation of Crystallised Calcium Carbide in the Electric Furnace, its Properties and Reactions.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1002—1007.

*See under* II., *page* 352.

*Crystalline Acetylene Compounds of Barium, Strontium, and the Alkalis.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1007.

*See under* II., *page* 353.

*Crystallised Aluminium Carbide.* H. Moissan. Bull. Soc. Chim. 1894, **11**, 1010.

*See under* II., *page* 353.

### PATENTS.

*Improvements in or connected with so-called "Dry" Electrolytes for Secondary Batteries.* V. C. Doubleday, London. From M. Süssmann, Neuruppin, Germany. Eng. Pat. 22,053, November 17, 1893.

This invention consists in the addition to the ordinary dilute sulphuric acid electrolyte of a cellulose powder made as follows:—Paper pulp, preferably prepared from filtering paper, is boiled in dilute sulphuric acid, and thoroughly washed; it is next boiled in dilute caustic potash, and again thoroughly washed; and it is finally boiled in alcohol, after which it forms a fine powder when dry.—G. H. R.

*Improved Means for Extracting Metals from their Ores.* W. Perkins, London. Eng. Pat. 5934, March 21, 1894.

A weak solution of cyanide of potassium is employed in the crushing process instead of water, the pulp from which is conducted into a tank furnished with a conical agitator built up of or covered with carbon plates. At the bottom of the tank is a bath of mercury. The cone agitator is connected with a battery or dynamo so that the carbon forms the anode of an electric circuit, the mercury being connected also so as to form the cathode. The apparatus being set in motion, the metal is gradually dissolved in the electrolyte and absorbed by the mercury, thus forming an amalgam, which can be drawn off at intervals and distilled in the usual way.

Tip-waggons furnished with filtering bottoms are provided to receive the exhausted pulp, and the solution separating from it is employed over again in the crushing apparatus.—J. H. C.

*A Process for Protecting Iron Pipes from Corrosion by Passage of Electrolysed Chloride Solutions employed as Disinfectants.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 6495, March 31, 1894.

*See under* XVIII. C., *page* 381.

*Improvements in Secondary Voltaic Batteries.* E. J. Clubbe and A. W. Southey, London. Eng. Pat. 7165, April 10, 1894.

In this cell, which is an improvement on that described in Eng. Pat. 10,765, 1893, the positive and negative elements are placed in perforated trays composed of some insulating material, and are superposed and kept in position on one another within an outer covering by means of corner pieces to hold them the proper distance apart, the whole being clamped together by rods of ebonite. The perforations, which are put as closely together as possible, are preferably not more than half an inch apart.—G. H. R.

*Improvements in or relating to Electrolytical Apparatus.* C. Kellner, Salzburg, Austria. Eng. Pat. 7801, April 19, 1894.

According to this improvement, the material employed for the diaphragm is characterised by having a feeble affinity for the hydroxide of the alkali formed during the electrolytic process in which it is used, and consequently of retaining the alkali only in feeble chemical combination, so that the diffusion of the hydroxide into the anode space is rendered difficult. Soap, either with or without a support, is used for the construction of the improved diaphragm, as it is claimed that this material fulfils the above requirements. The soap preferably contains the same alkali as the salt to be decomposed.—G. H. R.

*An Improvement in the Electro Deposition of Heavy Metals with a Base Metal Alloy.* W. A. Thoms and W. H. Burgum, London. Eng. Pat. 7853, April 20, 1894.

According to this invention, alloys of heavy metals, such as iridium, platinum, palladium, and the like, with a base metal, such as tin, cadmium, zinc, &c , may be deposited in a white hard reguline condition. As an instance of the method the following bath may be cited:—1 oz. metallic platinum is converted into chloride, and to this is added 2 oz. of a saturated solution of sodium or potassium hydrate. To 1 oz. of metallic tin converted into chloride, and 3 oz. of a saturated solution of sodium or potassium hydrate, is added, when cold, a solution of 40 oz. phosphate of soda dissolved in hot water. The two solutions thus formed are well mixed, 8 oz. potassium cyanide are added, and water to make up to two gallons. The bath is heated to 150° to 200° F. for two or three hours, and then allowed to cool to 80° F., which is the best working temperature.—G. H. R.

*An Improved Electrolytic Trough or Cell.* E. de Pass, London. From H. Thofehrn, Paris. Eng. Pat. 7994, April 23, 1894.

The improved electrolytic vessel is closed with a lid, through which the anodes pass in gas-tight joints, so as to compel the gases evolved to mix in the electrolyte; while the cathode is arranged in concentric rings at the bottom of the vessel. Tubes are provided for the admission of the solution, and the withdrawal of the products of electrolysis, and under the inlet tube is placed an inclined screen or shield, so arranged that the amount of gas rising to the upper part of the vessel can be regulated.—G. H. R.

*Improvements in and relating to Galvanic Batteries.* T. H. Rushton, Great Grimsby. Eng. Pat. 8480, April 28, 1894.

Each zinc plate is supported on pins or pivots at its top edge, which are just above the surface of the liquid. The plate is most fully immersed if allowed to hang freely, but if turned on the pins till in a horizontal plane it is quite above the surface of the liquid. It can be immersed to varying amounts by being placed in intermediate positions.

All the zincs of any one cell may be operated together by providing each with a crank attached to one of its pins, and connecting all the cranks by a rod moving horizontally at the side of the cell.

The pins rest in notches in the walls of the containing vessels, so that any zinc can be easily removed.

The negative electrodes are preferably placed in an inclined position.—E. T.

*Improvements in Method and Apparatus for Purifying Liquids Magnetically, to which may be added Electrolysis and Aëration.* J. T. Harris, New York, U.S.A. Eng. Pat. 24,639, December 18, 1894.

The apparatus consists of a tank in which the liquid to be treated is made to pass between the pole pieces of magnets, whereby it is claimed that the diamagnetic substances are repelled, and caused to settle, whilst those which are paramagnetic are attracted by the magnets. The liquid may be subjected to electrolysis to assist the action, and aëration may also be employed.—G. H. R.

*Improvements in Method of and Apparatus for Separating Metals.* B. Mœbius, New York, U.S.A. Eng. Pat. 469, January 8, 1895.

Between two rollers placed horizontally beneath the surface of the electrolyte, is stretched an endless band of silver sheet, which is kept in constant movement by turning the rollers. Horizontal trays, having porous bottoms, are placed just above the horizontal top surface of the silver band, and contain the bullion to be treated. This bullion is made anode, and the silver band cathode. A second endless band of rubber cloth, canvas, or other material is stretched between a roller beneath the liquid and another placed above it and beyond the end of the bath; when both bands are in movement the last presses on the silver where it passes round one roller, and rubbing off the loose crystalline deposit, carries it beyond the tank and deposits it in a special receptacle. A strong bath of sodium or potassium nitrate is preferred, with sufficient acid to keep some silver and all the copper in solution. A current of small electromotive force is used; the silver collected is ready for the melting pot; the gold, platinum, and lead remaining in the porous trays. The movement of the cathode and its constant cleaning by friction with the rubber band, prevent crystalline growths and consequent short-circuiting.—E. T.

*Process for Compressing and Moulding Electrolytically-obtained Metallic Precipitates.* I. Klein, Budapest, Hungary. Eng. Pat. 563, January 9, 1895.

This patent relates to cylindrical or tubular deposits upon cores which have been coated with some easily fusible material—such as lead or its alloys, or wax—and turned to the desired size and design. While deposition is going on, the cores with their deposit are being constantly rolled under pressure on a plate or cylinder planed or turned to fit such cores. In the specification, numerous methods are described for supporting the cores with their deposits and the plates or cylinders on which they roll; and a device is described for depositing in the interior of a tube and at the same time rolling such deposit.—E. T.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Use of Unsaponifiable Oils for Greasing Wool.* Leipziger Monatschrift f. Textilind. and Färberzeit. Dingler's Polyt. J. 294 [2], 44—45.

*See under V., page 362.*

*Tests for Vegetable Waxes.* Bayerisches Ind. und Gewerbebl. 25, 21.

*See under XXIII., page 390.*

*The Oil from the Seed of Hyoscyamus Niger.* H. Schwanert. Arch. der Pharm. 232, 130.

*See under XX., page 382.*

### PATENTS.

*Improvements in the Separation of Wool-wax from Wool-fat and in the Preparation of Lanoline from the more Fluid Residue.* B. Jaffé and L. Darmstaedter, Charlottenburg, Germany. Eng. Pat. 14,114, August 4, 1892.

See this Journal, 1892, 928. In the patent as now amended (January 8, 1895) all words in the above title after "Woolfat" are omitted, and the original four claims are now cut down to the following single claim :—" The division of raw or cleaned woolfat into harder or softer components by solution of the woolfat in fusel oil, separation of the harder woolwax by cooling the solution below the temperature of the melting point of woolfat, and recovery of the softer matters by evaporation of the solvent."—W. S.

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*Improvements in Purifying Liquids and Fats, and Apparatus therefor.* R. Andrew, London. Eng. Pat. 4622, March 5, 1894.

This relates to the purification of liquids, oils, and fats by aërating them alternately with hot and cold air. Two jacketed cylinders, connected with each other at the bottom, are employed, on the top of each of which an air exhauster is fixed. The liquid is placed in the first cylinder, or "heating vessel," the jacket of which is supplied with hot water or steam, and hot air is drawn through the liquid by means of the exhauster; when the heated liquid has been sufficiently treated, it is run into the second cylinder, which is cooled with water in the jacket, and a current of cold air is drawn through the liquid until the purification is complete.—J. J. K.

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*A Process and Apparatus for Oxidising Drying Oils.* F. Walton, London. Eng. Pat. 7126, April 10, 1894.

The object of this invention is to effect a saving of time and labour in the oxidation of drying oil by submitting it in a minutely subdivided condition to the action of oxygen. The oil is mixed with a small proportion of driers, heated to 50° C., and allowed to descend in the form of a shower into a jacketed cylinder (provided with an agitator). Air is blown in, during which the oil becomes viscid, and runs into a tank, from which it is pumped up again, and the operation is repeated until the oil is too viscid to flow. It is then mixed with about 5 per cent. of whiting, put into the cylinder, and subjected again to the beating and breaking action of the revolving arms, the temperature being prevented from rising above 55° C. by causing cold water to circulate through the jacket. As soon as the oil is converted into a thick paste, it is run into shallow trays to cool and set. These trays are placed in a drying oven, and kept at a temperature of 40° C., until the mass attains a dry spongy condition, when it is passed through a machine containing a spiked roller and a serrated bar to break it up into a granulated condition.—J. J. K.

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*Improvements in Soap.* J. H. Iredale and J. W. W. Huddleston, Liverpool. Eng. Pat. 8022, April 23, 1894.

The object of this invention is to produce an ammoniacal soda-soap from which the ammonia is not evolved until the soap comes in contact with water. A mixture of 7 parts of ordinary soap, 7 parts of ammonia-soda ash, and 56 parts of soda crystals, is ground and sifted. A finely-ground mixture of 30 parts of ammonia-soda ash, 10 parts of soap, and 2 parts of ammonium sulphate, is then thoroughly incorporated with it, and the whole pressed into cakes or used as a powder.—J. J. K.

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*Improvements in or relating to Cleansing or Washing Agents.* A. Gross, Szederjes Siebenbürgen. Eng. Pat. 13,853, July 18, 1894.

This relates to the production of an inodorous cleansing material. Petroleum ether is added to a solution of soda-soap in the proportion of 120 grms. per kilo. of soap, and 32 grms. of vinegar essence are then added to neutralise the free alkali, also finely-powdered stearin, and the mixture is heated and stirred for half an hour, when it is poured into moulds. The stearin assists the drying and solidifying, and imparts a fine and regular gloss during the ironing process. The washed articles are said to be absolutely inodorous.—J. J. K.

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*Improvements in the Process of Refining and Improving Butter, Lard, Oils, and other Fatty Matters.* B. J. B. Mills, London. From J. H. Campbell and C. H. Campbell, New York, U.S.A. Eng. Pat. 15,086, August 7, 1894.

This relates more particularly to the treatment of rancid butter, containing albuminoid substances, which support living organisms, rendering the butter unfit for food. The object of the process is to remove these albuminoid substances. The butter is first washed from salt and other matters, heated in a steam-jacketed pan, and air is blown through it to expel all the moisture; by this means the albuminoid matters are converted into solid substances, which are separated from the butter by showering with water and settling, or by filtration. A preferable method is to maintain a vacuum of 26 inches in the pan, the temperature of which may be 120° F. or lower, which effects the same object, and prevents volatilisation of the oils. When the butter-oil is rendered sweet, about half its weight of sweet milk at 90° F. is added, and air blown in until the mass is like a thick cream, then the same weight of sour milk or buttermilk is added, and the mixture treated again with air. The mixture is run into a tank containing ice-cold water, when it is changed from the liquid to the solid state. After draining, the purified butter is churned in the usual way.
—J. J. K.

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## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (A.)—PIGMENTS, PAINTS.

*Chromates of Iron.* C. Lepierre. Bull. Soc. Chim. 1894, 1115—1128.

The author has prepared a number of hydrated double chromates (potassium ferric chromates) by mixing saturated solutions of ferrous sulphate or ferric chloride and neutral potassium chromate, or of ferric chloride and potassium dichromate at a temperature of 3° or 4° C. For example, by precipitating a saturated solution of ferrous sulphate with an excess of neutral potassium chromate, a yellowish-brown finely crystalline precipitate is obtained which is filtered off, pressed, and washed rapidly with iced water, alcohol, and ether. It consists of $4CrO_3 . 3Fe_2O_3 . 4K_2O$ or $3Fe_2O_3 . 4K_2CrO_4$. That it is a chemical compound or lake of definite composition, and not merely a mixture, the author thinks is established by the mode of purification, by the fact that when air-dried it retains water of crystallisation equal to $20H_2O$, and by other considerations. A compound of this or very similar composition, has long been used in porcelain painting to obtain browns. Details are given of the preparation of nine other compounds containing different proportions of $CrO_3$, $Fe_2O_3$, $K_2O$, $H_2O$, and all of them are likely to be useful in ceramic art or for tin glaze. For the analysis of these bodies the author employs the method proposed by A. Carnot (*cf.* this Journal, 1889, 138). The double chromate is dissolved in very dilute hydrochloric acid and an excess of ammonia added, precipitating ferric hydrate, which is filtered off, washed, and calcined. The fact that the oxide so obtained on fusion with nitre always proves to be free from chromium, shows that dilute hydrochloric acid does not reduce chromic acid. The wash-waters concentrated, contain chromic acid or chromate;

reduction is effected by alcohol and hydrochloric acid, or better by hydrogen peroxide in acid solution. Chromic hydrate is then precipitated by the addition of ammonia, together with a little sulphuretted hydrogen, if hydrogen peroxide has been used, and the filtrate then contains the potassium as chloride. The author draws attention to an error occurring in a note to a translation of a memoir by Fresenius (Bull. Soc. Chim. 1894, 308), where it is stated that after removing barium from the other alkaline earths by means of chromate, it is necessary to remove the excess of chromium, and that this may be done by adding ammonia, filtering, and adding alkaline carbonate to the filtrate. But in a dilute solution of salts of strontium and calcium the addition of alkaline chromate causes no precipitation, and the subsequent addition of ammonia and ammonium carbonate precipitates carbonates, and not chromates. Even, then, admitting that the presence of chromium is objectionable, which it is not, its removal would not be accomplished by the means proposed.—T. A. L.

### *The Composition of Antimony Red.* H. Baubigny. Comptes rend. 1894, **119**, 687—690.

The scarlet-red precipitate formed when sodium thiosulphate is added to a solution (either hot or cold) of tartar emetic containing free tartaric acid, consists of antimony trisulphide, $Sb_2S_3$. No oxysulphide is produced under these conditions, as has been stated to be the case by Wagner. Similarly, the precipitate thrown down from a solution of antimony trichloride in absence of tartaric acid, even if it contain oxygen, contains that oxygen only in the form of admixed oxychloride.—H. T. P.

### *Influence of Temperature on the Transformation of Amorphous Zinc Sulphide into the Crystalline Variety.* M. A. Villiers. Comptes rend. 1895, **120**, 149—151.

A transformation of amorphous zinc sulphide into the crystalline variety is dependent to a large extent on temperature, although no definite point of transformation can be assigned to the change, time also being a factor.

The author treated an alkaline solution of zinc oxide, containing the least possible excess of alkali, with sulphuretted hydrogen in the cold, avoiding the re-solution of the resulting zinc sulphide. The amorphous sulphide produced in this manner was heated on the water-bath for about a minute while suspended in its mother-liquor. At temperatures ranging from 100° C. to 70° C. the zinc sulphide became crystalline, and was then found to be insoluble in excess of sulphuretted hydrogen. The rate of transformation is rapid at these temperatures, but is much retarded as the temperature falls. Thus, at about 30° C. one-half of the sulphide remains amorphous after three hours. This time is extended to 17 hours when the temperature is still lower, *e.g.*, 15—20. Between 10° and 15° C. the change appears to be completely arrested, and between 0° and 10°, even as long a period as 10 days and the presence of a small quantity of the crystalline sulphide which itself tends to aid the change, fails to effect the transformation. It is stated that the acceleration of the change by the presence of pre-formed crystalline sulphide can be proved by sprinkling crystalline zinc sulphide on a layer of the amorphous sulphide at such a temperature as allows the change to go on spontaneously. Under these conditions transformation takes place in successive strata, the non-crystalline layers being easily distinguished on account of their greater opacity.—B. B.

## PATENTS.

### *Improvements in the Manufacture of Oxides of Lead and Apparatus therefor.* S. Z. de Ferranti, London, and J. H. Noad, East Ham. Eng. Pat. 3372, February 16, 1894.

*See under X., page 369.*

### *An Improved Zinc Plate for Lithographic Printing Purposes.* E. T. Beal, Hull. Eng. Pat. 4779, March 7, 1894.

Lime or calcium chloride is dissolved in water. To the solution alum is added and the mixture stirred to the consistency of a thick creamy paste. Water, nitrous acid, and finally zinc sulphate are successively added with further stirring. In the solution thus prepared a sheet of zinc is steeped for a few minutes, then rinsed with water, and the greyish-black film removed with a sponge or brush. The plate may now be employed with advantage as a substitute for the ordinary lithographic stone.—R. B. B.

### *A New or Improved Paint for Coating Ships' Bottoms, Railway Waggons, Piers, and the Like.* J. E. Williams, Manchester. Eng. Pat. 6002, March 22, 1894.

One lb. of india-rubber "previously masticated" is passed between rollers to render it non-elastic, all the pigments required in the finished paint being added during the operation. It is then dissolved in 20 lb. of turpentine or similar liquid, 12 lb. of copal in the form of varnish, and 2 per cent. of boiled oil being ground in to complete the composition. The claim is for the use of india-rubber, treated as specified, and united with the ingredients mentioned, for producing an "anti-salt paint."—F. H. L.

### *Improvements in Printing and Blocking in Metallic Colours and in Inks for Use therein.* G. Priestley and E. Swann, Nottingham. Eng. Pat. 955, January 15, 1895.

In printing with gold, silver, and other metallic colours, three operations have hitherto been necessary, viz. : (1) printing with an adhesive liquid preparation; (2) applying metallic foil or powder; (3) dusting off the superfluous foil or powder. The present improvement consists in using an ink composed of metallic powder mixed with one-third of its weight of some kind of grease, such as lard, from which all the water has been removed. The mixture is then brought to the consistency of a stiff paste or ink, suitable for inking rollers, with gold size and varnish. The printing is performed with this ink at one operation.—R. B. B.

## (*B.*)—RESINS, VARNISHES.

### *A New Process for Obtaining Turpentine.* Chem. and Druggist, **46**, 1895, 481.

J. C. Schuler, originally of Lanier, in Georgia, has established a camp about 18 miles north of Lake Charles, in Louisiana, to put into practice a new method for tapping pine trees, discovered by him. Schuler states that he began the study of tapping the pine-tree 24 years ago, because he realised that the old-fashioned system of cutting "boxes" 4 ins. deep into the trees would result in the extermination of the forests. The result of Schuler's experiments is his present method of "facing," in which he uses glazed earthenware cups, whereby the life of the tree is preserved. By the cup process the yield is about one-fourth more than by the old method, with no loss from dipping, which in the old system is considerable. Moreover, by the cup process, the crude gum will turn out one-fifth more spirit and rosin of a better grade than could otherwise be realised. As a rule turpentine producers of the old school distil 100 galls. of spirits from 500 galls. of crude, with a residue of 10 "weight" barrels of rosin; while from the same amount of crude which has been collected in cups 125 galls. of spirits and 14 "weight" barrels of rosin may be realised. This difference is mostly due to evaporation in the boxes and a consequent partial crystallisation. In the cup Schuler places a little water, which, being lighter than the rosin, covers it and prevents the evaporation which would otherwise ensue; moreover, dippings from cups contain no chips or bark.

### *Galbanum Resin (Peucedanum Galbanifluum).*
A. Conrady. Arch. d. Pharm. **232**, 98.

The author has re-examined this gum. It consists of about 9·5 per cent. of an essence, 63·5 per cent. of resin, and 27 per cent. of gum and impurities. The essence is borneol isovalerate. The resin is a white powder, melting at 48—50° C. It is decomposed by dilute sulphuric acid into *galbaresinotannol*, $C_{18}H_{30}O_3$, and umbelliferone. Galbaresinotannol forms a yellow powder, soluble in alcohol, potash, and a concentrated solution of sodium salicylate, almost insoluble in ether, chloroform, and ammonia. It forms derivatives with potash and baryta. The *acetate* is a yellowish amorphous powder, melting at 61°, *the benzoate* is a similar powder, melting at 73°. Iodine and bromine yield mixtures of iodised or otherwise brominated derivatives. When dry-distilled, it yields a hydrocarbon, having the odour of cymene and boiling at 125°—130° C., and a bluish-green liquid, boiling at 250°—265°.—L. T. T.

### *Laccase, and the Oxidising Action of this Diastase.*
G. Bertrand. Comptes rend. **120**, 266—269.

In a former paper on the latex of the lacquer tree (Comptes rend. **118**, 1215; this Journal, 1894, 1071), the author showed that the formation of the black varnish from the colourless exudation did not wholly depend upon the contact of the laccol therein with oxygen, but was assisted by a diastatic ferment which he called laccase. He has now investigated the action of laccase on quinol (hydroquinone) and pyrogallol and finds that these substances are much more rapidly oxidised in presence of this ferment. At the same time a considerable amount of carbon dioxide is liberated. Laccase is also found in several other plants, more especially in those containing oxidisable phenols (gallic acid, tannin), and its existence as an oxidising diastase is well established.—T. A. L.

## PATENTS.

### *New or Improved Composition for Varnishing or Polishing.*
J. S. Macarthur, Glasgow. Eng. Pat. 4505, March 3, 1894.

The essential part of this invention consists in the addition of 5 or 10 per cent. of castor oil to any ordinary varnish of shellac and other resins, in methylated spirit, to keep it elastic. It may be dyed any desired colour, and is claimed to be specially adapted for "chip" hats or bonnets.
—F. H. L.

### *Improvements in the Manufacture of Compositions suitable for Use in Printing and Embellishing Textile, Felted, and other Material.*
S. H. Sharp, Leeds. Eng. Pat. 21,607, November 9, 1894.

This composition, which is to be used with stencil plates, consists of equal parts of lithographic varnish and gold size, the pigment being bronze powder, aluminium powder, or "aniline bronze powder," according to the desired colour of the design. It is applied under mechanical pressure.—F. H. L.

### *An Improved Preparation or Material for Lacquering or Covering Purposes.*
D. Marcus, London. Eng. Pat. 23,821, December 7, 1894.

The lacquer described in Eng. Pat. 11,029, 1892 (this Journal, 1893, 530), is improved by the addition to every 100 parts of it, of 10 to 25 parts of spirit or oil of camphor. Should its drying power still prove deficient, 2 to 5 parts of a 5 per cent. solution of potassium permanganate in camphor oil may be mixed in; and zinc oxide can be employed, if desired, to increase its "body."—F. H. L.

## XV.—MANURES, Etc.

### *Agricultural Value of Aluminium Phosphate from Grand-Connétable.*
A. Andouard. Comptes rend. **120**, 337—339.

The author has grown balsamine, flax, white mustard, and buckwheat in an artificial soil in order to compare the action of the various calcium phosphates from Algeria, the Ardennes, Carentan, Carolina, Florida, and la Somme with the phosphate of alumina from Grand-Connétable. In all cases the development of the plants has been much more rapid and complete with the aluminium phosphate, and in the case of balsamine, of which a complete series of analyses is given, the assimilation of nitrogen and phosphoric acid is far greater than when manured with any other phosphate.
—T. A. L.

## XVI.—SUGAR, STARCH, GUM, Etc.

### *The Quality of the Flowering Sugar-Cane.*
Prinsen Geerligs. Sugar-Cane, 1895, **27**, 76.

In consequence of the altered conditions of planting in Java the number of flowering canes has increased. The author shows that the quality of the cane is not thereby damaged; but because such canes die sooner they must be harvested earlier. This is not always possible in practice, in which case appreciable losses occur.—J. L. B.

### *Yields of a Russian Sugar Refinery.*
Weisberg. Journ. fabr. Sucr. 1894, **35**, 48.

According to the views of Sachs hardly any losses should occur in the refining of "crystal sugar" as commonly practised in Russia; moreover a yield of over 100 per cent. is shown to be possible. Nevertheless, a Dutch factory has applied to the Imperial Technical Society at Kief and obtained the following information:—The crystal sugar contains on an average 99·65 per cent. of sugar, 0·073 per cent. of ash, 0·277 per cent. of water and organic matter; on refining, the yield amounted to 100·29 per cent. of sugar (gross) and 2·282 per cent. of molasses. The 100·29 per cent. consists of 96·958 per cent. of nett sugar, 3·05 per cent. of paper wrappings, and 0·282 per cent. of packing thread; whilst the 2·282 per cent. of molasses contains 48·2 per cent. of sugar, 17 per cent. of invert sugar, 4·5 per cent. of ash, and 30·3 per cent. of water and organic matter. 100 parts of crystal sugar should accordingly yield 96·958 per cent. of refined sugar; and, besides 1·0999 per cent. of sugar present in the molasses, 1·592 per cent. is lost—an amount which is worthy of consideration.—J. L. B.

### *The Volume of the Cell Substance of Beetroots.*
Krocker. Zeits. f. Zuckerind. 1894, **44**, 958.

The experiments which the author has carried out show that the cell cuticle in an aqueous sugar solution contains water in a coloid condition. This phenomenon will not account for the high polarisation of aqueous extracts of beet-pulp when compared with extracts obtained by alcoholic digestion, and the author concludes it is due to the presence of organic substances not precipitable by lead acetate.

Beetroot pith exhibits a certain absorptive power towards alcoholic sugar solutions, which is perhaps comparable with that of animal charcoal, and thereby lowers the polarisation.
—J. L. B.

### *Temperature of Maximum Density and the Freezing Points of Cane Sugar Solutions.*

L. C. de Coppet. Ann. Chim. Phys. [7], **3**, 268—274.

The author has obtained the following numbers :—

| Weight of Sugar per 100 Grms. $H_2O$ | Temperature of Maximum Density. | Freezing Point. |
|---|---|---|
| | ° C. | |
| 0·344 | 3·84 | .. |
| 0·344 | 3·835 | .. |
| 0·681 | 3·71 | − 0·041 |
| 1·366 | 3·33 | − 0·081 |
| 2·056 | 3·025 | − 0·122 |
| 2·736 | 2·72 | − 0·160 |
| 3·420 | 2·385 | − 0·199 |
| 4·081 | 2·06 | − 0·237 |
| 4·733 | 1·74 | − 0·277 |
| 5·562 | 1·32 | − 0·326 |
| 6·099 | 1·14 | − 0·358 |
| 6·182 | 1·035 | − 0·360 |
| 7·516 | 0·41 | − 0·439 |
| 8·245 | 0·08 | − 0·477 |
| 8·867 | − 0·17 | − 0·513 |
| 9·543 | − 0·50 | − 0·549 |
| 10·100 | − 0·825 | − 0·576 |
| 10·998 | − 1·25 | − 0·627 |
| 11·565 | − 1·425 | − 0·664 |

The lowering of the temperature of maximum density is in all cases approximately eight times the lowering of the freezing point.

With more concentrated solutions the lowering of the freezing point is as follows :—

| Per Cent. of Sugar in Solution. | Freezing Point. |
|---|---|
| | ° C. |
| 15·005 | − 0·849 |
| 28·501 | − 1·599 |
| 40·106 | − 2·486 |
| 58·842 | − 3·407 |
| 65·37 | − 4·40 |
| 79·78 | − 5·63 |
| 105·72 | − 7·83 |
| 146·83 | −11·81 |

—H. I.

### *Filtration of Cane-Sugar Juice during Evaporation.*

Philippe. J. des fabr. Sucr. 1894, **35**, 48.

The author claims that it is possible to filter the juice continuously, without the aid of a pump, from the second into the third chamber of a triple-effect evaporating apparatus, by simply making use of a mechanical filter, which can be inserted or removed without disturbing the operation. The incrustation in the third chamber is thus completely obviated, and the purity of the juice is appreciably raised.

—J. L. B.

### *Solubility of Cane Sugar in Mixtures of Alcohol and Water.*

Schrefeld. Zeits. f. Zuckerind. 1894, **44**, 971.

The following observations were taken at 14° C. :—

| Per Cent. by Weight of Alcohol. | Per Cent. of Sugar. | Grms. of Sugar Dissolved in 100 c.cs. of the Mixture of Alcohol and Water. |
|---|---|---|
| 0 | 66·20 | 195·8 |
| 5 | 64·25 | 179·7 |
| 10 | 62·20 | 164·5 |
| 15 | 60·40 | 152·5 |
| 20 | 58·55 | 141·2 |
| 25 | 56·20 | 128·3 |
| 30 | 54·05 | 117·8 |
| 35 | 51·25 | 105·3 |
| 40 | 47·75 | 91·3 |
| 45 | 43·40 | 76·6 |
| 50 | 38·55 | 62·7 |
| 55 | 32·80 | 48·8 |
| 60 | 26·70 | 36·4 |
| 65 | 19·50 | 24·2 |
| 70 | 12·25 | 13·9 |
| 75 | 7·29 | 7·7 |
| 80 | 4·05 | 4·2 |
| 85 | 2·10 | 2·1 |
| 90 | 0·95 | 0·09 |
| 95 | 0·15 | 0·01 |
| 100 | 0·00 | 0·00 |

—J. L. B.

### *The "Rendement" employed in the Purchase of Raw Sugar.*

Broz. Böhm. Zeits. Zuckerind. 1895, **19**, 264.

The author points out that the new "*rendement*" generally employed in Germany, namely, polarisation—total non-sugar × 2·5, expresses the quality of raw sugar more correctly than the so-called "*ash rendement*" (polarisation − ash × 5); and, moreover, that its introduction is desirable in Austria. The author does not consider the "*rendement*" proposed by Seyffarth to be practicable.

—J. L. B.

### *Two Remarkable Decomposition Products of Saccharose.*

E. O. von Lippmann. Ber. 1894, **27**, 3408—3409.

On taking asunder a conduit which had been employed for "clairce," but which had been put aside for a long time, the tube was found to be partially filled with a black tasteless and odourless, almost dry, mass, which could be removed without difficulty. This substance had all the appearance of the so-called humus matter, and apparently must have been formed from the pure concentrated sugar solution (clairce) remaining in the tube at a temperature of 35°—40° C.

A crystalline substance was extracted from the mass by means of alcohol which, after repeated recrystallisation, fractional precipitation by basic lead acetate, and treatment with animal charcoal, was resolved into two acids. The one proved to be mellitic acid $C_6(COOH)_6$ (hexacarboxybenzene) which forms a barium salt, $C_{12}O_{12}Ba_3 + 3H_2O$, insoluble in water and alcohol; whilst the second was found to consist of pyromellitic acid $C_6H_2(COOH)_4$ (tetracarboxybenzene).

Cases are on record of the formation of mellitic acid as an oxidation product of carbon, thus, by the electrolysis of alkalis by means of charcoal, by treatment of charcoal with sodium hypochlorite, and by heating sugar or charcoal with concentrated sulphuric acid in excess. Such a process of oxidation as that described in the paper, occurring at a medium temperature, and quite spontaneously, has, however, never yet been observed.—A. R. L.

### *An African Gum resembling Tragacanth.* C. Hartwich. Arch. des Pharm. **232**, 43.

This gum differs from tragacanth in being completely vitreous in appearance. It occurs in large pieces which are more or less elongated, but never rolled. When heated with water it forms a starch which separates in opalescent masses, and only dissolves on very prolonged boiling. Its solution is dextro-rotary, and is precipitated by basic lead acetate, alcohol, and ammonium sulphate. With nitric acid the gum gives muric and oxalic acids, with sulphuric acid it yields furfurol. Potash colours it yellow, phloroglucinol and hydrochloric acid, or pyrogallic acid, pale red, but phenol and α-naphthol do not cause coloration. The gum appears to be formed under the bark.—L. T. T.

### *Contribution to the Analysis of Beetroots.* Anderlik. Böhm. Zeits. f. Zuckerind. 1895, **19**, 258.

*See under* XXIII., *page* 398.

### *Estimation of Water in Cane Sugar.* Gunning and Alberda. Sucr. Belge. 1894, **23**, 108.

*See under* XXIII., *page* 398.

### PATENT.

### *An Improved Starch or Linen Gloss for Laundry Purposes.* J. Hilton, Blackpool. Eng. Pat. 25,242, December 29, 1894.

This gloss is made as follows : to 4 gallons of water are added 40 ounces white fecula starch, 2 ounces of common soda, 6 ounces rock borax, 6 ounces carnauba or other like suitable substance, 22 ounces of talc, and 1 ounce of oil of turpentine. The mixture is subjected to a temperature of 150°—160° F., being continually stirred. On cooling, two or three days is allowed for precipitation.—L. T. T.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### *Estimation of Alcohol in the "Essential Oils" of the Distillery.* C. Fabre, Garrigou and Surre. Comptes rend. 1894, **119**, 747—748.

The "essential oil" residue (feints) of French distilleries is subject to lower excise duties, when it contains less than 6 per cent. of ethylic alcohol. But the accepted method of assay (Jour. de Chim. et de Pharm. 1893, **2**, 517), as recommended by the Committee of Arts and Manufactures, is now found to be incorrect. It consists in treating the oil four times with water saturated with marine salt, which dissolves the alcohol ; the brine is next treated with carbon bisulphide to separate amylic alcohol, and then distilled. The distillate contains ethyl, propyl, and isopropyl alcohols, and the last named is estimated by means of potassium permanganate. In experiments with three samples, A, B, and C, the above process was repeated eight times with each sample ; and the results quoted below, show that by the ordinary single treatment (recorded on the first line) less than half of the true value is recorded.

| — | Percentage of Alcohol recovered. | | |
|---|---|---|---|
| | A. | B. | C. |
| 1st extraction | 8·9 | 6·25 | 6·2 |
| 2nd " | 5·4 | 3·55 | 3·8 |
| 3rd " | 3·2 | 2·7 | 2·1 |
| 4th " | 1·9 | 1·4 | 1·15 |
| 5th " | 1·0 | 0·85 | 0·75 |
| 6th " | 0·7 | 0·45 | 0·30 |
| 7th " | 0·5 | 0·35 | 0·25 |
| 8th " | 0·25 | 0·25 | 0·20 |
| Total alcohol in sample . | 21·85 | 15·80 | 14·75 |

—W. G. M.

### *Freezing Points of Various Mixtures of Alcohol and Water.* R. Pictet. Comptes rend. 1894, **119**, 678—682.

The following are the results obtained :—

| Hydrates of Ethyl Alcohol. | Specific Gravity. | Alcohol. | Points of Crystallisation. |
|---|---|---|---|
| | | Per Cent. | ° C. |
| Alcohol + $H_2O$ | 0·8671 | 71·9 | − 51·3 |
| Alcohol + $2H_2O$ | 0·9047 | 56·1 | − 41·0 |
| Alcohol + $3H_2O$ | 0·9270 | 46·3 | − 33·9 |
| Alcohol + $4H_2O$ | 0·9417 | 39·0 | − 28·7 |
| Alcohol + $5H_2O$ | 0·9512 | 33·8 | − 23·6 |
| Alcohol + $6H_2O$ | 0·9578 | 29·9 | − 18·9 |
| Alcohol + $7H_2O$ | 0·9627 | 26·7 | − 16·0 |
| Alcohol + $8H_2O$ | 0·9662 | 24·2 | − 14·0 |
| Alcohol + $9H_2O$ | 0·9689 | 22·1 | − 12·2 |
| Alcohol + $10H_2O$ | 0·9712 | 20·3 | − 10·6 |
| Alcohol + $11H_2O$ | 0·9732 | 18·8 | − 9·4 |
| Alcohol + $12H_2O$ | 0·9747 | 17·5 | − 8·7 |
| Alcohol + $13H_2O$ | 0·9761 | 16·4 | − 7·5 |
| Alcohol + $16H_2O$ | 0·9793 | 13·8 | − 6·1 |
| Alcohol + $20H_2O$ | 0·9824 | 11·3 | − 5·0 |
| Alcohol + $35H_2O$ | 0·9870 | 6·8 | − 3·0 |
| Alcohol + $50H_2O$ | 0·9916 | 4·8 | − 2·0 |
| Alcohol + $100H_2O$ | 0·9962 | 2·5 | − 1·0 |

In the case of solutions stronger than that corresponding to the formula, alcohol + $7H_2O$, the formation of fine, exceedingly regular, hexagonal crystals was always observed, providing the solution was not stirred during freezing. With weaker solutions, this crystallisation did not occur.
—H. T. P.

### *The Carbohydrates of Yeast.* E. Salkowski. Ber. **27**, 3325—3329.

In a previous paper (Ber. **27**, 497 ; this Journal, 1894, 411), the author describes a gum he obtains from yeast by extraction with 3 per cent. caustic potash. The residue consists principally of cellulose. After purification, the substance appears as a slightly yellowish powder, which is turned brownish-red by iodine solution (iodine in potassium iodide). Although the coloration appears to be uniform, the cellulose consists of two substances, one of which is coloured by iodine and the other not. They can be separated by heating 5 grms. in 1 litre of water in a digestor for 20 hours under a pressure of 2—2½ atmospheres, when about half goes into solution. The latter gives the iodine reaction, whereas the residue does not, and the author proposes the names erythro- or erythro-hydro-cellulose and achröocellulose for the two substances. The former is dextro-rotatory $[\alpha]_D = 173^{\circ}\cdot 7$, and gives numbers on ultimate analysis corresponding to the formula $C_6H_{10}O_5$. In addition to the colour which it gives with iodine solution, it is precipitated by baryta water, and is converted quantitatively on treating with dilute acids into *d*-glucose. It is rapidly saccharified by saliva, although not so quickly as a solution of glycogen of the same concentration. The substance is in many respects similar to glycogen, and the author is of opinion that the glycogen said to be present in yeast is probably erythrocellulose. Achröocellulose obtained as the residue in the above operation, after drying forms a pellicle not easily powdered and not entirely soluble on boiling with 5 per cent. sulphuric acid, although the carbohydrates of the original yeast are easily dissolved by this treatment. Achröocellulose is not a simple substance; on treatment with acids it forms mainly glucose, but also a not inconsiderable amount of mannose.—T. A. L.

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### *Glucase.* F. Röhmann. Ber. 1894, **27**, 3251—3253.

Bial has observed that blood serum contains a ferment or ferments which convert starch into dextrin, maltose, and dextrose. If the serum has been exposed to alcohol for any length of time, the power of forming dextrose is lost; glucase, in a similar way, loses its power when exposed to alcohol; hence the author concludes that blood serum contains diastase and glucase. He cannot agree with E. Fischer (see below) that invertase hydrolises maltose; but considers that the yeast Fischer employed must have contained glucase. A yeast which hydrolised cane sugar and maltose was dried and extracted with water containing thymol; the extract retained all its hydrolytic functions; when this was precipitated with alcohol the precipitate still inverted cane sugar, but had no action on maltose.

—A. L. S.

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### *Influence of Configuration on the Action of Enzymes.* E. Fischer. Ber. **27**, 2985—2993.

Fischer and Thierfelder (this Journal, 1894, 1212) have investigated the action of yeast on different sugars, and from their experiments deduced certain conclusions as to the relation between the configuration of a sugar and its fermentability. The following experiments were made to trace the connection between the configuration of the bodies of the sugar group and their behaviour with enzymes.

The author (this Journal, 1894, 167) has already described methyl-glucoside, of which two stereoisomeric forms exist; α-methyl-glucoside is hydrolysed by invertase, whilst the β-modification is unacted upon by this enzyme. The same invertase hydrolysed cane sugar and also maltose, but had no action on milk sugar. The invertase was prepared from *Saccharomyces cerevisiæ* (type Frohberg), another specimen from Saaz yeast, had the same properties, although a specimen obtained from Merck, of Darmstadt, had no action on maltose or on α-methyl-glucoside, whilst it inverted cane sugar. It is then possible that the hydrolysis of maltose and α-methyl-glucoside was effected by a ferment like glucase present together with invertase in the yeast. (See previous abstract.) Emulsin was found to have no action on α-methyl-glucoside, on cane sugar, or on maltose, whilst it hydrolysed β-methyl-glucoside and lactose.—A. L. S.

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### *Influence of Configuration on the Action of Enzymes.* II. E. Fischer. Ber. **27**, 3479—3483.

In his first paper (see previous abstract) the author expressed an opinion that the hydrolytic functions of Frohberg yeast might be due to the presence of two enzymes, one of which (invertase) hydrolysed cane sugar and the other hydrolysed maltose. This opinion was supported by the experiments of Röhmann (see above), and the author has proved that this is the case. He found that water at 30° would extract the invertase from the fresh yeast and leave the maltose hydrolysing ferment behind. This latter may be obtained, together with invertase, by powdering the dried yeast with glass and extracting with water at 30°—35°. Alcohol precipitates an amorphous precipitate from the solution, which possesses the hydrolytic functions of the original yeast, but its action on maltose has been very much weakened, and is entirely destroyed by another precipitation with alcohol. The latter ferment cannot be identical with glucase, as this can be repeatedly precipitated from its aqueous solution by alcohol; but it resembles closely the ferment Röhmann detected in blood. The author proposes to call it yeast-glucase.

Milk-sugar yeast contains two enzymes, invertase and lactase; the latter hydrolyses lactose.

The author has examined the action of the above enzymes on various synthetical compounds of the sugar group.

—A. L. S.

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### *Pectase and the Pectic Fermentation.* G. Bertrand and A. Mallèvre. Bull. Soc. Chim. 1895, **13**, 77—82.

Pectase is an unorganised ferment which causes the coagulation of vegetable juices rich in pectin.

The ferment is best prepared from the central parts of carrots, these being far richer in pectase than the other parts of the vegetable. This is then reduced to a pulp, the liquid extracted by pressing, and, after filtering, the lime is precipitated by a slight excess of an alkaline oxalate. The clear liquid obtained, after filtering off the calcium oxalate, is very rich in pectase, and if chloroform be added, it can be kept undecomposed for several days when stored in bottles, which should be filled quite full and sheltered from the light.

A solution of pectine is best prepared from the residue (marc) of the carrots from which the pectase had been extracted. For this purpose, the residue is subjected to a short boiling with alcohol and the decolorised mass is treated with dilute (2 per cent.) hydrochloric acid. After standing for 24 hours the whole is pressed through a cloth and the resulting liquid filtered. In this solution, the pectine may be precipitated by the addition of alcohol, and it is freed from lime by extraction with 50 per cent. alcohol, containing 2 per cent. of HCl. Finally, the acid is removed by a series of solutions in water and precipitations by alcohol, or preferably, when nearly free from acid, by the addition of a trace of potash.

For fermentation experiments, a 2 per cent. solution of the pectine thus prepared is most suitable.

The author has investigated the action of pectase of the above solution deprived of lime, and has come to the conclusions that the ferment alone in absence of lime cannot coagulate the pectine, that, in fact, this transformation only takes place in the presence of a soluble salt of calcium, barium, or strontium. The influence of magnesium salts is less clear, and it is probable that they take no part in the reaction. The coagulated mass produced under these conditions by the pectase is not, as has hitherto been believed, pectic acid, but a pectate of one of the alkaline earths.

—H. I.

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### *β-Levulin.* E. Schulze and S. Frankfurt. Ber. **27**, 3525—3527.

The preparation of this substance from green rye has been described in a previous paper (this Journal, 1894, 533).

It is very easily soluble in water and is precipitated by alcohol from concentrated solutions, the precipitate becoming crystalline. For a 10 per cent. aqueous solution $[\alpha]_D = -28^{\circ}\cdot 7$. It is easily hydrolised by dilute acids, and yields levulose. Its composition corresponds fairly well with the formula $C_{12}H_{22}O_{11}$, but still better with the formula $C_{18}H_{32}O_{16}$. The authors propose to call it secalose.

—A. L. S.

### *Maltol.* H. Kiliani and M. Bazlen. Ber. 1894, **27**, 3115—3120.

This body, which was discovered by Brand (this Journal, 1894, 1213), was prepared by the authors from the condensate of the vapours from a manufactory of roasted malt (Malzkaffeefabrik), by extraction with chloroform. The body was purified by crystallisation from 50 per cent. alcohol and sublimation.

By slow evaporation of its alcoholic solution, maltol is obtained in long, colourless, strongly refractive needles. It is acid to litmus paper and, although it cannot decompose carbonates, it yields very characteristic metallic salts when a solution of metallic salt is added to a solution of maltol in its equivalent quantity of normal alkali. The salts have a composition represented by the formula $C_6H_5O_3.M'$.

*Benzoylmaltol*, $C_6H_5O_3.C_7H_5O$, is produced by the action of benzoyl chloride on a solution of maltol in normal alkali. It forms colourless crystals, melting point 115°—116°, and is neutral.

Maltol is oxidised by potassium permanganate according to the equation, $C_6H_6O_3 + 8O = C_2H_4O_2 + 4CO_2 + H_2O$. Oxidation with silver oxide gives the same products. The authors consider that maltol is probably a methyl-pyromeconic acid.—A. L. S.

### *The Specific Rotatory Power of Acetyl Maltose and of Maltose.* A. Herzfeld. Ber. **28**, 440—443.

Ling and Baker (J. Chem. Soc. 1895, 212) described an octacetyl maltose, which they stated to be different from the octacetyl maltose previously described by the author. He considers they were mistaken, and that the numbers they obtained were practically the same as his. As, however, the optical activity which Herzfeld determined in benzene differed materially from that found by Ling and Baker, who employed chloroform as a solvent, he re-determined this factor, using chloroform, and found $[\alpha]_D = 61$ as against $[\alpha]_D = 62{\cdot}2$ found by Ling and Baker. The benzene solution gave $[\alpha]_D = 76{\cdot}5°$.

As the author had a quantity of pure maltose, he carefully determined its optical activity, and obtained numbers closely agreeing with Meissl's general formula—

$$\alpha_D = 140{\cdot}375 - 0{\cdot}01837\ P - 0{\cdot}095\ T.$$

—A. L. S.

### *Estimation of Mannitol in Wines.* J. A. Muller. Bull. Soc. Chim. 1894, **11**, [22], 1073.

*See under* XXIII., *page* 399.

## PATENTS.

### *Apparatus for Pasteurising or Sterilising and Cooling Beers, and for Aerating or Charging Beers with Gas before Placing them in Cask or Bottle.* Paul Puvrez, France. Eng. Pat. 4894, March 8, 1894.

This apparatus consists of a steel or copper vessel, tinned on the inside, to contain the beer to be treated, fitted with a revolving agitator consisting of a copper worm terminated at its two ends by stuffing-boxes so arranged as to allow, at will, the circulation of hot water, low-pressure steam, or cold water through the agitator. The vessel is fitted with steam jets, for the purpose of sterilising the vessel before use, an inlet near the bottom terminating in a fine rose-sprayer, and two similar openings, but without the sprayer, near the top, to allow of the introduction, under pressure, of carbonic acid or filtered air, for aeration of the beer. There are also pressure-gauges, thermometer, manhole, filling and emptying valves, &c.

The vessel is filled with beer, and compressed air introduced by the upper valve above the surface of the beer, to a pressure of 1, 2, or 3 atmospheres, according to the description of the beer to be pasteurised. The object of this is, by compressing the surface of the liquid, to prevent the escape of the alcohol, the aroma, and the carbonic acid from the beer when it is being heated. Hot water is then circulated through the agitators, which are at the same time set in motion. When the beer has reached the correct pasteurising temperature, the hot water may, if desirable, be stopped, and a little waste steam substituted, by means of which the requisite pasteurising temperature is maintained. When the heating has been maintained for the requisite time, the hot water or steam is shut off and cold water turned on through the agitator. In order to hasten the heating and cooling, a circular pipe, pierced on the inside with small holes, surrounds the upper end of the cylindrical vessel, by means of which a thin stream of hot or cold water may be made to flow over the outer surface of the vessel. When the sterilised beer is cooled, carbonic acid, from a suitable generator or from a steel cylinder of liquified carbonic acid, is forced in through the lower spray-cock. When the pressure in the apparatus is in equilibrium with that of the reducing regulator of the carbonic acid supply, this supply is removed from the lower cock and attached to one of the two upper cocks above the surface of the beer. The other upper cock and the lower spray-cock are then set in communication with a gasefying pump, by which the gas above the surface of the beer is withdrawn and forced into the beer through the lower spray-cock, the pressure above the beer being maintained by carbonic acid passing through the regulator of the carbonic apparatus. In this way the saturation of the beer with carbonic acid is rapidly effected, and the sterilised and aerated beer may be drawn off into casks or bottled by means of any of the usual bottling machines.—L. T. T.

### *Wort Cooler.* H. E. Deckebach, Cincinnati, Ohio, U.S.A. Eng. Pat. 23,838, December 7, 1894.

In this apparatus, the cooling-water is conveyed through a copper cylinder, terminating in a pipe about 1½ to 2 ins. in diameter, which is bent back and spirally coiled tightly round the cylinder, the coils being 1½ to 3 in. apart. Round this a second cylinder, to carry the wort, fits tightly with an inlet at one end and an outlet at the other. The wort is thus made to travel in a spiral manner, and subjected to a great cooling surface. If economy of space be important, a second cooler may be formed by surrounding the outer cylinder with another coil carrying condensing water, and this with a third tightly-fitting cylindrical vessel. The author claims that by this apparatus the wort is efficiently cooled without contamination by atmospheric germs, and without loss of volatile aromatic essences. For an ordinary sized brewery, the inner cylinder may conveniently be about 10 ft. long by 4 in. in diameter, and the coil-pipes about 1½ in. in diameter. The apparatus is so made as to be readily taken to pieces for cleansing.

—L. T. T.

### *Improvements in Stills or Apparatus for Distilling Spirits and other Liquids.* G. Morris and H. L. Wethered, both of Bristol. Eng. Pat. 803, January 12, 1895.

The improvements consist in modifications in shape and construction of the still patented by G. Morris and W. Edney in 1893 (this Journal, 1894, 505). The most important change consists in the introduction of a central tube descending from the top, and carrying a rod and float. The upper part of this rod passes through the closed top of the tube, and carries a pointer, serving to indicate the level of the liquid in the still. The float is so arranged that when the liquid in the still is at its normal level, the float forms a valve closing the lower end of the central tube, whereas, when the liquid is below the normal, the lower end is open to the still. When the still is being used for the distillation of water, the central tube is connected with the outflow of the cooling-water, and thus an automatic feed is established.

—L. T. T.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (*A.*)—CHEMISTRY OF FOODS.

### *Observations on Flours.* Balland. Comptes rend. **119,** 565—567.

The following conclusions are tabulated from the results of 2,500 samples of flour analysed in the Laboratory of the French War Department between September 1891 and June 1894.

The highest and lowest percentages of water were 16·20 and 9·40; the highest percentage of gluten, 47·50; and of fatty matters, 3·10. The lowest percentage of acid, 0·013.

The water is a maximum in February and a minimum in August. The acid is lowest from November to January, and highest in July and August, the time most favourable for the growth of organisms in the grain. In 1893, the acidity varied from 0·013 in January to 0·037 per cent. in August. Hence, flours intended for long preservation should be made and packed in dry, cold weather.

None of the flours examined have been adulterated with mineral matters or foreign farinaceous substances. The causes for rejection of flours have been either on account of excess of "tailings," or a bad state of preservation. In the first case, the fatty matters were too high; in the other, the acidity.

The amount of hydration of the gluten varies very considerably (from 71·3 to 52 per cent.), so that the percentage of dried gluten cannot be calculated from that of the moist. In first-class flours, the percentage of water is about 70; in medium flours, 62 to 65. The best flours for bread making contain most water in the gluten. As the acidity of a flour increases, the water in the gluten diminishes. The amount of "insoluble nitrogenous matters" should be calculated from the dried gluten.

The use of Boland's aleurometer is not advised, as it gives contradictory results.

The percentage of gluten in flours of the same origin, varies in different years.

The author concludes by noting the great improvement in the quality of the flours supplied to the army, which has been effected since the establishment of the Laboratoire des Invalides.—J. T. D.

## (*B.*)—SANITARY CHEMISTRY.

### *Purity of Drinking Water Supplies.* J. C. Thresh. Journal of State Medicine, **3** (1895), 96—104.

The author criticises at length the value of the chemical and biological evidence upon which water is passed as fit, or condemned as unfit, for drinking.

After discussing the significance of such physical characteristics as colour, taste, odour, and turbidity, he points out that by means of chemical analysis it is possible to determine the presence of any objectionable kind or quantity of mineral constituents. As regards nitrates, which are probably never present in sufficient quantity to be in themselves objectionable, the evidence of experience is that waters containing comparatively large quantities of nitrates are often used with perfect impunity, and that waters containing little or none of these salts may give rise to serious outbreaks of disease. Therefore, the amount of nitrate in a water is only a very slight index of the risk or danger attendant upon its use.

Organic matter in water is alone a serious source of danger, and possibly only when present as living organisms, and only when these are of a specific character. Standards of purity based upon the amount of organic matter in a water are most untrustworthy. Some of the most extensive epidemics of typhoid fever have been traced with certainty to the use of waters passed as pure and wholesome by chemists and biologists; whilst in thousands of districts, people are thriving on water containing such large amounts of organic matter, even derived from sewage, as would lead any analyst to condemn them as grossly polluted. In support of the latter statement, the author quotes the following statistics of a number of parishes well known to him, similar in nearly all respects save in their water supply. In the first group (*a*), the people all derive their water from shallow wells, most of which, upon analysis, would be condemned as grossly polluted, whilst in the second (*b*), the supply is from springs or other sources, the water being chemically of excellent quality. The figures are the means for the ten years 1881–90:—

| Population. | Death-rate from all Causes. | Death-rate from Typhoid Fever and Diarrhœa. | From the Seven Chief Zymotic Diseases. | From Phthisis. | Of Children under Five Years. |
|---|---|---|---|---|---|
| (*a*) 18,490 | 14·7 | 0·44 | 1·49 | 1·45 | 3·99 |
| (*b*) 16,300 | 15·4 | 0·33 | 1·38 | 1·25 | 4·13 |

The most important factor which determines whether a water supply is safe or dangerous, is the possibility of specific pollution, and this is a risk which the author considers neither chemical nor bacteriological examinations can sufficiently indicate.

Can a water, known to be liable at any time to specific pollution, ever be accepted as a satisfactory water for domestic purposes? The evidence for or against this is not conclusive. Thus, whilst the extensive epidemics of typhoid fever prevalent in the Tees Valley during the last few years have been attributed, after most careful investigation by Dr. Barry, to the pollution of the River Tees, the water from which, after filtration, is supplied to the particular district affected, we have contrary evidence from the experience of London, which has always been remarkably free from typhoid fever, though supplied with filtered river water, previously polluted with the sewage of many villages and towns. More conclusive evidence as regards cholera has been afforded by the recent epidemics at Hamburg and Altona. The connection between the cholera mortality and the degree of purity of the water supply has been demonstrated by ample past experience both in this country and abroad. If it be a fact, as there is reason to believe, that the *Bacillus coli communis* may, under certain circumstances, assume a specific character and produce a disease undistinguishable from typhoid fever, the danger of using sewage-polluted water is enormously increased, and it becomes more than ever important to determine whether such danger can be removed by efficient filtration.

—L. A.

### PATENTS.

*Improvements in Apparatus for making Fresh Water from Salt Water, partly applicable also to Condensing and to Heating Feed Water.* H. Hocking, Liverpool. Eng. Pat. 7184, April 11, 1894.

*See under I., page* 352.

*Improvements in or connected with the Softening of Hard Water.* W. Brothers, Rawtenstall, Lancaster. Eng. Pat. 10, January 1, 1895.

Solid ammonium-hydrogen carbonate, $NH_4HCO_3$, is dissolved in hot or boiling water, and the solution is mixed in suitable proportion with the hard water to be softened.

—E. S.

## (*C.*)—DISINFECTANTS.

### *The Production of Gaseous Formaldehyde for Disinfecting Purposes.* R. Cambier and A. Brochet. Comptes rend. 1894, **119,** 607—609.

The authors have prepared formaldehyde for disinfecting purposes by (1) Heating trioxymethylene (paraformaldehyde); (2) The incomplete combustion of methyl alcohol.

In the first case, a difficulty that arises is the readiness with which the formaldehyde vapour repolymerises on cooling. This can only be avoided by the use of some contrivance which allows of the vapour, as it is formed, being immediately mixed with a large excess of air. The production from methyl alcohol is simpler. A special burner, connected to a constant level alcohol reservoir, is employed, and is stated to yield very satisfactory results. The burner consists of a metal tube plugged with asbestos. Its upper end is pierced by numerous holes, and is fitted with a large cap of platinum foil. The air supply is regulated by an outside sliding tube (as in a Bunsen burner) to which is attached a mica chimney. Laboratory experiments have shown that complete sterilisation may be secured by means of gaseous formaldehyde in the case of ordinary household dust, as well as cultures of pathogenic organisms. On a practical scale, however, numerous difficulties are encountered, only some of which have so far been overcome.

—H. T. P.

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### *Antiseptic Properties of the Vapours of Formaldehyde.* A. Trillat. Comptes rend. **119**, 563–565.

The author refers to his former work on this subject (this Journal, 1892, 772). The difficulty of procuring the aldehyde being a real one, he has made further experiments in which the vapours from the apparatus for preparing the aldehyde (in form, a sort of spray-producer or lamp, capable of converting 5 kilos. of alcohol per day, and giving aldehyde equal to about 25 per cent. of the weight of the alcohol), were used directly.

Hospital floor sweepings were placed on plates at different heights, and after exposure to the vapours, were sown in nutritive liquids. The dust was effectually sterilised in a room of 20 sq. meters area in eight hours, with an expenditure of 200 grms. of methyl alcohol; when the room was 300 sq. meters in area, 24 hours was taken, and 2 kilos. of alcohol were burnt. A second series of experiments, in which the dust was moistened with from 3 to 20 per cent. of water, showed that the antiseptic action was retarded in proportion to the amount of water present. Four hours fumigation of a sick chamber, with all its furniture, hangings, &c., in place, completely disinfected the floor, ceiling, and walls, as was shown by taking scrapings from them; the same was the case with fragments of paper, cloth, and wood, which had been dipped in or painted with bacterial fluids and placed in the room. No damage was suffered by metal articles or stuffs, though certain materials had their colours slightly changed in tint.

The odour of the aldehyde rapidly disappears on free ventilation, or on exposing a dish of ammonia in the room.

—J. T. D.

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### *Disinfection of Fæcal Matter.* H. Vincent. Comptes rend. (1894), **119**, 965–968.

The author has tried a large number of disinfectants, and he finds that the best disinfecting agent for fæcal matter and the contents of cesspools is sulphate of copper. Especially is this the case if the fæcal matter is first of all acidified with one per cent. sulphuric acid. *Normal fæces* mixed with the urine, whether putrefying or not, are disinfected in 24 hours by employing 6 kilos. of copper sulphate per cubic metre of excrement, the mean temperature being about 16° C. For the disinfection of *typhoid stools* and the destruction of Eberth's bacillus, under the same conditions of temperature, 5 kilos. of copper sulphate per cubic metre are sufficient. 3·5 kilos. per cubic metre of the same disinfectant are sufficient to destroy the *cholera bacillus*. In the two last cases, disinfection is complete in 12 hours. The author also points out that the *absolute* bacteriological sterilisation of fæcal matters and the contents of cesspools is practically impossible.—J. S.

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### *Lysol and Similar Antiseptic Compounds of Tar Products and Soap.* C. Engler and E. Dieckhoff. Arch. d. Pharm. 1892, **230**, 562.

The authors divide these mixtures into two groups, namely solutions of tar-oil in soap, and solutions of soap in tar-oil. The first of these embraces all those products in which the proportion of soap to tar-oil is such as to produce a solution, which retains its clearness when mixed with any quantity of water. To the second group belong those preparations in which the quantity of soap is insufficient to hold all the tar-oil in solution after dilution with water, which therefore partly separates out, giving rise to the formation of emulsions. Whilst the higher phenols more especially possess the property of becoming soluble in water by the addition of a suitable proportion of soap, the use of soap also furnishes a means of preparing aqueous solutions of hydrocarbons, which, according to the quantity of soap used either remain clear or become turbid, by further dilution with water. The simultaneous presence of phenols greatly increases the solubility of the hydrocarbons. The scientific interest which attaches to these preparations as throwing some light on the hitherto little considered relations of the solubility of substances in mixtures, is pointed out by the authors, and the following interesting data are given in reference to the solubility of phenols and hydrocarbons in various media.

The higher phenols are readily soluble in aqueous solutions of the salts of certain carboxylic and hydroxycarboxylic acids and phenolates, a fact upon which is based a method of preparing antisepties patented by von Heyden.

Pure phenol is at 20°, miscible in any proportion with a saturated solution (at 15°) of sodium acetate. A still greater capacity of dissolving phenols is shown by sodium valerate, a 50 per cent. solution of this salt taking up any proportion of phenol, the solution remaining clear at 15° after the addition of any quantity of water. Cresol, which is but very slightly soluble in sodium acetate, is miscible with a 50 per cent. solution of sodium valerate in any proportion.

Phenol likewise dissolves readily in the aqueous solutions of the salts of the higher fatty acids, and this solubility appears to be in direct proportion, in the case of soap solutions of equal strength, to the increase of the number of carbon atoms of the fatty acid they contain. Rosin soap also possesses the property of dissolving large quantities of phenol.

Cresol dissolves readily in a 15 per cent. solution of oleic soap, one part of the latter being capable of rendering soluble in water five times the amount of cresol. This fact explains the possibility of preparing soluble mixtures, which contain 50 per cent. of cresol.

The salicylates, benzoates, phenylacetates, &c., of ammonia and aniline also take up cresol in aqueous solution, although not in the same quantity as soap solutions. Glycerin is a good solvent for cresol, ortho-cresol being soluble to the extent of 1 grm. in 4 c.c.; para-cresol of 1 grm. in 9 c.c.

The solubility of benzene, toluene, xylene, and oil of turpentine in the aqueous solutions of fatty and oleic acid and rosin soaps, is increased not only by the presence of phenols as already mentioned, but also by camphor. The solubility in water of mixtures of hydrocarbons of the paraffin series with soap and phenol, decreases with the increase of the former, whilst cresol substituted for the phenol in the mixture, causes up to a certain extent, an increase in the solubility. Thus, a mixture of 100 c.c. of lysol (cresol and soap) and 200 c.c. of mineral oil can be diluted with twice as large an amount of water as a mixture containing but 20 c.c. of mineral oil. A very considerable excess of oil is necessary to again reduce the solubility in water.—F. M.

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### *Solubility of Ozone.* Mailfert. Comptes rend. 1894, **119**, 951.

*See under* XX., *page* 381.

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### *Soluble Cresol Compounds.* C. Engler and E. Dieckhoff. Arch. d. Pharm. **232**, 351.

*See under* XXIII., *page* 398.

### PATENTS.

*Improvements in or relating to Disinfectants and Deodorants.* R. J. Stephens and J. Hewes, Leicester. Eng. Pat. 5066, March 10, 1894.

This is a combination of ground or powdered "Crich" lime and charcoal, with or without the admixture of alum and camphor, and is intended for preventing (and for removing when formed), the well-known slimy or mucous coating, or incrustation which forms on and adheres to the sides of public urinals, and emits an offensive odour. —J. C. C.

*A Process for Protecting Iron Pipes from Corrosion by Passage of Electrolysed Chloride Solutions employed as Disinfectants.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 6495, March 31, 1894.

The iron pipes are immersed in a solution of a chloride of an an alkali or alkaline earth, such as magnesium chloride, and a layer of alkaline oxide (magnesia) is deposited on them by electrolysis. To coat them internally the solution is passed through them while being electrolysed. This oxide coating serves as a protection against the disinfectant solutions mentioned in the title.—E. T.

*An Improved Mode of Rendering Fabrics Impervious to Infection.* H. R. Hirschler, Paris, France. Eng. Pat. 6747, April 4, 1894.

The fabric is first treated with a solution of a metallic salt, such as soluble salts of bismuth, tin, or aluminium. It is then immersed in a solution of an organic acid of the aromatic series constituting an antiseptic. The antiseptic used, is salicylic acid or one of its homologues: benzoic or cresotinic acid. In this way the insoluble salt is precipitated in the fabric, and renders them antiseptic.—J. C. C.

## XIX.—PAPER, PASTEBOARD, Etc.

### PATENTS.

*Improvements in Treating Paper and other Fabrics, and in the Preparation of Solutions for that Purpose, and the obtainment of a By-product in the said Preparation.* A. E. Healey, Willesden Junction. Eng. Pat. 5054, March 10, 1894.

The improvements relate to the process used in the production of "Willesden goods" by the treatment of fabrics of cellulose fibres with a solution of cuprammonia. According to this invention, a soluble chromate is added to the solution of cuprammonia, and by the use of the liquid so produced, paper and other fabrics have a brighter tint, a greater durability of colour, and are more easily dyed. A suitable method of preparing this liquid (without the presence of air to oxidise the copper) is to treat fragments of copper with bichromate of potash, to which aqueous ammonia is afterwards added; the hydrated oxide of chromium precipitated, is obtained as a by-product. In some cases it is preferable to treat the fabrics with a solution of chromate before or after the usual treatment with cuprammonia solution.—S. P. E.

*Improvements relating to Apparatus used in the Process of Breaking and Bleaching Fibrous Materials.* B. Cawthorn, Hylton, and J. P. Cornett, Claxheugh. Eng. Pat. 6521, April 2, 1894.

This invention relates to an apparatus for breaking and bleaching fibrous materials, and consists essentially of an ordinary "Hollander" or beating engine from which the "roll" and "bed-plate" have been removed. The circulation is produced by means of a centrifugal or other suitable pump which withdraws the pulp from the opening at the bottom of the engine and delivers it again over the "back-fall." By this means a better circulation and mixing of the pulp and bleaching liquor is produced.—S. P. E.

*Improvements in Machines for Reducing Paper Stock to Pulp.* A. P. Brown, Rock Falls, U.S.A. Eng. Pat. 1615, January 23, 1895.

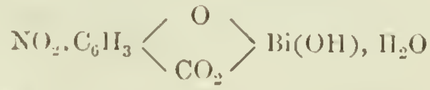
This invention relates to beating engines for paper pulp, and the main improvement consists in the substitution of a comparatively small revolving beating roll for the usual fixed bed-plate. The general form of the engine is similar to the ordinary beating engine in which the "midfeather" is horizontally fixed, and the circulation of the pulp takes place in a vertical plane. One or two revolving "bed-plates" are made to rotate in conjunction with the beating roll, but in an opposite direction to the latter, so that the adjacent moving surfaces are travelling in the same direction but at different surface speeds; the beating roll running about three times the rate of the "bed-plates." By this arrangement, the patentee claims to obtain a better disintegration of the fibres without pulverising them, and a more perfect circulation. Several modifications are illustrated and described, differing mainly in the position of the midfeather and consequently the course of circulation. The beating roll may be partially or wholly submerged in the pulp; in one form of engine the pulp has to pass over the top of the roll and thence return between the roll and revolving bed-plate. Suitable appliances are provided for raising or lowering the roll as required.—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Nitrosalicylates of Bismuth.* H. Causse. Bull. Soc. Chim. 1894, **11** [24], 1185—1188.

When producing bismuth salicylate by the double decomposition of bismuth nitrate and sodium salicylate, the reaction is never complete. Sometimes small quantities of long white silky needles appear, at others, a yellow to orange crystalline precipitate, at others, a red coloration, the latter being often erroneously ascribed to the presence of iron. These phenomena are due to the formation of β-nitrosalicylates which form very readily. The author has in this way obtained three β-nitrosalicylates of bismuth of the following formulæ:—

$$[NO_2.C_6H_3(OH).CO_2]_3\,Bi,\ 2H_2O;$$



$$NO_2.C_6H_3 \left\langle \begin{matrix} O \\ CO_2 \end{matrix} \right\rangle Bi(OH),\ H_2O;$$

$$[NO_2.C_6H_5(OH).CO_2]_2 : [Bi_2(OH)_2]_2;$$

and β-nitrosalicylic acid.—L. T. T.

*Solubility of Ozone.* Mailfert. Comptes rend. 1894, **119**, 951—953.

The author finds that at ordinary pressures, water dissolves about two-thirds of its volume of ozone at 0° C. and about one-half its volume at 12° C. Hence water dissolves nearly 15 times as much ozone as oxygen, under the same conditions of temperature and pressure; and the author suggests that water saturated with ozone might advantageously be employed in hospitals for disinfecting and antiseptic purposes. In certain circumstances it might also be used for sterilising water.

Below 20°—25° the solubility of ozone in acidulated water is the same as in pure water. Above this temperature the solubility is somewhat greater.—J. S.

### *Newly-discovered Occurrence of Vanillin.* E. O. von Lippmann. Ber. 1894, **27**, 3409.

On the steep rocky declivity of the Schiltalp, above Mürren (Lauterbrunnen Valley), the orchid "*Nigritella suaveolens*" is found in many cases in the form of a thick turf. The plants evolve an intense odour of vanillin, and the author succeeded in isolating vanillin from the flowers. Besides vanillin, however, another substance is present in the extract which has the odour of heliotropin or piperonal; its true nature has not yet been established.—A. R. L.

### *Crystallisable Bodies existing in true Coto-Bark.* O. Hesse. Annalen, 1894, **282**, 191—207.

From the true coto-bark imported from Bolivia about 20 years ago, Jobst and Hesse (Annalen, **199**, 17) isolated and described two bodies—*cotoïn* and *dicotoïn*. "True coto-bark" has been obtained (since 1889), from the Amazons (Brazil) and from Venezuela. The source of coto-bark is as yet unknown, although it has been stated to be identical with Winter's bark (from *Drimys Winteri*). But according to the author, a comparison of the latter with Bolivia coto shows this to be by no means the case. The present investigations have been made with material prepared from Bolivian coto-bark.

*Cotoïn* ($C_{14}H_{12}O_4$).—The results obtained, establish the identity of Bolivia cotoïn with Merck's cotoïn (from bark from the Amazons) and that derived from Venezuela coto.

*Dicotoïn.*—Two specimens (*B* and *C*) prepared by Tod were examined. *B* was composed of dicotoïn and a little cotoïn. A good method of separation—applicable also to the purification of crude cotoïn—was found to be by treatment with dilute caustic soda solution, which readily dissolves cotoïn, but not dicotoïn. It has been found necessary to modify the formula of dicotoïn from that previously accepted ($C_{44}H_{34}O_{11}$) to $C_{25}H_{20}O_6$ on account of the discovery that it is readily decomposable into cotoïn and another substance, identical in composition ($C_{11}H_8O_2$) with, and closely resembling Ciamician and Silber's *phenylcumalin* (this Journal, 1894, 756), the only difference being in the melting points (61° and 68° C. respectively). Dicotoïn appears to be split up into its components by mere solution in certain solvents; and a separation may be effected by the addition of ferric chloride to an alcoholic solution of dicotoïn. On spontaneous evaporation, a tarry residue mixed with colourless needles of the new compound is obtained, from which the latter may be extracted by petroleum ether. Dicotoïn may be regenerated by mixing solutions of its components in molecular proportions and allowing to crystallise.

*Pseudo-dicotoïn.*—The preparation *C* referred to above is thus designated. It forms sulphur-yellow, monoclinic crystals, and in general closely resembles dicotoïn, differing, *however*, from the latter in composition ($C_{25}H_{20}O_7$). By solution in petroleum spirit, pseudo-dicotoïn is partially decomposed—completely by the action of dilute soda—into cotoïn and a body (provisionally termed *oxyphenylcumalin*) of the formula $C_{11}H_8O_3$, and melting at 61° C. It is soluble in the usual solvents, and when fused with potash yields, besides much benzoic acid, relatively small amounts of another body, β-phenylcumalinic acid, $C_{11}H_{10}O_3$. The latter when heated, is converted into an anhydride melting at 221° C., of the composition $C_{11}H_8O_2$, which may be called *β-phenylcumalin*.

*Paracotoïn.*—This may be prepared by treating crude cotoïn with soda solution. The insoluble residue consisting of para- and dicotoïn yields up only the latter to petroleum spirit. The final residue may be recrystallised from alcohol. Thus obtained, paracotoïn fuses at 149° C., and has the composition assigned to it by Ciamician and Silber (this Journal, 1894, 756).—H. T. P.

### *The Oil from the Seed of Hyoscyamus Niger.* H. Schwanert. Arch. der Pharm. **232**, 130.

This oil, obtained by extracting the fruit with hot alcohol, is a pale greenish-yellow oil of sp. gr. 0·9291. On saponification it yields glycerin, and oleic and palmitic acids. —L. T. T.

### *Balsam of Tamacoaré (Brazil).* F. Pfaff. Arch. der Pharm. **231**, 522.

This balsam, used as a substitute for cubebs, is obtained from *caraipa fasciculata*, which grows chiefly on the banks of the Amazon. It is distinguishable from artificial or adulterated products by being almost inodorous, and soluble in dilute alkalis.—L. T. T.

### *Balsam of Peru or Tolu.* H. Frog. Arch. der Pharm. **232**, 701.

The author has isolated from balsam of tolu *cinnamëin* (about 62—64 per cent.), a yellow liquid distilling at 298°—302° C., cinnamic acid, and a resin. This yellow resin is aromatic, melts at 70°—80°, and is soluble in alcohol. When heated for some days with water or alkali, it yields cinnamic and benzoic acids and *tolu-resinotannol*, $C_{18}H_{20}O_5$, a brown, non-crystallisable powder, insoluble in water and petroleum spirit, soluble in acetone, acetic acid, alkalis, &c.

Examination of the bark of *myroxylon pereira* showed that the balsam did not exist therein ready formed. It is therefore a pathogenic secretion like benzoin.—L. T. T.

### *Gum Benzoin.* F. Ludy. Arch. der Pharm. **231**, 500.

The author has studied the different gum benzoins of commerce. In Sumatra benzoin, the ligneous portion amounts to 12—15 per cent. Of the remainder, the composition is cinnamate of benzoresinol, 5 per cent.; cinnamates of resinotannol, 64 per cent.; cinnamic acid, 30 per cent.; and small quantities of vanillin and benzoic acid. Penang benzoin contains about 10 per cent. of ligneous matter, much benzoic acid, and little or no cinnamic acid. Palembang benzoin contains 7—8 per cent. of impurities, benzoic acid, and no cinnamic acid. The Sumatra benzoïn forms a source for cinnamic acid, and the author recommends the benzoresinol and resinotannol as sources of material for the manufacture of picric acid.—L. T. T.

### *The Presence of Methyl Salicylate in Certain Indigenous Plants.* E. Bourquelot. Comptes rend. 1894, **119**, 802—804.

The author has demonstrated the presence of methyl salicylate—hitherto detected only in certain plants of exotic origin (various species of *Gaultheria*, &c.)—in several indigenous plants of the genera, *Polygala*, and *Monotropa*. The ether occurs in the roots of *Polygala vulgaris* L, *P. depressa*, Wenderoth, and *P. calcarea*, Schultz. Of these, the first named is a common field plant. Its roots when crushed give off a distinct odour of salicylic ether. The latter may be extracted as follows:—The fresh roots are crushed and digested for about ¼ of an hour with water at 60° C. The liquid is filtered, slightly acidulated with hydrochloric acid, and extracted by ether. The ethereal extract when digested at 60° C. with water and tested with ferric chloride yields the violet colour reaction of salicylic acid. In *Monotropa hypopitys*, L, a parasitic plant found on the roots of pine-trees, salicylic ether occurs in the stalks. To separate it, the bruised stalks are digested with 90 per cent. alcohol, the alcoholic solution distilled almost to dryness, and the residue extracted with petroleum ether, which dissolves the methyl salicylate. From this solution, the salicylic acid may be extracted by soda-lye, and the latter, after acidification, extraction with ether, &c., yields crystals of almost perfectly pure salicylic acid.—H. T. P.

### *Essence of Cananga.* A. Reychler. Bull. Soc. Chim. 1894, **11**, 1045—1050.

This essence, obtained under the name *Oleum Canangæ* (Java), has the percentage composition C = 85·68, H = 11·81, O = 2·51. Its specific gravity at 21° is 0·9058, its index of refraction $n$ = 1·49655 and $[\alpha]_D = -28·5°$. A preliminary investigation of the oil has been made, and as a result of the hydrolysis with alcoholic potash, benzoic acid, a resinous acid, and probably acetic acid have been obtained. The distillate from the saponification, separated by means of steam, appears to contain substances of the aromatic series. A substance, $C_{10}H_{18}O$, with a molecular refraction 48·81, has been isolated from the essence, and also a sesquiterpene boiling at 252°—257° C., having a molecular refraction 66·66 and $[\alpha]_D = -32·2$. On heating this substance to 250° C., it has the following physical constants :—Sp. gr. 0·9057 at 17°, $n$ = 1·50103, molecular refraction 66·40 and $[\alpha]_D = -1·25$. The author, in conclusion, referring to a previous paper on Ylang-Ylang essence (this Journal, 1894, 1085), mentions the identity of Ylangol and Linalool. The essence also contains a second compound, $C_{10}H_{18}O$ geraniol.—T. A. L.

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### *Cananga Essence.* M. A. Reychler. Bull. Soc. Chim. 1895, **13**, 140—142.

This essential oil, treated with alcoholic potash, and subsequently distilled with a current of steam, gave a product from which, by fractional distillation, a liquid boiling at 170° to 210° was separated. The ethereal solution of this, was subjected for several days to the action of metallic sodium, whereupon, by distillation in a vacuum, the mixture yielded a volatile oil and a residue consisting of an alcoholate. From the latter, by distillation with a current of steam, a volatile oil was obtained, the greater portion of which after fractionating, had a boiling point of 193° to 200°, and was found identical with linaloöl. The volatile oil resulting from the distillation *in vacuô* of the product obtained by the treatment with sodium, referred to, was subjected to fractional distillation. The fraction passing over between 171° and 175° appeared to be a comparatively pure compound belonging to the aromatic series. By oxidation with chromic acid mixture, it was converted into anisic acid, melting point 178°—179°, the formation of which seems to indicate the presence of the methyl ether of paramethylphenol (boiling point 175°).

The author has previously observed that the most volatile fractions of ylang-ylang oil likewise yield on oxidation an acid melting at 178°, about the identity of which with anisic acid there can be little doubt.

The general resemblance between essence of ylang-ylang and essence of cananga is so close as to make it appear probable that both of them are derived from the same species of plant. The difference in respect of the quantitative composition may be owing to different modes of culture, climatic conditions, or to different processes of manufacture, some manufacturers being known to collect only the first products of the distillation.—F. M.

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### *Hydrochloro-Sulphate of Quinine.* C. Lepierre. Bull. Soc. Chim. 1894, 1138—1139.

The existence of this salt, discovered by Grimaux (Bull. Soc. Chim. 1892, 819; this Journal, 1893, 462) has been disputed, but the author, who has repeated the work, bears out the original statements, and working according to the original directions, he obtains crystals several centimetres in length. Analyses made of the crystals deposited at different times, show that they all have the same composition. Owing to its great solubility (1 part dissolves in 1·1 parts of water in the cold, or at most at a temperature not exceeding 35° C.). The salt is of therapeutic importance, and can be used for hypodermic injections in cases of chronic malarial fever. The salt does not decompose spontaneously, even in aqueous solution, but like many of the quinine salts it is hygroscopic, and must be kept in well-stoppered bottles.—T. A. L.

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### *A Contribution to our Knowledge of the Opium Alkaloids.* O. Hesse. Annalen, 1894, **282**, 208—214.

Certain antagonistic results of Goldschmiedt's relating to the optical properties of laudanine, have induced the author to re-examine his older preparations, with the result that a new, optically active, alkaloid, *laudanidine*, has been isolated from them. It may be separated from laudanine by taking advantage of the ready solubility of its hydrochloride in water. The solution of the two bases is treated with hydrochloric acid, and the precipitation of the laudanine assisted by the addition of common salt. The mother-liquor is then saturated with ammonia and shaken with ether. A small portion of the *laudanidine* is thus extracted, whilst the remainder separates in small crystals. Laudanidine crystallises well from alcohol; its formula ($C_{20}H_{25}NO_4$) is identical with that of laudanine, which base it completely resembles in point of crystalline form, solubility in various media, behaviour towards ferric chloride, sulphuric acid, alkalis, &c. It melts at 177° C. (laudanine at 166° C.), and has a specific rotatory power in chloroform solution, $[\alpha]_D = -87°·8$ (laudanine $[\alpha]_D = O$). Its salts in general crystallise well, and resemble those of laudanine. The hydrochloride, as mentioned above, however, forms an interesting exception. An aqueous solution of this salt becomes turbid on the addition of potassium iodide, and after a time deposits colourless crystals of the hydriodide. With platinic chloride an amorphous brownish-yellow double salt is obtained. When heated with acetic anhydride, laudanidine readily yields an acetyl derivative—

$$C_{20}H_{24}(C_2H_3O)NO_4 + H_2O.$$

The latter is soluble in chloroform and acetone, slightly soluble in ether and water. Its alcoholic solution is coloured a deep green by ferric chloride. Concentrated sulphuric acid dissolves the acetyl derivative, forming a faintly pink solution, or in presence of iron, deep pink. On heating, these colorations change to reddish-violet and deep violet respectively. The base does not combine with hydrochloric acid or platinic chloride, but appears to form compounds with potash and soda.

*Relation of Laudanidine to Laudanine, Codamine and Laudanosine.*—Like laudanine, laudanidine contains three methoxyl groups and one phenolic hydroxyl—

$$C_{17}H_{15}N(OH)(OCH_3)_3$$

Both bases are isomeric with codamine, whilst laudanosine may be considered as their higher homologue. A determination of methoxyl in codamine and laudanosine shows that they must be represented by the formulæ :—(codamine) $C_{18}H_{18}NO(HO)(OCH_3)_2$; (laudanosine) $C_{17}H_{15}N(OCH_3)_4$.

Laudanosine may, therefore, be regarded as the methyl-ether of a dextro-rotatory base, isomeric with laudanidine. The latter is apparently formed by the partial decomposition of laudanine; and, adopting the above theory, laudanine would consist of two bases, possessing equal but opposite optical activities. Laudanosine would be the methyl ether of the dextro-rotatory component. The author intends further investigating the opium alkaloids in this direction.—H. T. P.

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### *Vellosine, an Alkaloid from Pereira-Bark.* M. Freund and C. Fauvet. Annalen, 1894, **282**, 247—267.

Pereira bark (derived from *Geissospermum Vellosii*), which is employed in Brazil as a fever remedy, was investigated by Hesse (Ber. **10**, 2162), who isolated from it two alkaloids, *Geissospermine* (crystalline) and *pereirine* (amorphous). Besides these, a third, crystalline base was observed. A beautifully crystalline base has been recently introduced under the name "Geissospermine"; but in an earlier communication the authors have shown that this preparation is a new alkaloid (this Journal, 1893, 618), whilst Hesse has pointed out the same fact (this Journal, 1894, 416). The new alkaloid, for which the name *Vellosine* is proposed, forms coarse, granular crystals melting at 189° C., and possessing the formula, $C_{23}H_{28}N_2O_4$. It is dextro-rotatory, $[\alpha]_D = +22·8°$ (in chloroform solution). Vellosine combines with only one equivalent of acids, resembling brucine in this respect, as also in the fact that it contains two methoxyl groups. Boiling dilute haloid acids convert it into an amorphous base, *Apovellosine*, of the composition $C_{46}H_{51}N_4O_7$. The latter, contrary to what might be expected, combines with four equivalents of acids, forming salts that crystallise well. Apovellosine contains four methoxyl groups, which are removed by boiling with concentrated hydrobromic acid. The compound produced, *apovellosol*, has, so far, been obtained only in combination with acids.

By fusion with potash, apovellosine is not converted back into vellosine, but yields a beautifully crystalline base, *apovellosidine*, $C_{42}H_{54}N_4O_6$.

The physiological action of vellosine has been studied by M. Schultze, with the following results:—

1. Vellosine is not a local irritant.
2. It is poisonous, 0·005 grm. producing marked effects in frogs, whilst 0·05 grm. proved fatal. Similar results obtained in the case of rabbits with doses of 0·075 and 0·15 grm. respectively.

In its general physiological action, vellosine very closely resembles brucine.—H. T. P.

### *Arrow Poisons of Malacca.* C. G. Santesson. Arch. der Pharm. **231**, 591.

This poison is obtained from the Blay-Hitam, a bind-weed of the species *strychnos*. The alkaloid proved to be almost exclusively brucine, with traces of strychnine and another less toxic alkaloid.—L. T. T.

### *Gaultherine, a New Glucoside from Betula Lenta.* A. Schneegans and J. E. Geroch. Arch. der Pharm. **232**, 437.

The glucoside (first obtained in 1844 by W. Procter) is obtained by extracting the bark with alcoholic lead acetate solution, precipitating by ether, and recrystallising from alcohol. The lead destroys a soluble ferment which effects the hydrolysis of the glucoside when alcohol alone is used for extraction.

*Gaultherine*, $C_{14}H_{18}O_8.H_2O$, forms needles soluble in water or alcohol, not in chloroform, ether, acetone, or benzene. The aqueous solution has a bitter flavour, is levo-rotatory, and reduces Fehling's solution, when boiled. It is hydrolysed by mineral acids, by baryta, or by water at 130°—140° (not by diastase, saliva, or emulsion), giving a sugar and methyl salicylate.—J. T. D.

### *Two Cactus Alkaloids.* A. Heffter. Ber. 1894, **27**, 2975—2979.

*Anhalin* was obtained from *Anhalonium fissuratum.* It forms stellate masses of white prisms, slightly soluble in cold water, more soluble in hot water, and very easily in alcohol, methyl alcohol, ether, chloroform, and petroleum spirit. It melts at 115°, and dissolves in concentrated sulphuric acid, in which, on the addition of a drop of nitric acid, a green coloration is produced.

It forms a sulphate, $(C_{10}H_{17}NO)_2H_2SO_4.2H_2O$, m.p. 197°, a hydrochloride, and an oxalate. As the cactus contains but 0·02 per cent. of the alkaloid, it was not possible to obtain sufficient of it for a complete investigation.

*Pellotin* was obtained from *Anhalonium Williamsi* (Pellote), 0·89 per cent. of alkaloid being obtained. The base is but very slightly soluble in cold water, but easily soluble in alcohol, acetone, ether, and chloroform. It forms hard colourless tabular crystals, m.p. 110°, and has a composition corresponding to $C_{13}H_{21}NO_3$. It dissolves in concentrated sulphuric acid, and on the addition of a spot of nitric acid the solution assumes an intense permanganate colour. It forms salts with one equivalent of acid. Examined by Zeisel's method, pellotin is found to contain two methoxyl groups.—A. L. S.

### *Alkaloids of the Conine Group.* R. Wolffenstein. Ber. **28**, 302—305.

In a previous paper the author described the finding of methylconine in a sample of commercial conine (this Journal, 1894, 1217). He has now detected conicine ($C_{18}H_{15}N$) in commercial conine from *Conium muculatum*; the bases were separated by making use of the different solubilities of their hydrochlorides in acetone. Conicine is optically inactive and amesotomic, and is 17·5 times more poisonous than conine.—A. L. S.

### *Emetine.* H. Kung-Krauser. Arch. d. Pharm. **232**, 466.

Continuing former work (this Journal, 1887, 736), the author finds that emetine, with the formula $C_{30}H_{40}N_2O_5$, resembles quinine. It forms a platinochloride—

$$C_{30}H_{40}N_2O_5.2HCl, PtCl_4,$$

and molecular compounds with chloroform and with petroleum spirit. He has prepared the *sulphate* (a bright yellow and very poisonous body) and the *carbonate of methylemetonium.*

The pure base was isolated by decomposing the platinochloride with sulphuretted hydrogen, evaporating the filtrate, and extracting the residue with ether alcohol. It is a yellow powder of strongly toxic character.

*Ethylemetonium iodide* is prepared by heating emetine with ethyl iodide to 150°—180° in sealed tubes; it crystallises in fine needles soluble in water. The *hydroxide* is similar to that of methylemetonium.

The mother-liquors arising in the preparation of emetine yield a base containing sulphur: a reddish powder, poisonous, forming salts which exhibit a strong fluorescence. Emetine also yields fluorescent derivatives on heating with acetic or benzoic anhydride. The action of hydriodic acid on emetine leads the author to propose the formula $C_{26}H_{27}N_2(OCH_3)_4.OH$ for the base.—J. T. D.

### *Identity of Sophorine and Cytisine.* C. Plugge. Arch. d. Pharm. **232**, 444.

Sophorine is prepared from the bruised seeds of *Sophora tomentosa* by extraction with 60 per cent. alcohol and a little acetic acid. The extract is precipitated by lead acetate and ammonia, the lead removed by hydrogen sulphide, the filtrate supersaturated with sodium hydrate, and the base extracted by chloroform.

Sophorine and cytisine give identical reactions with Erdmann's reagent, strong nitric acid, auric chloride, picric acid, &c., and have the same formula, $C_{11}H_{14}N_2O$. The aurochlorides and platinochlorides of sophorine and cytisine, as also those of methylsophorine and methylcytisine, are identical. The author's work is corroborated by that of Partheil, who has also shown that cytisine and ulexine are identical.—J. T. D.

### *Canadine.* E. Schmidt. Arch. d. Pharm. **232**, 136.

This, the third alkaloid from the root of *Hydrastis canadensis*, has been described by Hale, Prescott, Burt, and Deichmann. Its formula is $C_{20}H_{21}NO_4$, and it yields white silky needles melting at 132·5° C., and becoming yellow when exposed to the light. It is insoluble in water, soluble in alcohol, chloroform, and benzene. The salts are but slightly soluble, except the sulphate: this latter—

$$C_{20}H_{21}NO_4, H_2SO_4 + aq.$$

crystallises in bi-refracting colourless tables or groups of needles. The solution of the sulphate oxidises readily, when exposed to the air, to berberine sulphate. The methiodide melts at 228°—232° C., and with silver oxide yields a quaternary base giving the chloroplatinate—

$$(C_{20}H_{21}NO_4.CH_3Cl)_2PtCl_4$$

Canadine contains two oxy-methyl groups; is converted by iodine into berberine hydriodide according to the equation $C_{20}H_{21}NO_4 + 2I_2 = C_{20}H_{17}NO_4, HI + 3HI$, and is therefore tetrahydroberberine.—L. T. T.

### PATENTS.

*Manufacture of certain Bodies suitable as Remedies.* A. Zimmermann, London. From The Chemische Fabrik auf Actien (vormals E. Schering), Berlin. Eng. Pat. 6033, March 22, 1894.

The following new remedial products are claimed, as described below :—

1. Piperazine tartrate.
2. Tetra-ethyl ammonium tartrate.
3. Piperazine-tetra-ethyl ammonium tartrate.
4. Piperazine citrate.
5. ,, salicylate.
6. Tetra-ethyl ammonium citrate.
7. Piperazine sodium tartrate.
8. ,, potassium ,,
9. ,, lithium ,,
10. Tetra-ethyl-ammonium sodium tartrate.
11. ,, ,, potassium ,,
12. ,, ,, lithium ,,
13. ,, ,, carbonate.
14. ,, ,, acetate.
15. Piperazine lactate.
16. Tetra-ethyl ammonium lactate.
17. Ethenylethylene-diamine citrate.
18. ,, ,, salicylate.

Further claims are the following :—

The manufacture of the carbonic acid salts of organic bases such as tetra-ethyl-ammonium, tetra-ethylene diamine, and hexa-ethylene diammonium hydroxide by the action of carbonic acid upon these bases.

The manufacture of organic acid salts of the bases referred to by the action upon the latter of such organic acids as those figuring in the salts given in the list quoted above.—J. S.

*An Improved Manufacture of Musk-like Substances.* W. Mallmann, Roermond, Holland. Eng. Pat. 417, January 7, 1895.

This invention has reference to the preparation of musk-like substances prepared by nitrating ketones, such as may be obtained from butyl toluene, boiling point 186° C., or butyl xylene, boiling point 200° C., and from the chlorides of the fatty acid series, according to the method of Friedel and Crafts.

Dimethyl-butyl-acetophenone, *e.g.*, is nitrated as follows : —One part of the ketone is introduced into 10 parts of ice-cold fuming nitric acid, sp. gr. 1·525, and the nitrating mass is then poured on ice. The nitro-product is separated, washed with water, thereafter with soda solution, and then re-crystallised from alcohol.—J. S.

*The Manufacture and Production of Mono- and Di-Phenetidin Citric Acids.* J. Y. Johnson, London. From F. von Heyden-Nachfolger, Dresden, Germany. Eng. Pat. 1254, January 18, 1895.

This patent relates to the manufacture and production of two new chemical compounds, mono- and di-phenetidine citric acids. 42 parts of citric acid are heated with 27·5 parts of para-amido-phenetol for some hours at 100°—200° C. The product is dissolved in soda solution, filtered, and the mono-phenetidine citric acid precipitated by the addition of hydrochloric acid. It is purified by crystallising from chloroform or water. In a similar way, the di-phenetidine citric acid is obtained by doubling the quantity of para-amido-phenetol. An equivalent amount of the ether or chloride of citric acid may be employed instead of the citric acid itself, and the separation of water may be effected by the addition of dehydrating agents instead of by heating. It is stated that the mono- and di-phenetidine citric acids and their salts are medicinal substances acting energetically as precipitants, whilst (as is alleged) being free from the objection of producing secondary symptoms. —J. S.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*Development of the Latent Image in Photography by Alkaline Peroxides.* G. A. Le Roy. Comptes rend. **119**, 557.

Solutions of alkaline peroxides, or of hydrogen peroxide rendered strongly alkaline, may be used as developers with gelatin-bromide or gelatin-chloride plates.

They are, however, less active than the ordinary developers, so that the time of exposure must be increased when they are used. The image, too, diminishes considerably in intensity during the fixing process.—J. T. D.

### PATENTS.

*The Reduction of Aromatic Nitrocompounds in a Neutral Solution and the Formation of Aromatic Hydroxylamines serving as Photographic Developers.* Lumière Bros. and A. Seyewetz. Bull. Soc. Chim. 1894, **11**, 1038—1045.

Reductions with iron, zinc, and tin, are generally carried out in acid or alkaline solutions and rarely in neutral ones. The great advantage however, of employing a neutral solution is the fact that the reduction product can be directly separated from the reducing agent, which in other cases is sometimes a tedious operation. On the other hand, reduction in a neutral liquid is frequently of long duration and incomplete. This method is, however, employed on a large scale and good yields obtained. An example of this is the production of aniline from nitrobenzene, which is carried out by means of a large quantity of iron and a very small quantity of hydrochloric acid. The authors cite Wohl's explanation (this Journal, 1894, 1188) of this reaction, and have applied the method to nitramines and nitrohydroxy-compounds in order to obtain diamines and amidophenols, but have only obtained small yields of impure products. Bamberger (Ber. **27**, 1347 and 1548) and Wohl (Ber. **27**, 1433) have shown that in the formation of aniline, β-phenylhydroxylamine is an intermediate compound, and they have obtained good yields of this product by reducing nitrobenzene with zinc dust in presence of a small quantity of chloride of zinc, calcium, or magnesium. By applying this method to nitramines and nitrohydroxy compounds with a view of obtaining the corresponding hydroxylamines, the authors of the present paper have found that in all cases the reduction has been complete, resulting in the formation of diamine and amidophenol. The products are, however, very pure, and an almost theoretical yield is obtained. With homologues of nitrobenzene, the method yields the corresponding hydroxylamine. For instance, a mixture of 30 grms. of *p*-nitrotoluene, 200 c.c. of water, 350 c.c. of alcohol, and 12 grms. of dry calcium chloride is heated to boiling. After removing the flame, 150 grms. of zinc dust in portions of 25 grms. are added in the course of half-an-hour. The whole is then boiled for about another half hour, the liquid decanted from the zinc oxide, and the alcohol distilled off. A yellowish crystalline mass is obtained, which, after drying on a porous plate, is washed with petroleum spirit. The resulting product *p*-tolyl-β-hydroxylamine $CH_3.C_6H_4.NHOH$ forms white plates melting at 92°—93° C. The substance dissolves to the amount of 1 per cent. in cold, and 5 per cent. in hot water, and is gradually converted in this solution into *p*-azoxy-toluene melting at 75° C. The same reaction takes place when the substance is heated to 115°—120° C. The hydrochloride forms white needles sparingly soluble in water. On boiling with mineral acids, it is converted into amidocresol, and gives with sodium nitrite a nitroso compound melting at 57°—58° C. It also combines with benzaldehyde and formaldehyde. Orthonitrotoluene forms an oily hydroxylamine, *o*-nitro-*p*-xylene $[(CH_3)_2:NO_2 = 1:4:2]$ gives a hydroxylamine melting at 88°—89° C. Tolylhydroxylamine and its homologues are photographic developers. The same method of reduction has been applied to α-nitronaphthalene, but, although a solution is obtained which reduces Fehling's solution in the cold, the reaction cannot be stopped at the formation of the hydroxylamine, and α-naphthylamine is the only product which could be isolated.—T. A. L.

*The Reactions caused by the Decomposition of Sodium Thiosulphate in Fixing Photographic Images.* Seyewetz and Chicandard. Bull. Soc. Chim. 1895, **13** [1], 11.

The authors have investigated some of the decompositions of "hypo," to which are due the alterations which gradually occur in photographic plates and in combined fixing and toning solutions for sensitised papers. They confine themselves in this paper to the action on sodium thiosulphate when present in large excess, of acids and of alum.

When acids act on excess of the thiosulphate, sulphur, hydrogen sulphide, sulphurous acid, and sodium sulphate are found. The author's explanation of the actions is, that acid sodium thiosulphate is first formed—

$$2Na_2S_2O_3 + 2HR = 2NaR + 2NaHS_2O_3,$$

(where R is a monad acid radical), which then breaks up—

$$2NaHS_2O_3 = Na_2SO_4 + SO_2 + H_2S + S.$$

The secondary actions of the sulphur dioxide (or sulphurous acid) and the hydrogen sulphide, so formed, on thiosulphate and on each other were next examined. That of sulphurous acid on excess of sodium thiosulphate, was found to be exactly like that of any other acid; that of hydrogen sulphide on thiosulphate, is slowly to form acid sodium sulphite, sodium hydrosulphide, and sulphur—

$$Na_2S_2O_3 + H_2S = NaHSO_3 + NaHS + S;$$

whilst the mutual action of sulphurous acid and hydrogen sulphide, yields sulphur, water, and pentathionic acid, the latter then acting on excess of thiosulphate like any other acid. These secondary actions take place but slowly, so that it is several days before sulphur ceases to deposit.

Aluminium sulphate acting in the cold on excess of sodium thiosulphate first furnishes aluminium thiosulphate—

$$3Na_2S_2O_3 + Al_2.(SO_4)_3 = Al_2(S_2O_3)_3 + 3Na_2SO_4,$$

which slowly acts on the water, giving hydrogen sulphide and regenerating aluminium sulphate—

$$Al_2(S_2O_3)_3 + 3H_2O = Al_2(SO_4)_3 + 3H_2S.$$

The hydrogen sulphide acts on the thiosulphate as above, whilst the aluminium sulphate would, by its continuous regeneration, eventually decompose the whole excess of thiosulphate were it not that the acid sodium sulphite formed by the hydrogen sulphide, decomposes it, with formation of sodium sulphate and acid aluminium sulphite, neither of which acts on the thiosulphate, so that a limit is eventually reached beyond which the decomposition does not proceed. The amount of acid sodium sulphite needed to prevent all action of alum on sodium thiosulphate, varies with the proportions of the two latter, being, for a mixture of 20 grms. of "hypo" and 1 grm. of alum one-fifth, and for a mixture of 20 grms. of "hypo" and 80 grms. of alum, one-hundredth of the weight of the alum.—J. T. D.

## PATENTS.

*A Process for the Reproduction of Objects, either in Relief or in Intaglio, with the Aid of Photography.* M. Russo and G. B. Zanardo, Rome. Eng. Pat. 3121, February 13, 1894.

A negative of the object to be reproduced is first obtained; this should be strongly developed, but without having its transparency impaired. From it a transparent positive is made of approximately the same density. The sensitive plate to be used, is made by filming a ground-glass plate with bichromated gelatin, and upon this laying a sheet of non-sensitised gelatin about 5 mm. thick, and then again coating the surface of this with the bichromated gelatin. This specially-prepared plate is exposed under the negative and positive, which are superimposed in such a way that the details are slightly out of register, the object being to produce a relief effect, eliminating the difference in colour of the various parts of the object to be reproduced. The exposure required is three to four hours in sunlight. After exposure, the plate is developed by washing in water until the desired relief is obtained, after which it is immersed in a 5 per cent. solution of sulphate of iron for several hours, being then ready for use to produce the mould from which reliefs may be produced by electrotyping, &c.—J. C. C.

*Improvements in the Manufacture of Photographic Printing Plates.* A. Zimmermann, London. From The Chemische Fabrik auf Actien vormals E. Schering, Berlin, Germany. Eng. Pat. 4276, February 28, 1894.

In Eng. Pat. 2036 (this Journal, 1895, 65) a process is described for rendering gelatin insoluble, by treatment with formic aldehyde; as, however, this substance and its sulphite are not sensitive to light, the object of this invention is to obviate this difficulty. Thus, plates coated with formalin gelatin, are previously treated with an aqueous solution of some substance capable of evolving oxygen under the influence of light—ferric chloride for example,—and exposed under a negative. The light acting upon the ferric chloride develops oxygen, which oxidises the formic aldehyde to formic acid, thereby making the insoluble film soluble in those parts where the light has been transmitted, thus giving a diapositive from a positive, after development by washing. As the sulphite does not act as a hardener, gelatin treated with it is soluble; if, however ferric chloride or other similar substance be present, the sulphite is oxidised and the formic aldehyde liberated, where acted upon by light, also the gelatin is hardened in those parts. By this method, a positive can be obtained from a negative in contra-distinction to the first method described.

—J. C. C.

# XXII.—EXPLOSIVES, MATCHES, Etc.

## PATENTS.

*Improvements in the Manufacture or Production of Phosphorus and Compounds thereof.* A. Shearer and R. R. Clapp, Forest Gate. Eng. Pat. 7636, April 17, 1894.

Phosphorus is produced by this process, by subjecting native phosphate of alumina, a metallic chloride, and carbon to the action of hydrochloric acid gas. The calcined phosphate of alumina, together with the chloride and carbon, are ground to a fine powder, and heated in a suitable retort provided with an opening for the hydrochloric acid gas, and an outlet for the vapours. The reaction may be regarded as proceeding in two stages, the first requiring about 10 hours at a full red heat, and may be represented thus:—

$$Al_2O_3P_2O_5 + 4NaCl + 6HCl + 3C =$$
$$(Al_2Cl_64NaCl) + 6H + 3CO + P_2O_5.$$

The mass is then raised to a white heat, when phosphorus and carbonic oxide are produced according to the following reaction: $P_2O_5 + 5C = P_2 + 5CO$. This latter reaction requires about 30 hours, varying according to the amount of phosphorus present.—S. P. E.

*Preparation of Ammonium Chromates and of Explosive Compounds.* V. J. Feeny. Communicated from the United States Smokeless Powder Co., San Francisco. Eng. Pat. 19,684, October 16, 1894.

A solution of potassium chromate or bichromate is added to a solution of ammonium picrate, whereby ammonium chromate or bichromate and potassium picrate are formed;

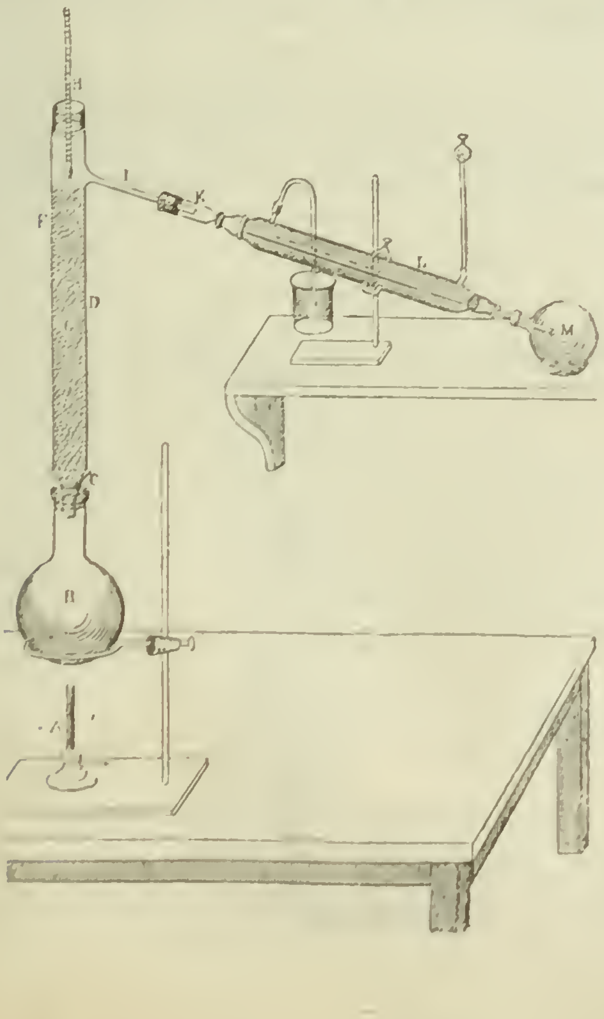
the latter being insoluble in water, is precipitated in the form of fine crystals, whilst the solution of the chromate or bichromate of ammonia is evaporated to dryness. For the manufacture of explosive compounds, the picrate of ammonia is used in excess of that required to produce potassium picrate; thus 14 parts by weight of bichromate are dissolved in the least possible quantity of water, to this are added 86 parts by weight of picrate of ammonia, and then evaporated to dryness by hot air. By this means 12 parts of bichromate of ammonia, 25 parts of picrate of potassium, and 63 parts of picrate of ammonia, are obtained. If the picrate of potassium be in excess of that required for the explosive, a portion may be removed previous to evaporation.—S. P. E.

# XXIII.—ANALYTICAL CHEMISTRY.

## *APPARATUS, ETC.*

### *Laboratory Apparatus for Fractional Distillation.* M. P. Monnet. Bull. Soc. Chim. 1895, **13**, 108—114.

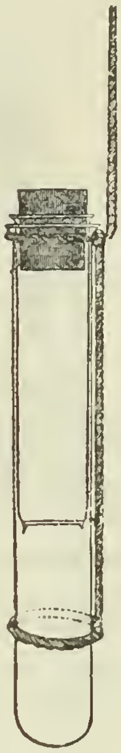
The rectifying tube of the apparatus represented in the accompanying figure, consists of a plain glass tube, from 14 ins. to 16 ins. in length, and having an internal diameter of from $1\frac{1}{8}$ ins. to $1\frac{3}{8}$ ins. It is filled with granules of metal or fragments of glass or quartz. These are retained by means of a small corrugated funnel *c*, which at the same time allows of a free passage of the vapours. Ordinary lead shot may advantageously be employed, the lower half of the tube being charged with a large, the upper with a smaller size. For very volatile liquids, the length of the tube may be increased and a number of layers of shot of different size may be used, each layer being separated from the successive finer one by the introduction of a disc of copper gauze. By this arrangement the various-sized pellets can readily be kept separate when being removed from the tube.



In efficiency, this fractionating tube compares favourably with the rectifying columns used in working on a large scale. By a single slow distillation, the author succeeded in obtaining 95 per cent. of the total alcohol, at a strength of from 93° to 95°, from a mixture of equal parts of alcohol and water. The separation of mixtures of toluene and benzene, methyl alcohol and acetone, aniline and ortho-toluidine, also gave good results.—F. M.

### *A Simple Laboratory Hydro-Extractor.* G. W. A. Kahlbaum. Ber. 1895, **28**, 391.

This is an extremely simple laboratory apparatus for separating crystals from their mother-liquor. It consists (see figure) of two test-tubes, one fitting into the other. The bottom of the narrower, which is also the shorter one, is cut off, and a piece of platinum gauze is fused on to it, as in a Linnemann's column. This narrower tube is filled with the crystals to be extracted, closed with a cork, and fitted into the wider tube, which is tied round with cord. The whole apparatus may, for safety, be fitted into a thermometer case and this fixed in a net of cord.



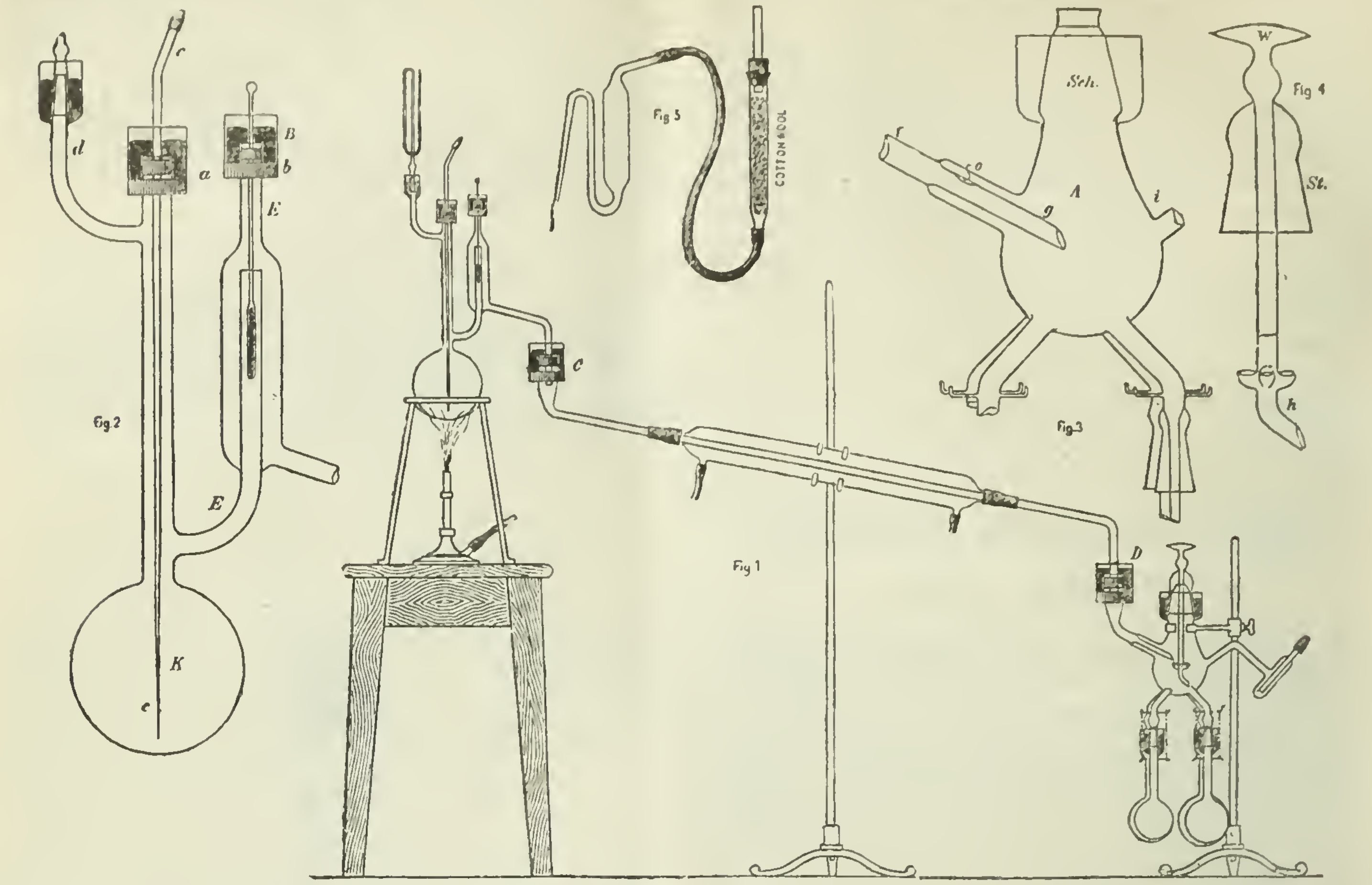
The apparatus is put into use by taking the end of the cord in the hand and swinging it rapidly round for a short time.

The apparatus is especially suitable for extracting crystals which melt at a low temperature, say 20° or under, and which are thus not easy to separate from the mother-liquor by pressing in filter paper or on porous plates. Recrystallised acetophenone, drained for 24 hours in an exsiccator, gave in Beckmann's apparatus a solidifying point of 19·11°. Extracted in the apparatus described, the solidifying point was raised to 19·46°.—H. M.

### *Apparatus for Fractional Distillation at very Low Pressure.* G. W. A. Kahlbaum. Ber. 1895, **28**, 393.

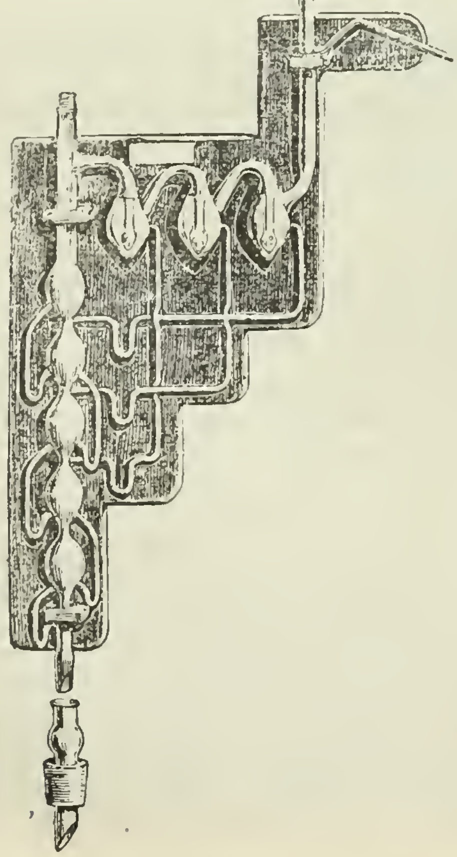
This is a laboratory apparatus with which fractional distillation may be carried on at extremely low pressures, even under 3 mm., with the aid of a mercury pump.

It consists of—(1) a fractionating flask, K (Fig. 2), of peculiar shape, fitted with a manometer (at *d*, Fig. 2), a thermometer, and a capillary air inlet, *c*, *c*, to secure quiet ebullition; (2) an ordinary condenser; and (3) a pear-shaped receiver, A, connected with the pump at *i*, and with four small flasks to collect the distillate. The liquid to be distilled is introduced into K (Fig. 2) through *d* by means of a small funnel drawn out to a point. In order to make the connections perfectly air-tight, they are all secured by mercury lutes (*d*, *a*, *b*, Fig. 2, and *c*, *d*, Fig. 1). After a distillation, and before opening the apparatus, the mercury in the lute-cups should be removed by means of a pipette, shown in Fig. 5.—H. M.



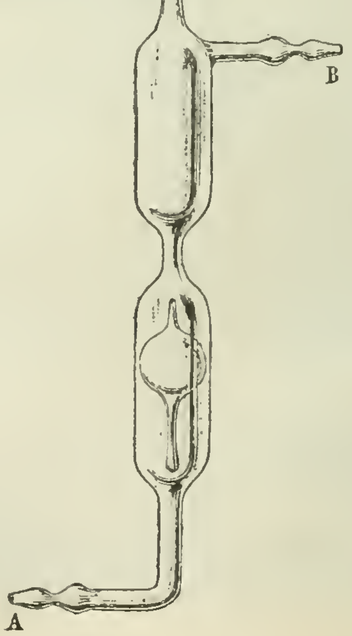
*An Improved Rectifier for Fractional Distillation.* E. Barillot. Bull. Soc. Chim. 1894, **11—12**, [3], 929—931.

THE apparatus (see drawing) consists of an ordinary Le Bel-Henninger fractionator, modified by the addition to its upper end, of a horizontal series of bulbs, each of which is connected to the upright column by a separate over- or back-flow tube. The lateral bulbs may be provided with internal dipping-tubes; and the number of them employed in series must depend on the number of bulbs in the Le Bel tube, and may suitably be less by two. Experiments with various mixtures of methyl alcohol and acetone have shown the analysing power of the apparatus to be very considerable.—H. T. P.



*Safety-Valve for Water Vacuum Pump.* Berlemont. Bull. Soc. Chim. 1895, **13** 33—34.

THIS apparatus is intended to avoid the rushing back of the water into an exhausted vessel on the arrest of the water



supply at the pump. The formerly-used valves of caoutchouc for this purpose are in this contrivance replaced by a glass valve, whose upper surface is ground to fit the tube, and which, on stopping the water, closes the apparatus completely. The advantage which the apparatus presents is that the use of india-rubber is avoided, and as a consequence it is much more lasting, and may be used with ether, benzene, and carbon bisulphide, which would destroy india-rubber.

The annexed figure will illustrate the construction of the apparatus :—A is joined to the pump, $B^1$ to the vessel to be exhausted, and B may be attached to a second vessel or to a manometer. The hollow bulb, sealed at either end, inside the lower compartment of the apparatus, and serving as a valve, is so arranged that when the water enters below it, it floats, and by rising and fitting as a plug into the opening above, it prevents the further progress of the water.—H. I.

## INORGANIC CHEMISTRY.—QUALITATIVE.

### *Sulphides of Nickel and Cobalt.* A. Villiers. Bull. Soc. Chim. 1895, **13** [4], 165—169.

When a solution of caustic soda which has been saturated with sulphuretted hydrogen is added quickly to one containing a nickel salt, much of the nickel sulphide remains dissolved, but if the addition be made gradually, nearly the whole of the sulphide will be precipitated. This supports the author's view that nickel sulphide exists in a soluble modification at the moment of its formation, and becomes insoluble if time be allowed for it to undergo condensation. A slight excess of acid will completely precipitate nickel sulphide from its solution in alkalis.

Cobalt sulphide will only dissolve in alkaline sulphides which contain a large excess of sulphur, and then only to a slight extent. It may be concluded either that cobalt sulphide does not exist in a soluble modification, or that this form of it is so transient, that the alkali fails to retain it in solution.—A. G. B.

### *Qualitative Separation of Nickel from Cobalt.* A. Villiers. Bull. Soc. Chim. 1895, **13**, [4], 170—171.

The author applies the facts detailed in the preceding abstract to the separation of cobalt from nickel. The sulphides precipitated in the usual course of analysis by ammonium sulphide, are boiled with dilute hydrochloric acid, and the residual black sulphides dissolved in aqua regia; the solution is evaporated to expel the bulk of the acid, tartaric acid is added, and this is followed by a large excess of caustic soda (potash will not serve). The liquid is next saturated with sulphuretted hydrogen and filtered immediately; the presence of a notable proportion of nickel will be detected by the black colour of the filtrate, which will only be brown if the nickel be present in traces. A colourless filtrate proves with certainty the absence of nickel, but if the original liquid contain only a small quantity of cobalt and is dilute, the filtrate may be coloured by cobalt sulphide; the addition of a large excess of soda will, however, obviate the chance of error from this cause.

A small proportion of nickel sulphide, dependent on the concentration of the liquid, remains behind with the cobalt, and contrariwise, a small proportion of cobalt sulphide will pass into solution if a large excess of nickel be present. Ammonium salts interfere with the reaction. The behaviour of nickel salts in ammoniacal solution, with ammonium sulphide containing sulphur, is already well known; the author refers to it as a means for detecting nickel.—A. G. B.

### *Detection of Traces of Copper by the Action of Hydrobromic Acid on Copper Salts.* G. Denigès. Bull. Soc. Chim. 1894, **11**, 1024—1027.

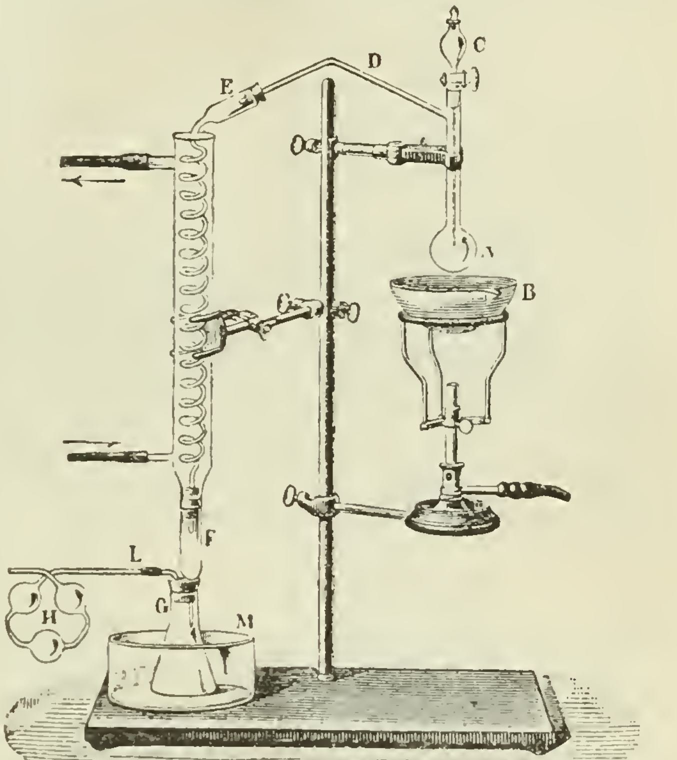
The author gives details of a method he described in 1889 (this Journal, 1889, 420), for detecting traces of copper, and he also replies to Sabatier (Bull. Soc. Chim. 1894, 683; this Journal, 1894, 1092) who has criticised the method and substituted orthophosphoric acid for the sulphuric acid originally employed. The method now employed is as follows :—A solution of 25 grms. of potassium bromide in 50 c.c. of water is cooled to 15° C., and to this solution are added drop by drop, 25 c.c. of pure sulphuric acid. After cooling, the clear solution (which is colourless in the absence of bromate) is decanted or filtered off. If a solid or liquid containing copper be added to this solution a purple red colour is produced. The test succeeds even in presence of cobalt and nickel. The reagent can be kept some time, and in the event of its turning yellow the addition of a trace of sodium bisulphite will decolourise it.

—T. A. L.

## INORGANIC CHEMISTRY.—QUANTITATIVE.

### *The Estimation of Boron.* H. Moissan. Bull. Soc. Chim. 1894, **11** [18—19], 955—958.

The author makes use of Gooch's method, slightly modified so as to render it more rapid and accurate. The apparatus —shown in the drawing—is employed, consisting of a small long-necked distilling flask A, fitted with a tap-funnel C ground in, the tube of which reaches nearly to the bottom of the flask. The flask is connected to a spiral condenser and a receiver G, standing in a dish of cold water M. A set of bulbs, H, containing dilute ammonia is joined to the receiver, and serves to retain small amounts of methyl borate that volatilise over.



*Process.*—The boron, prior to separation, must be converted into boric acid, and this may usually be effected by heating the substance under examination with nitric acid in a sealed tube. The boric acid or borate is then transferred to the distilling flask, using as little liquid as possible, 1 c.c. of nitric acid added, and distilled to dryness. 10 c.c. of methyl alcohol are next added and distilled off completely, the operation being repeated four times. 1 c.c. of nitric acid and 1 c.c. of water are again added, distilled off, and the treatment with methyl alcohol repeated (three or more times) until all the boric acid has been driven over. This point may be recognised by inflaming a drop of the final distillate, collected on filter paper. No trace of green coloration should be visible in the flame. The main distillate and contents of the bulbs are subsequently transferred to a platinum dish, containing an excess of lime (8—10 grms. to 0·5 grm. of boric acid), and of known weight, the temperature being, if necessary, kept low by placing the dish in ice water. After about 15 minutes, the liquid is cautiously evaporated at a temperature below that of boiling methyl alcohol. This is an operation requiring much time and attention. The temperature is then gradually raised until the mass is completely dried, and the dish finally heated over the blow-pipe until constant in weight. The increase of weight represents boric anhydride.

The lime employed must be prepared when required, by strongly heating until constant in weight, a suitable amount of basic calcium nitrate. The latter is obtained by partially decomposing calcium nitrate by heat. In the basic state, the salt may be conveniently stored. Four test analyses made with boric anhydride yielded very concordant results, the average amount recovered being about 99·7 per cent.

—H. T. P.

### *Volumetric Estimation of Salts of Zinc.* L. Barthe. Bull. Soc. Chim. 1895, **14** [2], 82—85.

When a dilute solution of a zinc sulphate is titrated with caustic potash until the liquid is neutral to phenol phthalein a precipitate is formed, which has constantly the composition $(ZnO)_4ZnSO_4$. A similar compound is also obtained with the nitrate and acetate, but not with the chloride. The quantity of zinc can readily be obtained by multiplying the c.c. of KOH $\left(\frac{N}{10}\right)$ required, by the factor $\frac{00325 \times 5}{4}$, where 32·5 is the equivalent of zinc. In practice, in order to analyse a zinc salt (sulphate or nitrate), one-thousandth of its equivalent is dissolved in 100 c.c. distilled water, or a 1 per cent. solution may be employed. In 10 c.c. of this liquid, diluted to approximately 100 c.c., and the excess of acid is determined by means of rose bengal. In a second similar sample the amount of KOH required for neutralisation (with phthalein as indicator) is obtained. After subtracting the amount required in the first from that in the second, the quantity of zinc can readily be calculated. Incidentally the author has found that the precipitate produced by KOH, when added to a zinc solution in quantity insufficient for complete neutralisation to phenol phthalein, is not the above, but has rather the composition $(ZnO)_3ZnSO_4$, a salt previously obtained by other methods by Kane and Schindler, this by the further addition of alkali is changed into the former compound.—H. I.

### *Estimation of Phosphorus in Iron and Steel, &c.* P. Bénazet. Bull. Soc. Chim. 1894, **11**, [22], 1083—1091.

The author has carried out a very large number of analyses in order to compare the results obtained by means of the various methods now chiefly used for estimating the amount of phosphorus in the phosphomolybdate precipitate, (1.) *Direct weighing of the precipitate dried at 100° on a tared filter.* The precipitate is washed with cold water containing 1 per cent. of nitric acid and dried at 100° till the point of the filter begins to turn blue. The precipitate then contains 1·63 per cent. of phosphorus. (2.) *Calcination at 400°—500°.* For this method, Meinecke gives the factor as 1·764 per cent. In 200—300 analyses made by the author, the calcined precipitate contained from 1·78—1·81 per cent. He therefore recommends 1·80 as the best factor which gives very satisfactory results, though when the quantity of phosphorus is large (above 0·1 per cent.), this factor may give results which are a shade too high. Care must be taken not to allow the temperature to become too high. (3.) *Colorimetric estimation by solution of the phosphomolybdate in stannous chloride.* The solvent solution consists of stannous chloride, 12 grms. dissolved in 80 cc. of hydrochloric acid and made up to 1 litre. The process is unsatisfactory for percentages above 0·025, as the blue colour then becomes too intense. The colour is not very persistent, which also makes the test troublesome. (4.) *Volumetric estimation: Reduction of the precipitate with zinc and re-oxidation with potassium permanganate.* The precipitate is dissolved in the least possible quantity of weak ammonia, excess of sulphuric acid added, then 8—10 grms. of pure zinc, and the whole boiled. The liquid becomes brown and then pure green. The latter colour shows the completion of the reaction, but the boiling should be continued for about five minutes longer. It is best always to boil for half-an-hour. The solution is decanted from the zinc, and re-oxidised by a permanganate solution containing 1·8 grms. of $K_2Mn_2O_8$ in a litre of water. As a result of a large number of tests, the authors confirm Blair's contention that the reduction of the $MoO_3$ is to $Mo_{12}O_{19}$ and not to $Mo_2O_3$. In standardising the permanganate solution by means of iron, 100 mgrms. of iron are therefore equal to 1·628 mgrms. of P.

The results of all four methods are satisfactory, but on the whole, (2) is probably the most generally useful.

—L. T. T.

### *Chromates of Iron.* C. Lepierre. Bull. Soc. Chim. 1894, 1115.

*See under* XIII., *page* 372.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *The Bleaching Powder Test for Aniline.* R. Nietzki. Ber. **27**, 3263—3264.

Aniline from various sources gives the well known colour reaction, but an excess of bleaching powder is necessary in order that the test may succeed properly, which Hantzsch and Freese appear to have overlooked. In testing for aniline salts in solution, the acid must have been previously neutralised by caustic alkali. An excess of the latter is not prejudicial, whereas sodium carbonate interferes with the delicacy of the reaction. (See page 398.)—T. A. L.

### *Tests for Vegetable Waxes.* Bayerisches Ind. und Gewerbebl. **25**, 21.

The following analytical method is given for the distinction and identification of the various kinds of vegetable wax:—

One part of the sample to be tested, is dissolved by the aid of heat, in 10 parts of chloroform. The solution is cooled by immersion in cold water.

I. The chloroform solution remains clear after cooling.
  (*A.*) The wax is completely soluble in ether.
    (*a.*) An alcoholic solution of ferric chloride produces a precipitate in the alcoholic wax solution which remains insoluble on boiling: wax of *Myrica quercifolia.*
    (*b.*) The alcoholic solution is turned black by the addition of ferric chloride: wax of unknown species of Myrica.
    (*c.*) The alcoholic solution assumes a brownish colour on addition of ferric chloride, no precipitate being formed: wax of *Myrica cerifera, Orizaba wax.*
  (*B.*) The wax is but partly soluble in ether. A small piece of the wax is saponified by boiling with 10 times its weight of an alcoholic potash solution. The alcoholic soap solution is boiled with 100 parts of water.
    (*a.*) Complete solution takes place: *Japan wax.*
    (*b.*) The soap is only partially soluble: *African beeswax.*
II. The chloroform solution becomes turbid on cooling.
  (*A.*) An alcoholic solution of lead acetate, added to an alcoholic solution of the wax produces a turbidity after 5 minutes standing: *wax from stick-lac.*
  (*B.*) The mixture of the alcoholic solutions remains clear.
    (*a.*) The ethereal solution of the wax mixed with its own volume of alcohol, turns turbid: *Carnauba wax.*
    (*b.*) The ethereal solution remains clear: *Bahia wax.*—F. M.

### DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (*Continued from page 312.*)

A. Lehne and A. Rusterholz. Färber Zeit. 1891 *et seq.*

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| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 67.<br>Wool Scarlet R. [Sch.]<br>(*Animal fibre.*) | *Conc.*:—Fibre darker; on addition of water—fibre assumes original colour, liquid faint rose.<br>*Dil.*:—Heated—liquid pale bluish-red; with excess of soda-lye—more inclined to yellow. | *Conc.*:—Fibre at first darker, then again brighter. On addition of water—fibre orange, liquid reddish.<br>*Dil.*:—Heated—fibre bright yellow, liquid colourless. | *Conc.*:—Fibre darker, liquid bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid faint brick-red. On addition of water—liquid rose.<br>*Dil.*:—Warmed—fibre bright orange, liquid brick-red; on acidification—liquid more inclined to blue. | Same as dilute soda-lye, but somewhat fainter. | .. .. | .. .. | .. .. |
| 68.<br>Azoeosine. [By.]<br>(*Animal fibre.*) | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint rose. | *Conc.*:—Fibre somewhat darker, then brighter, and finally yellow.<br>*Dil.*:—Heated—fibre yellow, liquid colourless. | *Conc.*:—Fibre dark red; on addition of water—fibre as originally, liquid pale rose.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately orange, liquid colourless; the original colour is not restored on addition of water.<br>*Dil.*:—Fibre immediately orange; heated—fibre bright orange, liquid pale orange; on acidification—faint bluish-red. | Heated—fibre orange, liquid faint orange; on acidification—bluish-red. | Slowly decolorised on warming. | Colouring matter only slightly extracted on boiling. | .. .. |
| 69.<br>Azorubine S. [A.]<br>Fast Red C. [B.]<br>Carmoisine. [By.]<br>Azorubine A. [C.]<br>Acid Azorubine. [D.]<br>(*Animal fibre.*) | *Conc.*:—Heated, with subsequent addition of water—liquid red.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda-lye—no change. | *Conc.*:—Fibre somewhat darker, then brighter, and finally yellow; on addition of water—liquid bright yellow.<br>*Dil.*:—Warmed—fibre yellow, liquid yellowish; with excess of ammonia—intensely golden-yellow. | *Conc.*:—Fibre and liquid at first reddish-violet; on addition of water—original colour restored, liquid intensely red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark red, liquid brownish; on addition of water—fibre brighter, liquid red.<br>*Dil.*:—Warmed—liquid intensely red; on acidification—bluish red. | Fibre unaltered, liquid rose. | Fibre decolorised on boiling. | .. .. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 70.<br>New Coccinine. [A.]<br>Brilliant Ponceau. [C.]<br>Cochineal Red A. [B.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid red.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda lye—colourless. | *Conc.*:—Fibre and liquid at first dark red, becoming by degrees yellow.<br>*Dil.*:—Heated—fibre yellow, liquid yellowish; with excess of ammonia—no alteration. | *Conc.*:—Fibre reddish-violet, liquid intensely reddish-violet. On addition of water—fibre as originally, liquid intensely red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated with subsequent addition of water—fibre dark brown, liquid brownish.<br>*Dil.*:—Fibre immediately brown, liquid on heating brownish; acidified—bluish-red. | Colouring matter extracted on boiling. | Fibre almost decolorised on boiling (yellowish). | .. .. | .. .. |
| 71.<br>Double Brilliant Scarlet 3 R [By.]<br>Double Scarlet S. [A.]<br>Brilliant Ponceau. [By.]<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre darker, liquid reddish; on addition of water—fibre as originally.<br>*Dil.*:—Heated—liquid faint bluish-red; with excess of soda-lye—liquid more inclined to yellow. | *Conc.*:—Fibre Bordeaux red, liquid reddish. On addition of water—fibre as originally.<br>*Dil.*:—Heated—fibre yellow, liquid yellowish; with excess of ammonia—intensely yellow. | *Conc.*:—Fibre dark Bordeaux red, liquid reddish. On addition of water—fibre as originally.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated, with subsequent addition of water—fibre and liquid orange.<br>*Dil.*:—Heated—fibre bright orange, liquid pale brick-red; on acidification—faint brick-red. | Heated—liquid faint reddish colour. | Warmed—fibre slowly decolorised. | .. .. | .. .. |
| 72.<br>Pyrotin R P O. [D.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark violet, liquid colourless; on addition of water—the original colour restored, liquid reddish.<br>*Dil.*:—Heated—liquid bright red; with excess of soda-lye—no change. | *Conc.*:—Fibre and liquid deep blue; on addition of water—both red.<br>*Dil.*:—Fibre darker; warmed, fibre and liquid—brownish-yellow. With excess of ammonia—intensely yellow. | *Conc.*:—Fibre and liquid reddish-violet; on addition of water—both red.<br>*Dil.*:—Heated—liquid bluish-red; with excess of soda-lye—more yellowish shade. | *Conc.*:—Fibre dark reddish-brown, liquid brownish; acidified—rose. | Heated—liquid intensely yellowish-red. | Fibre at first darker, then on heating colourless. | Liquid scarcely coloured. | Colouring matter readily extracted on boiling with ammonium acetate solution. |
| 73.<br>Azarine S. [M.]<br>(*Vegetable fibre.*) | *Conc.*:—Heated—fibre faint yellowish-rose.<br>*Dil.*:—Same as concentrated. | *Conc.*:—Liquid bluish-red.<br>*Dil.*:—Warmed—liquid bluish-red; heated—fibre decolorised, liquid yellowish. | *Conc.*:—Fibre and liquid reddish-violet; on addition of water—both orange.<br>*Dil.*:—Fibre orange, liquid faint orange. | *Conc.*:—Fibre reddish-violet, liquid faint reddish tint.<br>*Dil.*:—Heated—fibre darker, liquid bluish-red. | Same as dilute soda-lye. | Cold—liquid bluish-red; heated—fibre colourless, liquid yellowish. | Colouring matter extracted with production of a bluish-red solution. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 74.<br>Ponceau 6 R. [M.] [B.]<br>(*Animal fibre.*) | *Conc.* :—Heated—liquid bluish-red.<br>*Dil.* :—Heated—liquid intensely bluish-red: with excess of soda-lye—brownish. | *Conc.* :—Fibre scarlet, liquid reddish; on addition of water—fibre orange, liquid bright orange.<br>*Dil.* :—Heated—liquid bluish-red, then fibre yellow, liquid yellowish. | *Conc.* :—Fibre dark violet; on addition of water—colour restored, liquid rosaniline red.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre immediately reddish-brown, liquid brownish.<br>*Dil.* :—Fibre immediately reddish-brown, liquid brownish; acidified—bluish-red. | Heated—liquid intensely bluish-red. With excess of soda-lye—brownish. | Warmed—fibre and liquid colourless. | .. .. | Boiled with ammonium acetate solution—liquid intensely bluish-red; on addition of soda-lye—brownish. |
| 75.<br>Cotton Scarlet. [B.]<br>Brilliant Crocein. [C.]<br>(*Animal and vegetable fibres.*) | *Conc.* :—Fibre dark reddish-brown, liquid colourless: on addition of water—colour restored.<br>*Dil.* :—Heated—liquid bluish-rose: with excess of soda-lye—almost decolorised. | *Conc.* :—Fibre and liquid dark blue; on addition of water—the original colour restored, liquid reddish.<br>*Dil.* :—Fibre at first dark Bordeaux, liquid reddish violet; then fibre yellow, liquid almost colourless. With excess of ammonia—liquid bright yellow. | *Conc.* :—Fibre and liquid reddish-violet; on addition of water—original colour restored on the fibre, liquid reddish.<br>*Dil.* :—Heated—liquid bluish-rose; with excess of soda—colourless. | *Conc.* :—Fibre immediately dark reddish-brown, liquid faint brownish tint.<br>*Dil.* :—Fibre immediately reddish-brown. | Heated—liquid bluish-red. | Decolorised on gently warming. | Scarcely any perceptible action. | .. .. |
| 76.<br>Cloth Red B. [O.]<br>(*Animal fibre.*) | *Conc.* :—Fibre dark reddish-violet: on addition of water—original tint restored.<br>*Dil.* :—No action. | *Conc.* :—Fibre immediately blue, liquid greenish-blue; on cautiously adding water, the original colour is restored, liquid reddish.<br>*Dil.* :—Heated—fibre brownish, liquid yellowish: with excess of ammonia—intensely golden yellow. | *Conc.* :—Fibre and liquid immediately dark blue: on addition of water—colour restored to fibre, liquid reddish.<br>*Dil* :—No action. | *Conc.* :—Fibre reddish-violet; on addition of water—liquid faint reddish-violet.<br>*Dil.* :—Same as concentrated soda-lye. | Same as dilute soda-lye. | Fibre decolorised on gently warming. | Colouring matter readily extracted on boiling, forming deep bluish-red; solution on addition of concentrated sulphuric acid or of nitric acid—at first violet, then blue. | .. .. |
| 77.<br>Cloth Red G. [O.]<br>(*Animal fibre.*) | *Conc.* :—Fibre reddish-violet: liquid on warming—bluish: on addition of water—original colour restored, liquid colourless.<br>*Dil.* :—Liquid faint rose on boiling. | *Conc.* :—Fibre and liquid immediately indigo-blue; on addition of water—original colour restored to fibre, liquid brick-red.<br>*Dil.* :—Heated—fibre at first dark Bordeaux, then almost decolorised liquid yellowish: with excess of ammonia—intensely yellow. | *Conc.* :—Same as concentrated nitric acid.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre darker; on addition of water—fibre brighter, liquid faint reddish tint.<br>*Dil.* :—Heated—fibre darker, liquid bluish-red. | Heated—liquid bluish-red. | On heating—fibre decolorised. | Colouring matter readily extracted in the cold. On addition of concentrated sulphuric acid or of nitric acid—liquid at first reddish-violet, then blue. | The alcoholic extract is of a more yellowish tint with Cloth Red G than with Cloth Red B. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 78.<br>New Red L. [K.]<br>Biebrich-Scarlet.<br>Ponceau 3 R B. [A.]<br>(Ponceau 3 R.)<br>Ponceau B. [M.]<br>Fast Ponceau B. [B.]<br>Imperial-Old-Scarlet. [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-brown, liquid colourless; on addition of water—original colour restored.<br>*Dil.*:—Heated—liquid bright rose. | *Conc.*:—Fibre immediately greyish-blue, liquid blue; on addition of water—original colour restored to fibre, liquid rose.<br>*Dil.*:—Heated—fibre at first darker, liquid reddish; then fibre brownish, liquid colourless. | *Conc.*:—Fibre dark green, liquid bluish-green; on addition of water—the original colour restored to fibre, liquid rose.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark reddish-violet, liquid colourless; on addition of water—original colour restored.<br>*Dil.*:—Warmed—fibre dark-violet, liquid violet; acidified—rose. | No action | On warming—fibre decolorised. | Colouring matter very slightly extracted. | .. .. |
| 79.<br>Bordeaux B X. [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark reddish-violet; on addition of water—original colour restored.<br>*Dil.*:—Heated—liquid faint reddish. | *Conc.*:—Fibre immediately dark violet, liquid faint violet; on addition of water—colour restored, liquid reddish.<br>*Dil.*:—Fibre darker; heated—fibre bright brown, liquid yellowish; with excess of ammonia—intensely yellow. | *Conc.*:—Fibre immediately dark blue, liquid greenish-blue; on addition of water—the original colour restored to fibre, liquid faint bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre reddish-violet, liquid colourless; on addition of water—original colour restored.<br>*Dil.*:—Fibre darker, liquid faint bluish-red. | Heated—liquid intensely bluish-red; acidified—liquid brighter. | On warming—fibre decolorised. | Colouring matter extracted with the production of a bluish-red-coloured solution; more readily when boiled. | .. .. |
| 80.<br>Salmon Red. [B.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately blue.<br>*Dil.*:—Behaves as with concentrated hydrochloric acid. | *Conc.*:—Fibre immediately pale blue, then colourless.<br>*Dil.*:—Fibre immediately blue; heated—colourless. | *Conc.*:—Fibre immediately pale reddish-violet; on addition of water—blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | No action | .. .. | Fibre at first blue, then decolorised. | .. .. | .. .. |
| 81.<br>Rouge de St. Denis. [P.] [A.]<br>(*Vegetable fibre.*) | No action | *Conc.*:—Fibre darker; on addition of water—again brighter.<br>*Dil.*:—Heated—liquid faint yellowish tint; with excess of ammonia—intensely yellow. | *Conc.*:—Fibre dark Bordeaux, liquid red; on addition of water—fibre brighter.<br>*Dil.*:—No action. | *Conc.*:—Fibre more yellowish tint, liquid faint brick-red.<br>*Dil.*:—Fibre orange, liquid faint yellowish-rose; acidified—faint bluish-red. | .. .. | Fibre slowly decolorised on warming. | .. .. | Compare Farb. Zeit. 1889 90, 105. |
| 82.<br>Croceïne Scarlet 7 B. [By.]<br>Ponceau 6 R B. [A.]<br>(*Animal fibre.*) | *Conc.*:—Fibre violet, liquid faintly blue; on addition of water—the original colour restored, liquid faint rose.<br>*Dil.*:—Heated—liquid bluish-red. | *Conc.*:—Fibre and liquid immediately blue; on addition of water the original colour is restored, liquid rose.<br>*Dil.*:—Fibre Bordeaux, liquid colourless; heated—fibre yellow, liquid yellowish. | *Conc.*:—Fibre dark blue, liquid blue; on addition of water—original colour restored, liquid rose.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark Bordeaux; on addition of water—fibre brighter, liquid faint brownish-red.<br>*Dil.*:—Fibre darker; heated—liquid reddish; acidified—liquid intensely red. | Heated—liquid rose. | Fibre decolorised on warming, liquid faint yellowish colour. | .. .. | The colouring matter is readily extracted by boiling ammonium acetate solution. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 83.<br>Azofuchsine G. [By.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid rose; on addition of water—colour strongly extracted.<br>*Dil.*:—Heated—liquid rose; with excess of soda-lye—violet. | *Conc.*:—Fibre and liquid orange.<br>*Dil.*:—Cold—liquid rose; heated—fibre orange, liquid pale orange. | *Conc.*:—Fibre and liquid faint dark violet; on addition of water—the original colour restored, liquid intensely red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre and liquid reddish-violet.<br>*Dil.*:—Fibre of a more yellowish shade, liquid bluish-rose. | Fibre scarlet, liquid yellowish-rose; acidified—bluish-red. | Fibre decolorised on warming. | .. .. | Heated with ammonium acetate solution—liquid intensely bluish-red; on addition of ammonia—orange. |
| 84.<br>Azofuchsine B. [By.]<br>(*Animal fibre.*) | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint bluish-rose. | *Conc.*:—Fibre and liquid brick-red; on addition of water—both orange.<br>*Dil.*:—Fibre and liquid yellow. | *Conc.*:—Fibre Bordeaux-red, liquid reddish-violet; on addition of water—liquid bluish-red.<br>*Dil.*:—Heated—fibre and liquid yellow. | *Conc.*:—Fibre brick-red.<br>*Dil.*:—Fibre orange, liquid pale orange; acidified—bluish-rose. | Same as dilute soda-lye. | Fibre decolorised on warming. | Very little action | The colouring matter is extracted on boiling with ammonium acetate solution, with the formation of a bluish-red liquid, which on addition of soda-lye becomes faint orange. |
| 85.<br>Rhodamine Extra.<br>[B.]<br>Rhodamine B. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-orange, liquid colourless; on addition of water—original colour restored.<br>*Dil.*:—Heated—liquid yellowish-red; with excess of soda-lye—more bluish and weaker fluorescence. | *Conc.*:—Fibre at first scarlet, then orange, and finally yellow; on addition of water—the original colour partially restored, liquid pale rose.<br>*Dil.*:—Warmed—fibre dirty orange, liquid bluish-rose; with excess of ammonia—decolorised. | *Conc.*:—Fibre reddish-orange; on addition of water—original colour restored.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre bluish.<br>*Dil.*:—Warmed—liquid intensely bluish-red; acidified—almost decolorised. | Colouring matter extracted with the formation of a bluish-red solution, which on acidification is almost decolorised. | On heating—fibre at first orange, and after some time almost decolorised; liquid orange. | Little action | .. .. |
| 86.<br>Rhodamine S. [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brighter and more yellowish: on addition of water—the original colour restored.<br>*Dil.*:—Heated—fibre almost decolorised, liquid rose. | *Conc.*:—Same as concentrated hydrochloric acid, but on addition of water the fibre is somewhat bluer than originally.<br>*Dil.*:—Warmed—fibre almost decolorised, liquid bluish-rose; with excess of ammonia—colourless. | *Conc.*:—Same as concentrated hydrochloric acid.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately decolorised.<br>*Dil.*:—Heated—fibre decolorised. | Heated—fibre almost decolorised; liquid rose. | Fibre decolorised on warming. | .. .. | Boiling ammonium acetate solution extracts the colouring matter from the fibre. |
| 87.<br>Cyclamine. [Mo.]<br>(*Animal fibre.*) | *Conc.*:—Fibre almost decolorised (dirty), liquid colourless.<br>*Dil.*:—Cold—fibre almost decolorised, liquid colourless. | *Conc.*:—Fibre yellow, liquid colourless.<br>*Dil.*:—At first as with dilute hydrochloric acid, and subsequently fibre intensely yellow. | *Conc.*:—Fibre brownish-orange, liquid colourless; on addition of water—almost decolorised.<br>*Dil.*:—Warmed—fibre almost decolorised. | *Conc.*:—No action.<br>*Dil.*:—Warmed—liquid bluish-rose; acidified—colourless. | No action | Not completely decolorised even on heating. | .. .. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 88.<br>Neutral Red. [C.] [D.H.]<br>Toluylene Red.<br>(*Vegetable fibre.*) | *Conc.* :—Fibre and liquid immediately intensely blue; on addition of water—the original colour restored, liquid reddish-violet.<br>*Dil.* :—Cold—fibre and liquid violet; with excess of soda-lye—rose; fibre on rinsing with water—again red. | *Conc.* :—Fibre and liquid at first blue, then fibre decolorised, liquid brownish-red.<br>*Dil.* :—Cold—fibre and liquid blue; warmed—liquid faintly bluish-red; with excess of ammonia—colourless. | *Conc.* :—Fibre and liquid green; on addition of water—both blue.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre olive-yellow.<br>*Dil.* :—Fibre immediately orange; heated—fibre decolorised, liquid orange; acidified—intensely violet. | Same as dilute soda-lye. | Fibre immediately decolorised, liquid faint greenish-yellow. | Colouring matter extracted on boiling—solution strong bluish-red colour; liquid acidified—violet; on addition of excess of soda-lye—yellowish. | Ammonium acetate solution extracts the colouring matter—liquid bluish-red; on acidification—violet; with excess of soda-lye—faint reddish-yellow. |
| 89.<br>Hessian Purple B. [L.] [A.] [By.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre grey, liquid colourless; on addition of water—the original colour restored.<br>*Dil.* :—Heated—fibre dirty reddish-brown. | *Conc.* :—Fibre dirty brown, liquid colourless; on addition of water—the original colour restored.<br>*Dil.* :—Heated—fibre pale rose, liquid rose; with excess of ammonia—colourless. | *Conc.* :—Fibre pale violet, liquid colourless; on addition of water—the original colour partially restored.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre—bright bluish-red.<br>*Dil.* :—Fibre brighter, liquid faint rose. | Same as dilute soda-lye. | Fibre decolorised in the cold. | .. .. | .. .. |
| 90.<br>Pyronine B. [L.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre and liquid reddish-orange; on addition of water, the original colour is restored, liquid bluish-rose.<br>*Dil.* :—Heated—fibre brighter, liquid rose with greenish fluorescence; with excess of soda-lye—yellowish. | *Conc.* :—Fibre and liquid scarlet; on addition of water—fibre almost decolorised.<br>*Dil.* :—Heated—fibre at first orange, then almost decolorised, liquid yellowish-red; with excess of ammonia—bright yellow. | *Conc.* :—Fibre and liquid orange; on addition of water—the original colour restored, liquid bluish-rose.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre at first orange, then yellow, liquid colourless.<br>*Dil.* :—Fibre pale yellow; heated—more greenish shade, liquid yellowish; acidified—rose. | Heated—Fibre brighter, liquid faintly yellowish; acidified—faint rose. | Fibre decolorised on warming, liquid yellowish-red. | Colouring matter slightly extracted on boiling; solution—green fluorescence. | The colouring matter is extracted by boiling with a solution of ammonium acetate, giving a bluish-red solution, which becomes colourless on adding soda-lye. |
| 91.<br>Naphthylene Red. [B.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre dark blackish-green, liquid colourless; on addition of water—fibre black.<br>*Dil.* :—Fibre yellowish-grey. | *Conc.* :—Fibre at first blue, then black, liquid colourless. On addition of water—liquid yellowish.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre immediately blue, liquid colourless.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—Heated—liquid faint rose; acidified—colourless. | Same as dilute soda-lye. | Fibre immediately decolorised in the cold. | Little action | Treated with nitrous acid, the fibre becomes yellowish-brown; fibre after washing, placed into soda-lye—dark brown, liquid bright brown. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 92.<br>Stilbene Red. [A.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately dark blue (almost black), liquid colourless.<br>*Dil.* :—Fibre blackish-blue. | *Conc.* :—Fibre and liquid pale reddish-violet; on addition of water—fibre dirty violet, liquid rose.<br>*Dil.* :—Fibre blackish-blue; heated—almost decolorised, liquid faint brownish colour. | *Conc.* :—Fibre dark violet, liquid colourless.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—Heated—liquid faint rose; acidified—colourless. | Same as dilute soda lye. | Fibre at first blue, then by degrees decolorised. | Little action. | .. .. |
| 93.<br>Congo. [A.] [By.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately dark blue, liquid colourless.<br>*Dil.* :—Fibre immediately dark blue. | *Conc.* :—Same as concentrated hydrochloric acid.<br>*Dil.* :—Fibre immediately dark blue; heated—almost colourless, liquid yellowish. | *Conc.* :—Same as concentrated hydrochloric acid, liquid faint bluish tint.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—Heated—liquid pale rose; acidified—bluish tint. | Same as dilute soda-lye. | Fibre immediately blue; warmed—colourless. | No action | *With Nitrous Acid* :—Fibre reddish-brown; on addition of ammonia the original colour does not reappear, but the colour is changed to purplish-brown, liquid bluish-red. Fibre becomes bluish-black on treatment with picric acid |
| 94.<br>Brilliant Congo R. [A.] [By.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately brown, liquid colourless; on addition of water—fibre reddish-brown.<br>*Dil.* :—Heated—fibre reddish-brown, liquid colourless. | *Conc.* :—Fibre immediately brownish-violet, liquid brownish; on addition of water—fibre pale violet.<br>*Dil.* :—Fibre reddish-brown; heated—fibre decolorised, liquid yellowish. | *Conc.* :—Fibre immediately greenish-blue, liquid colourless; on addition of water—fibre brown, liquid rose.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—No action.<br>*Dil.* :—No action. | No action | Fibre at first reddish-brown, then decolorised. | Colouring matter only very slightly extracted. | *With Nitrous Acid* :—Fibre black; treated with ammonia—blackish-violet. With picric acid—brownish. |
| 95.<br>Alkali Red. [D.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre blue, liquid colourless; on addition of water—fibre bluish-grey.<br>*Dil.* :—Fibre immediately blue—liquid colourless. | *Conc.* :—Fibre immediately dark blue, then greenish-olive; on addition of water—liquid brownish.<br>*Dil.* :—Fibre immediately blue; heated—fibre brownish, liquid faintly yellow. | *Conc.* :—Fibre and liquid greenish-blue.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre somewhat more yellowish shade.<br>*Dil.* :—Heated—liquid faint rose. | Heated—fibre more yellowish shade, liquid faintly orange. | Fibre at first blue, then rapidly decolorised. | Little action. | .. .. |

—A. R. L.

*Reactions of Chelidonine with Phenols in Sulphuric Acid Solution.* Battandier. Comptes rend. **120**, 270—271.

When a few particles of chelidonine are sprinkled on to a solution of phenol in sulphuric acid, a colour reaction is obtained according to the phenol employed. The carmine coloration with guaiacol is the most characteristic of a number of other phenols mentioned in the paper. Chelidonine itself in sulphuric acid solution, gives a green coloration with a trace of nitric acid, with potassium chlorate solution, or with an arseniate.—T. A. L.

*Contributions to the Chemistry of Lignite Tar.* F. Heusler. Ber. **28**, 488. *Detection of Naphthenes; of Thiophen; of Acetone and its Homologues, and of the Ethylene Hydrocarbons.*

*See under* III., *page* 357.

*Constitution of Cœruleïn.* M. Prud'homme. Bull. Soc. Chim. 1894, 1136.

*See under* IV., *page* 359.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

*The Presence of Sulphur in Aniline and Para-amidophenol and the Bleaching Powder Test.* A. Hantzsch and H. Freese. Ber. **27**, 2966—2968.

The authors retract their previous statement (this Journal, 1894, 1189) with regard to the bleaching powder test for aniline, and find that aniline from several different sources and of undoubted purity does give the violet coloration, and that this is not dependent upon the presence of thiophen compounds is shown by the fact that amido, nitro, and dinitro-thiophen do not. These sulphur compounds, however, probably take some part in the browning of aniline, as the authors, by distilling an aniline free from sulphur, obtained a distillate which remained colourless for several weeks. For purifying aniline and estimating the sulphur it contains by means of acetone, it is boiled for 10 hours with 10 per cent. of acetone, dilute hydrochloric acid added until acid to congo paper, and the solution then extracted with ether until a colourless extract is obtained. After evaporating off the ether, the residue contains the sulphur compounds in which the sulphur is determined by the Carius method. *See* page 390.—T. A. L.

*Inapplicability of Kjeldahl's Method to the Determination of Nitrogen in Platino-chorides.* Delépine. Bull. Soc. Chim. 1895, **13**, [4], 222.

Trimethylamine platinochloride and ammonium platinochloride both yielded only a portion of their nitrogen as ammonia, when decomposed by the Kjeldahl method (permanganate being used as an oxidant). The author supposes that the observed deficiency is due to loss of nitrogen, as such, owing to the evolution of some of the chlorine of the platino chloride and the interaction of this with another portion of the salt. The following equation expresses his view—

$$PtCl_6(NH_4)_2 + Cl_6 = PtCl_4 + 8HCl + N_2.$$

—A. G. B.

*Use of Sodium Peroxide in the Estimation of Sulphur and Chlorine.* A. Edinger, Ber. **28**, 427—428.

In this preliminary note, the author points out that sodium peroxide may with advantage be employed in the estimation of sulphur and chlorine in organic substances which are not volatile from alkaline solution. By evaporating the substance in a platinum vessel with a 3 or 4 per cent. solution of sodium peroxide, igniting gently, and then boiling with a concentrated solution of the peroxide, the sulphur and chlorine in organic substances are converted into sodium sulphate and chloride respectively. The method is applicable in the case of sulphonic acids, mercaptans, and especially to the simultaneous determination of platinum and chlorine in insoluble platinum salts of the quinoline series.—J. S.

*Soluble Cresol Compounds.* C. Engler and E. Dieckhoff. Arch. d. Pharm. **232**, 351.

The authors describe a method of analysing various commercial cresol products (sapocarbol, lysol, solveol, solutol, tricresol, &c.). The substance mixed with salt is distilled with steam. The distillate contains the free cresols, phenols, and the neutral bodies and bases (naphthalene, pyridine, &c.) These are separated by saturation with soda and subsequent extraction with ether or by steam distillation. The residue from the first distillation contains the cresols combined as cresolates. After neutralisation these are distilled off with steam. The method is said to give sufficiently accurate results. The following table gives some of the results obtained in percentages:—

| —— | Ash. | Cresols. | Naphthalene. |
|---|---|---|---|
| Sapocarbol............ | 2·6 | 37·3 | .. |
| Lysol ................ | 6·5 | 40·0 | 2·0 |
| Solveol .............. | 11·3 | 23·5 | 9·2 |
| Solutol .............. | 18·1 | 47·0 | 0·8 |

—T. A. L.

*Contribution to the Analysis of Beetroots.* Anderlik. Böhm. Zeits. f. Zuckerind. 1895, **19**, 258.

In connection with Krœker's experiments, the author finds that the warm digestion of normal beetroots gives results higher to the extent of 0·07—0·36 per cent. than the alcoholic extraction. In the case of withered beetroots this difference amounts to 0·52 per cent., and may possibly be explained by the quantity of pulp, but this is a point requiring further investigation.—J. L. B.

*Estimation of Water in Cane Sugar.* Gunning and Alberda. Sucr. Belge, 1894, **23**, 108.

It is well-known that beet-root sugar loses its water without decomposition when heated to 105° C. from 3—5 hours in a current of dry air, and that 108° is not too high a temperature for drying alkaline sugars, since they only lose from 0·001 to 0·002 per cent. of their weight as different amines (calculated as ammonia) and of acids, chiefly consisting of carbon dioxide derived from the bicarbonates, 0·03 per cent. in the case of white sugars, and 0·07 per cent. in that of raw sugars.

Slightly acid beet sugars lose practically no carbon dioxide when heated to 108° in a current of dry air, but at a given moment the pre-existing fatty acids are liberated, without, however, the formation of new ones.

Exact determinations of moisture are not possible in strongly acid beet sugars, nor in colonial cane sugars. If these are dried at 108° unreliable values are obtained; for levulose when heated above 95° loses 10 per cent. of water with the formation of levulosan, which at 108° undergoes further decomposition. At this temperature also, a kind of destructive distillation of the organic non-sugar occurs; acids which invert fresh quantities of cane sugar being formed. At a temperature of 108°, the following volatile decomposition products have been observed:

formic, acetic, butyric, and valerianic acids, acetone, furfuraldehyde, and a crystalline sublimate of an unknown nature, giving a blue coloration with ferric chloride.

—J. L. B.

### *Estimation of Mannitol in Wines.* J. A. Muller. Bull. Soc. Chim. 1894, **11** [22], 1073—1080.

In estimating mannitol in wine by the rotation produced by saturating the aqueous solution of the mannitol with borax (this Journal, 1894, 767), the presence of glycerol and some similar substances reduces the rotation. The author finds that for solutions containing not more than 1 grm. of mannitol in 50 c.c. of solution, the reduction caused by small quantities of glycerol, &c., such as are present in wine, is directly proportional to the amount of mannitol present. If, therefore, the rotation of the borated solution be observed, then a known small quantity of mannitol is added and the rotation again taken the absolute quantity of mannitol in the original solution can be calculated. If $p_1$ is the weight of mannitol deduced (by means of the table given in the former paper, *loc. cit.*) from the rotation of the first solution, $p_2$ that from the rotation of the solution after the addition of the known weight $p$ of mannitol, $k$ the proportion-constant of reduction, and $x$ the true weight of mannitol originally present; then—

$$p_1 = x(1 - k) \qquad p_2 = (x + p)(1 - k)$$

and from these $x = \dfrac{pp_1}{p_2 - p_1}$

The complete analysis is carried out as follows:—200 c.c. of wine are concentrated to expel the alcohol, and about 1 grm. of pure yeast suspended in water then added, and the whole allowed to ferment to destroy the fermentable carbohydrates. When fermentation is complete, the whole is evaporated on the water-bath, the residue transferred to a flask and the evaporating basin washed out with 20 c.c. of water and this added to the residue in the flask. 200—210 c.c. of absolute alcohol previously heated to near its boiling point is added, and the whole digested with reflux condenser for 1—1½ hours. Under these conditions, the solution becomes clear, the insoluble matter being deposited on the sides of the flask. The whole is then filtered hot and the residue washed with boiling 90 per cent. alcohol. The filtrate is allowed to cool completely, and if any mannitol crystallises out, this (precipitate *a*) is filtered off, washed with just enough absolute alcohol to free it from mother-liquors and these washings added to the filtrate (filtrate *b*). The precipitate *a* is dissolved in 160 c.c. water and decolorised with animal charcoal. 40 c.c. are taken diluted to 50 c.c., then examined in the polariscope. A second 40 c.c. is then taken, 1·4 grms. of dry borax added, the whole diluted to 50 c.c., and then the rotation observed. If it shows any rotation before the addition of borax this must, if negative, be added, if positive, be subtracted from that observed subsequent to the addition of the borax. The equivalent of this corrected reading deduced from the table (this Journal, 1894, 767) and multiplied by 4 gives the mannitol in the crystalline precipitate.

The alcohol is distilled off from filtrate *b*, the residue dissolved in water, a slight excess of lead sub-acetate added, the precipitate filtered off, the filtrate is freed from lead by means of sulphuretted hydrogen and re-filtration, and is then evaporated to about 50 c.c., and neutralised with soda. The solution is decolorised by means of animal charcoal and made up to 160 c.c. This solution is then examined in the polariscope as follows:—(i.) 40 c.c. simply diluted to 50 c.c.; (ii.) 40 c.c. + 1·4 grms. of dry (equivalent of crystallised) borax and this made up to 50 c.c. ($p_1$); and (iii.) 40 c.c. solution 5 c.c. of a 10 per cent. solution of pure mannitol (*i.e.*, $p = 0·5$ grm.) and 1·4 grms. dry borax, and this made up to 50 c.c.; ($p_2$), and $x$ is then calculated by the above formula. The value of $x$ multiplied by 4 and added to the weight of mannitol found in precipitate *a* gives the mannitol in the 200 c.c. wine.

The table previously given (*loc. cit.*), is for observations made with a 500 mm. tube.

The following table gives the solubility of mannitol in alcohol at various strengths and at various temperatures, the numbers representing grms. of mannite in 100 grms. of solution:—

| Strength of Alcohol. | Boiling Point of the Solvent. | 17° C. | 3° C. |
|---|---|---|---|
| Per Cent. | | | |
| 80 | 11·44 | 0·615 | 0·556 |
| 85 | 6·215 | 0·351 | 0·166 |
| 90 | 3·626 | 0·338 | 0·160 |

—L. T. T.

### *Estimation of Alcohol in the Essential Oils of the Distillery.* C. Fabre. Garrigou and Surre. Comptes rend. 1894, **119**, 747.

*See under* XVII., *page* 376.

## *ANALYTICAL AND SCIENTIFIC NOTES.*

### *Action of Picric Acid and Picrates on Metallic Cyanides. The Isopurpurates.* R. Varet. Comptes rend. **119**, 562.

The author confirms, by further researches, the conclusion he formerly stated (Comptes rend. **112**, 339), that when picric acid or picrates act on metallic cyanides, isopurpurates are formed in all cases where the picric acid can displace hydrocyanic acid from the cyanide, but not where the reverse action takes place. Thus, the cyanides of potassium, sodium, lithium, barium, strontium, calcium, magnesium, cadmium, and zinc are all decomposed by picric acid, and all form isopurpurates; whilst the cyanides of mercury, copper, and silver are not decomposed by picric acid, and do not form isopurpurates.

The author points out that this is another case in which thermochemical theory enables us to predict the possibility or otherwise of a reaction for the purposes of chemical industry.—J. T. D.

### *Freezing Point of some Organic Substances.* R. Pictet. Comptes rend. 1894, **119**, 955—957.

The author has determined the freezing points of some organic substances, and has arrived at the following conclusions:—

1. The introduction of a $CH_3$ group into a molecule belonging to the aromatic series, lowers the freezing point. Example, benzene melts at 4° whilst toluene still remains liquid at − 100°.

2. If a H-atom occurring in a methyl group attached to another radical is replaced by a Cl-atom, the freezing point is raised. If all three H-atoms in the methyl group are replaced by Cl the rise of freezing point ceases. Thus, toluene remains liquid at − 100°, benzyl chloride crystallises at − 47·9°, benzyl dichloride ($C_6H_5.CHCl_2$) and benzyl trichloride ($C_6H_5.CCl_3$), both crystallise at − 17°.

3. Baeyer's law, that in a homologous series, the freezing points alternately rise and fall according as the number of C-atoms in the member is even or uneven, was confirmed. Thus propionic acid melts at − 24°, acetic acid at + 16·5°, and normal butyric acid at − 19°.

4. In the case of isomeric substances, the more symmetrical the molecule, the higher lies the freezing point. Thus normal butyric acid crystallises at − 19°, whilst isobutyric acid remains liquid at − 100°.—J. S.

### *New Reaction for the Detection of Hydrogen Peroxide in Green Plants.* A. Bach. Comptes rend. 1894, **119**, 1218—1221.

In the experiments tried, 25 grms. of green leaves, plucked in the middle of the day, were treated with 75 c.c. of water, containing 0·1 per cent. of oxalic acid (the presence of mineral acids is to be avoided), in a large covered porcelain vessel, kept in a dark place. At intervals, 5 c.c. of the liquid were withdrawn for test. They were mixed with 5 c.c. of a solution containing 0·03 grm. of potassium bichromate and five drops of aniline per litre, and with one drop of a 5 per cent. solution of oxalic acid. The presence of hydrogen peroxide was shown by the formation of a violet-rose colour, which could be conveniently contrasted with that of a blank test, carried on simultaneously. Out of 25 plants examined, 18 showed the presence of the peroxide, viz.:—*Brassica asperifolia, oleifera, Daucus carota, Beta vulgaris, Geranium rotundifolium, Hedera helix, Lauro cerasus, Aster, Tropæolum pentaphyllium, Chrysanthemum Balsamita, Mercurialis annua, Urtica, Calla palustris, Vicia Faba, Papaver rhœas, Sisymbrium nasturtium, Dyanthus caryophyllus, Apium petroselinum, Fragaria vesca.* Five plants gave a negative result:—*Medicago sativa, Chicorium intybus, Avena sativa, Viola odorata, Lilia bulbiferum.* Whilst two were doubtful:—*Lactuca sativa* and *Vicia.* Hence it appears that the green portions of plants contain hydrogen peroxide, or peroxides acting analogously to it.—W. G. M.

## New Books.

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali with the Collateral Branches. By George Lunge, Ph.D., Professor of Technical Chemistry at the Federal Polytechnic School, Zürich. (Formerly manager of the Tyne Alkali Works, South Shields.) Second Edition, revised and enlarged. Volume II. Saltcake, Hydrochloric Acid, and Leblanc Soda. London: Gurney and Jackson, 1, Paternoster Row. 1895. Price 2*l.* 2*s.*

The work commences with a Preface to the Second Edition of Vol. II. Next follows the Table of Contents, and then a brief Introduction, in which the author gives it as his opinion that, though the Leblanc process, as regards alkali itself, "will not survive to a remote future," yet its first stage, concerned with the manufacture of saltcake and hydrochloric acid, by decomposing common salt, "is sure to remain an important branch of chemical industry." This part of the entire Leblanc process is therefore described in its entirety in this volume.

The subject-matter of the work fills 920 pages, and a carefully arranged Alphabetical Index concludes it. The illustrations number no less than 305, and they are beautifully executed. Chapter I. is devoted to a description of the Properties and Occurrence in Nature of the Raw Materials and Products of the Alkali Industry. II. Analyses of the Raw Materials and Products of the Soda Manufacture. III. Enumeration of the Processes for Obtaining Sulphate of Soda. IV. Sulphate of Soda and Hydrochloric Acid from Common Salt and Sulphuric Acid. V. The Manufacture of Sulphate by the Process of Hargreaves and Robinson. VI. Purification of Sodium Sulphate (Glauber's Salt); Applications. VII. The Condensation of the Hydrochloric Acid produced in the Manufacture of Sulphate of Soda. VIII. Weak Acid; Control of Condensation; Purification, Pumping, and Conveyance of Hydrochloric Acid. IX. Manufacture of Hydrochloric Acid by other than the Ordinary Means. X. General and Historical Notes on the Alkali Manufacture. Theory of the Leblanc Process. XI. The Manufacture of Black Ash. XII Black Ash and Tank Liquor. XIII. Manufacture of Finished Soda and Bicarbonate. XIV. Yield and Costs. XV. Caustic Soda. XVI. Tank Waste.

Chemical Analysis of Oils, Fats, Waxes, and of the Commercial Products derived therefrom. From the German of Prof. Dr. R. Benedikt. Revised and Enlarged by Dr. J. Lewkowitsch, F.I.C., F.C.S., Technical Manager at the Whitehall Soap Works, Leeds, Consulting Chemist, and Chemical Engineer. London and New York: Macmillan and Co. 1895. Price 21*s.*

8vo volume, containing Preface, Table of Contents, Subject-matter filling 673 pages, and illustrated with 42 beautifully executed engravings, and an Alphabetical Index. The work, as Dr. Lewkowitsch states in his preface, is substantially the English version of Benedikt's "*Analyse der Fette und Wachsarten,*" though with alterations and considerable additions of his own. It is therefore a translated, revised, and enlarged work, and in the latter connection it must be noted that more space is devoted to the work of English and American chemists than is naturally the case in the German work of Benedikt, from which it springs.

The translator and joint author, as he may certainly be termed, states that it is his hope that "Through the amalgamation of scientific accuracy with practical knowledge a work has been produced which by its completeness may prove useful to the analytical, technical, and scientific chemist, as well as to the teacher of chemistry."

Chapter I.—A. Acids. B. Alcohols. II. Physical and Chemical Properties of Fats and Waxes. III. Determination of Foreign Matters of a Non-Fatty Nature, and Preparation of the Fatty Substance for Analysis. IV. Physical Properties of Fats and Waxes. V. Ultimate Analysis of Fats and Waxes. VI. Qualitative Examination of Fats of known Origin by Strictly Scientific Methods. VII. General Methods of Quantitative Analysis of Fats, or Mixed Fats and Waxes. VIII. Detection and Quantitative Determination of Foreign Substances dissolved in Fats. IX. Systematic Examination of Liquid Fats (Oils) and Waxes. X. Systematic Examination of Solid Fats and Waxes. XI. Description of Natural Fats and Waxes; Methods of Examining them and Detecting Adulterations. XII. Technical and Commercial Analysis of the Raw Material and Products of the Fat and Oil Industries. XIII. Examples, in which the methods described in the chapters preceding, are illustrated and can be employed in the examination of technical products.

Theoretical Chemistry from the Standpoint of Avogadro's Rule and Thermodynamics. By Prof. Walter Nernst, Ph.D., of the University of Göttingen. Translated by Prof. Charles S. Palmer, Ph.D., of the University of Colorado. With 26 Woodcuts and 2 Appendices. London and New York: Macmillan and Co. 1895. Price 15*s.*

In introducing this work, of which he is the translator, Prof. Palmer says in his preface:—"For the last four or five decades, most of the advanced work in pure Chemistry has been largely synonymous with Organic Chemistry. But with the growth of the Science, another great branch has developed which promises to become equally important; and that is the New Physical Chemistry."

The character as well as the contents of the work will be gleaned from the following classification:—Introduction to some Fundamental Principles of Modern Investigation. Book I. The Universal Properties of Matter. I. The Gaseous State of Aggregation. II. The Liquid State of Aggregation. III. The Solid State of Aggregation. IV. The Physical Mixture. V. Dilute Solutions. Book II. Atom and Molecule. I. Atomic Theory. II. The Kinetic Theory of the Molecule. III. The Determination of the Molecular Weight. IV. The Constitution of the Molecule. V. Physical Properties and Molecular Structure. VI. The Dissociation of Gases. VII. Electrolytic Dissociation. VIII. The Physical Properties of Salt Solutions. IX. Colloidal Solutions. X. The Absolute Size of Molecules. Book III. The Transformation of Matter. (The Doctrine of Affinity, I.) I. The Law of Chemical Mass Action. II. Chemical Statics. Homogeneous Systems. III. Chemical Statics. Heterogeneous Systems. IV. Chemical Equilibrium in Salt Solutions. V. Chemical

Kinetics. Book IV. The Transformation of Energy. (The Doctrine of Affinity, II.) Thermo-Chemistry. The Application of the First Law of Heat. Temperature and Complete Chemical Equilibrium. Temperature and Incomplete Equilibrium. Temperature and the Reaction Velocity. Heat and Chemical Energy. Electro-Chemistry. Photo-Chemistry. Appendix I. Containing Some Important Developments in Theoretical and Physical Chemistry for the Year 1893.

The Work is one of 680 pages, and with Alphabetical Indexes of Authors' Names and of Subject-matter.

Principles and Practice of Agricultural Analysis. A Manual for the Estimation of Soils, Fertilisers, and Agricultural Products. For the Use of Analysts, Teachers, and Students of Agricultural Chemistry. Volume I. Soils. By Harvey W. Wiley, Chemist of the U.S. Department of Agriculture. Chemical Publishing Co., Easton, Pa., U.S. America. 1894. Price $3·75.

The object of this work is, as set forth in the Preface, "to place in the hands of teachers and students of Agricultural Analysis, and of Analysts generally, the principles which underlie the science and art of the analysis of soils, and the best approved methods of conducting it." The book itself is a large 8vo volume, containing Preface, Table of Contents, List of Illustrations, which number 93, Introduction, and text covering 593 pages, with an alphabetical index of subjects forming the closing feature.

The subject-matter is divided into eight parts :—I. Rocks and Rock Decay. Origin of Soils. II. Taking Samples for Analysis. Treatment of Sample in the Laboratory. III. Physical and other Properties of Soils. IV. Mechanical Analysis. V. Estimation of Gases in Soils. VI. Chemical Analysis of Soils. VII. Oxidised Nitrogen in Soils. VIII. Special Examination of Waters. Special Treatment of Muck Soils. Unusual Constituents of Soil.

Micrographic Chart for Brewers. Enlarged from some of the Plates in "The Microscope in the Brewery and Malthouse." By Chas. Geo. Matthews, F.C.S., F.I.C., and F. E. Lott, F.I.C., A.R.S.M. Magnification = About one thousand diameters. Messrs. Matthews and Lott, The Laboratory, Bridge Chambers, Burton-on-Trent; or the offices of the "Brewing Trade Review," "Brewers' Guardian," or the "Country Brewers' Gazette." Price 2*s*. 6*d*.

This is a Chart 1 ft. 10 ins. in length, and 1 ft. 4 ins. in width, in which upon a black ground are very clearly depicted the enlarged microscopic images of various yeasts, &c., and yeast in various stages of development or deterioration. Each microscopic image occupies a circular space 4¾ ins. in diameter. The Chart is designed to be hung upon the laboratory or lecture-room wall. The Microscopic figures are as follows :—I. A Burton Yeast. II. A London Yeast. III. Sac Pastorianus. IV. Deteriorated Yeast (Aged). V. Deteriorated Yeast (Wild Cells with Bacteria). VI. Beer Deposit. VII. Forced Beer Sediment (Clean). VIII. Forced Beer Sediment (Clean). Forced Beer Sediment (very Unclean). The chart is neatly mounted on polished wooden rollers.

Handwörterbuch der Pharmacie. Herausgegeben von A. Brestowski. Wien und Leipzig: Wilhelm Braumuller, k.u.k. Hof- und Universitäts-Buchhändler. 1894. London: H. Grevel and Co., 33, King Street, Covent Garden. Price per Number, M. 2.40.

Continuing Vol. II. of this large Dictionary of Pharmacy, Parts 19 and 20 now appear. Part 19 commences with "*Rhodiumoxyd*" and ends with "*Schwefelsäuren*," which subject is continued into Part 20, as far as the end of the first page (page 545). Part 20 ends with "*Stereochemie*," which is continued into Part 21. Parts 19 and 20 bring up the total number of pages of the work thus far completed, to 624.

Chemisch Technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1894. Erstes Halbjahr, Erste Hälfte. Mit in der Text gedruckten Illustrationen. 1895. Berlin, S.W.: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstr. 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

The first issue for the first half year of 1894, of Dr. Jacobsen's Repertory of Chemical Technolgy. It contains Reports of the progress of the following branches of Chemical Industry :—I. Building Materials, Cements, and Artificial Stone. II. Dyes, Colours, and Textile Printing. III. Fats, Oils, Illuminating and Heating Materials. IV. Fermented Liquors. V. Tanning, Leather, and Glue Preparation. VI. Textiles. VII. Glass and Earthenware. VIII. Wood and Horn. IX. India-rubber and Gutta-percha. X. Cements and Agglutinating Materials, XI. Lakes, Varnishes, and Paints. XII. Metals. This number contains 168 pages of subject-matter, and is illustrated with wood cuts.

## Prizes.

The Medal of the *Société Chimique de Paris* has been awarded to Prof. Wm. Ramsay, F.R.S., for his researches upon Argon and Helium.

The bronze medal of the *Société Industrielle de Mulhouse* has been awarded to M. Camille Schoen for a memoir on the preservation of hydrogen peroxide. After repeated experiments M. Schoen confirms the statement that napthalene is the best agent for this purpose.

## Trade Report.

### *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

#### France.

*Customs Decisions.*

The following decisions affecting the classification of articles in the French Customs tariff have recently been given by the French Customs authorities :—

The admission of liquid insecticide is prohibited, being a secret remedy, the composition of which is not indicated.

Mica of iron, being adapted for purposes of bronzing, is dutiable at 5 per cent. *ad valorem* as colours not distinguished.

Paste consisting of exotic fecula, made up with a slightly alkaline solution, is dutiable as exotic fecula, and their derivatives.

#### United States.

*Customs Decisions.*

The following decisions respecting the construction to be given to Acts of Congress, relating to the classification of articles in the Customs tariff, and the application of the Customs laws of the United States, have recently been given by the authorities in that country :—

Lactophenin is dutiable at 20 per cent. *ad valorem* as a coal-tar preparation under paragraph 19.

Germol, a chemical compound and liquid disinfectant, is dutiable at 25 per cent. *ad valorem* under paragraph 60 of the Act of 28th August 1894.

Sodium benzoate, made from artificial or coal-tar, benzoic acid, and soda, is exempt from duty under paragraph 443 Act of 28th August 1894.—*Ibid.*

## *GENERAL TRADE NOTES.*

### The Development of the Russian Metallurgical Industry.

Considerable interest is being shown in Russian industrial circles at the present time in connection with a proposal for the development of the metallurgical industry presented by M. Ourbanovitch.

The *Bulletin du Musée Commercial* says that owing to the protective tariff numerous metallurgical establishments have been started in South Russia and Poland and the Ural works have shown great activity, but while it is a fact that Russia can at present produce almost all the iron necessary for her own requirements, Russian merchants have much difficulty in meeting the competition of Western Europe.

One of the reasons for this condition of affairs is, it would appear, the very slight increase in the average production of the Russian works. For example, in one year, the 89 works in operation in the Oural mountains only produced altogether 262,000 tons of iron, or an average of about 3,000 tons per factory, whilst in the United States and Western Europe there were few works producing less than 50,000 tons per annum.

This naturally largely increases the cost of production, and in some Russian works the interest on capital, the expenses of management, &c., amount to about 35 per cent. of the selling price.

The absence of facilities in the means of communication is also not without influence, for sales cannot be readily effected, very large capital being required. The blast furnaces of the Oural are obliged to provide themselves with raw material in winter, when the roads are practicable for sledges, whilst in order to send their manufactured articles to the consuming markets, these same works must wait until the Volga navigation is open, that is to say, until the commencement of the summer. Moreover, the Oural works are obliged to restrict their output by reason of the fact that they use charcoal, the supply of which at their disposal is necessarily limited.

In these conditions, M. Ourbanovitch advises the Oural works to form a syndicate, to abandon the manufacture of iron, and to devote themselves exclusively to the production of cast iron. The surplus of the combustible thus placed at the disposal of the Ural merchants will allow of their producing at least 1,000,000 tons of cast iron, in place of 400,000 tons, the present figure of production.

On the other hand, it is suggested that the forges and rolling mills should be transferred to the Lower Volga, where raw naphtha and the residue from the distillation of naphtha would procure them an excellent and cheap combustible without taking into consideration that it would be much nearer the centres of consumption.

The Oural cast iron would be brought in boats down the Volga and carried to the works at little expense. In this way a great saving would be effected, and from the time that the Oural cast iron arrives in the works of the Lower Volga in sufficient quantity, its subsequent treatment would be carried out exactly under the same economic conditions as in Western Europe, with this difference in favour of the Russian works, that 65 tons of naphtha residue would be really equivalent to 100 tons of best coal, the manufacture of finished irons and of rails would be effected at a cheaper rate in Russia than in other European countries, without reckoning that Russian merchants would be certain of being able to produce articles of the first quality.

According to M. Ourbanovitch, it will be possible in this manner to produce manufactured rails and irons at rather over 5*l.* per ton, and plates for boilers at 9*l.* per ton, which will enable the Russian merchants to compete advantageously with their rivals, without taking into account protective Customs tariffs.

M. Ourbanovitch adds that there is a little doubt as to the future development of the metallurgical works of Donetz and Ekaterinoslaw, which are situated in relatively unfavourable conditions by reason of the distance of 480 kilometres separating the coal mines from the iron deposits, of the high price of coke delivered at the works, and of the scarcity of skilled labour. According to him, also, too much ought not to be expected of the Poland works because of the absence of coal and the poverty of the ores.

### The Present Condition of Russian Industries.

The *Revue d'Orient* in its issue for the 5th March publishes some particulars of Russian industry. The production of cast iron, the basis of the metallurgical industry increased from 27,390,000 pouds in 1881 to 70,800,000 pouds in 1893 (poud = 36 lb. avoirdupois), or an increase of 160 per cent. This industry has shown a marked development in the South of Russia, where the works situated near the rich deposits of Krivorog ore are abundantly supplied with combustible material. From 17,900,000 pouds in 1880, the manufacture of iron has increased in 1893 to 30,100,000 pouds, an increase of 68·1 per cent. The production of steel has increased by 59·3 per cent. (29,800,000 pouds in place of 18,700,000 pouds); as regards rails, the quantity exported from Russian works has only shown slight progress, 1,600,000 pouds, but there should be noted the essential difference that out of the 12,200,000 pouds delivered in 1880, 10,200,000 were made with imported cast-iron, whilst, out of the 13,800,000 pouds produced in 1893, 2,800,000 pouds only were made with cast-iron coming from abroad, whilst the rest, 11,000,000 pouds was made in Russian works with Russian raw material. In 1880 the total quantity of manganese ore extracted did not exceed 600,000 pouds; in 1893 it reached 15,200,000 pouds. Owing to the use of this ore in the manufacture of steel, the demand for manganese has increased enormously and the Caucasian ore has found many valuable foreign markets. The extraction of mercury dates back in Russia only about ten years, but already the country is becoming independent of foreign supplies. The production of coal, which was 200,900,000 pouds in 1880, reached 460,200,000 pouds in 1893, or an increase of 129 per cent. For salt, 88,000,000 pouds in place of 47,500,000, the difference being 85 per cent.

The naphtha industry has shown a large development. The construction of the necessary railways and other suitable measures have enabled Russian production not only to supply the country with petroleum and lubricating oils, but to organise a vast exportation throughout the whole world. In 1880, the extraction of naphtha was 21,400,000 pouds; in 1893 it amounted to 337,000,000 pouds. Parallel with this progress in production, the imports of naphtha and derivatives of naphtha have decreased from 1,200,000 pouds to 20,000 pouds, whilst the exports have increased from 247,000 pouds to 59,300,000 pouds.

### Mining and Metallurgical Industries of Spain.

The *Revista Minera* publishes the following statistics of the mineral and metallurgical production of Spain in 1894.

*Iron Ore.*—The working of iron ore during the year 1894 amounted to 4,972,625 tons, exceeding by 325,748 that of 1893.

*Metallurgy.*—The metallurgical works produced in 1894 nearly the same quantity of cast iron as in 1893, or 260,090 tons of pig, of which 48,538 were exported.

This total shows an increase of 17,308 tons over the exports in 1893.

The tendency for 1895 would appear to be a decreased production in all the works.

*Copper.*—The production of copper ore in the province of Huelva amounts for the year 1894 to 2,270,000 tons of pyrites, containing on an average 2·50 per cent. of copper, 162,600 tons of foliated ore, and 55 tons of double sulphate of lead and copper. In the province of Murcia, 1,200 tons of ore have been obtained. As regards copper cake containing 75 per cent. of metal, its production in 1894 amounted to 28,000 tons, and copper matte of an average yield of 45 per cent. to 17,000 tons. In the same province of Huelva, there were extracted 2,800 tons of sulphate of copper, from which 2,200 tons of sulphuric acid of 66 degrees strength had been extracted.

Miscellaneous products.—*Zinc.*—The Royal Asturian Mining Company extracted in 1894, 31,200 tons of calamine in the province of Santander; the Posadas mines, in the province of Cordoba, have extracted 3,000 tons of blende, and, in the province of Murcia, 900 tons of zinc ore. The *Restauracion* mine of Linares has produced a large quantity of calamine, of which only 650 tons were sold, from the calcination of which 53 per cent. of zinc resulted. The same Royal Asturian Company worked, at Arnao, 13,500 tons of calamine and blende, which produced 5,700 tons of raw zinc; 2,500 tons of this latter product supplied 2,400 tons of zinc in plates, and from the other 600 tons 540 tons of refined zinc were extracted. The Arnao factory exported in 1894, 1,700 tons of raw zinc, 392 tons of refined for Europe, and 154 tons of zinc in sheets for Cuba and Porto Rico.

*Silver.*—The Metallurgical society of Mazarron has obtained by the treatment of its leads 33,000 kilogrammes of silver, the society of Pennaroya, 20,000 kilogrammes, and La Cruz of Linares, 60,000 kilogrammes.

*Manganese.*—The province of Huelva yielded in 1894, 1,200 tons of manganese.

*Pyrites of Iron.*—In the same province, the extraction of this product amounted to 170,000 tons, and in the province of Gerona to 148 tons of arsenical pyrites.

*Tin.*—The province of Orentes supplied 11 tons, and that of Pontevedra 12 tons.

*Wolfram.*—In the latter province, 13 tons of iron tungstate were extracted.

*Antimony.*—The extraction is limited to 5 tons in the province of Cordova and to 10 tons in that of Orentes.

*Barytes.*—Three hundred tons were extracted in the province of Gerona, and 70 in that of Tarragona.

*Fluorspar.*—Sixteen tons were extracted in the province of Barcelona.

The following statement is given by the *Bulletin de la Bourse des metaux et des charbons de Paris* of the imports and exports for 1894 of all substances belonging to metallurgy :—

*Imports in* 1894.—Coal, 1,612,147 tons; coke, 225,700 tons; tar, pitch, and asphalt, 29,639 tons; raw petroleum, 44,052 tons; cast iron, 26,561 tons; moulded pig, 9,616 tons; steel, 23,121 tons; tin plate, 3,212 tons; tin in ingots, 936 tons; silver in bars, 1,935 kilos.; alkaline carbonates, 26,902 tons; nitrate of soda, 23,984 tons; sulphur, 5,674 tons; machines, motors, and boilers, 3,131 tons.

*Exports in* 1894.—Ores of iron, 4,988,222 tons; copper, 539,290 tons; zinc, 34,238 tons; lead, 12,162 tons; manganese, 7,319 tons; antimony, 45 tons; salt, 230,179 tons; coal, 17,537 tons; pyrites of iron, 520,128 tons.

*Metals.*—Cast iron, 48,719 tons; copper, 66,700 tons; zinc, 2,680 tons; lead, 158,736 tons; mercury, 869,947 kilos.; gold in ingots and coined, 341 hectogrammes; silver in ingots and coined, 265,201 hectogrammes.

These figures compared with those of 1893 show increases in almost all the imports. On the other hand, the exports diminished to an extent represented by a value of 1,698,992 pesetas.

## A Valuable Find.

The Park Mines, near Barrow, have yielded millions of tons of hematite ore since their discovery 40 years ago. Now the Barrow Steel Company, the owners of the mine, have discovered another deposit of the richest ore at the north-east of the present mines, analysed samples of which show 60 per cent. of metal and only 8 per cent. of silica. This discovery is of the greatest importance to Barrow, and to its steelworks, inasmuch as the newly-discovered ore is worth 13*s.* 6*d.* per ton to-day, delivered at the Barrow works, as compared with 8*s.* as the cost of delivering the new Park ore, which is equal in quality with that of Hodbarrow. This will represent a saving of 10*s.* a ton on the cost of pig iron. Barrow has evidently another chance of life, despite Spanish competition.—*Ironmonger.*

## Mineral Production of the United Kingdom.

The following table shows the quantities of the more important minerals raised in the United Kingdom during each year since 1884 :—

| Years. | Coal. | Fireclay. | Oil Shale. | Iron Ore. | Lead Ore. |
|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. |
| 1884 | 160,757,779 | 2,053,927 | 1,518,871 | 16,137,887 | 54,485 |
| 1885 | 159,351,418 | 1,878,514 | 1,770,413 | 15,417,982 | 51,302 |
| 1886 | 157,518,482 | 1,782,054 | 1,728,503 | 14,110,013 | 53,420 |
| 1887 | 162,119,812 | 1,810,490 | 1,411,378 | 13,089,041 | 51,563 |
| 1888 | 169,935,219 | 1,879,273 | 2,076,469 | 14,590,713 | 51,259 |
| 1889 | 176,916,724 | 2,192,346 | 2,014,860 | 14,546,105 | 48,465 |
| 1890 | 181,614,288 | 2,405,727 | 2,212,250 | 13,780,767 | 45,651 |
| 1891 | 185,479,126 | 2,394,065 | 2,361,119 | 12,777,689 | 43,859 |
| 1892 | 181,786,871 | 2,212,333 | 2,089,937 | 11,312,675 | 40,024 |
| 1893 | 164,325,795 | 2,186,243 | 1,956,520 | 11,203,476 | 40,808 |
| 1894 | 188,277,525 | 2,164,863 | 1,986,385 | 9,078,532* | 39,886½ |

* The complete returns of iron ore produced have not yet been rendered.

—*Imp. Inst. Jnl., April* 1895, 142.

## German Chemical Dividends.

The shareholders in the Chemische Fabrik, vormals Goldenberg, Geromont, and Co., in Winkel, Rheingau, will receive 23 per cent. dividend for 1894. The directors of the salt-mines, Inowrazlaw, propose to distribute 1¾ per cent. dividend for 1894, against 1 per cent. for 1893. The Chemische Fabrik Buckau, near Magdeburg, have made a net profit of 325,021 m. (against 318,622 m. in 1893). They propose to pay a dividend of 8 per cent., the same as distributed for 1893. The Actiengesellschaft für Anilinfabrikation, in Berlin, propose a dividend of 12½ per cent., against 10 per cent. for 1893. The patent for the preparation of artificial indigo lately taken out by this factory is officially stated to be unworkable in practice. The net profit of the Verein Chemischer Fabriken in Mannheim, for 1894, has been 829,209 m. Out of this the shareholders will receive a 12 per cent. dividend (they received 14 per cent. for 1893), and 100,000 m. is carried to the credit of the new year. The directors' report states that the sales of soda in 1894 yielded 250,000 m. less than in 1893. The sale of other articles, especially sulphuric acid, also shows a great decrease, and, in order to reduce the quantity of sulphuric acid on the market, the company have opened an experimental works for the manufacture of manurial phosphates. The commercial prospects are not considered favourable.—*Chemist and Druggist.*

## Chrome Lead Poisoning.

At the last meeting of the Manchester Chamber of Commerce, a series of resolutions of the Chemical Sectional Committee was laid before the Board, illustrated by a number of sample hanks of yarn which had been dyed by Mr. Levinstein, chairman of the committee—some with chrome lead colours, the rest with other colouring materials, for the purpose of comparison. The Board substantially adopted the resolutions of the Sectional Committee, as follows :—1. "That the drying of goods with chrome lead colours, and especially the handling of goods dyed with these colours, is injurious to the people employed, unless special provisions are made and due precautions taken, and unless the workpeople heartily co-operate in making use of the appliances provided for their protection." 2. "That in view of the fact that the wearing of goods next to the skin coloured wholly or partially with chrome lead dyes, under certain conditions may be injurious to health, it is desirable to substitute these dyes by others derived from innocuous colouring matters of similar colouring properties." 3. "That it would be an injustice to the dyeing trade to place any restrictions upon the colouring of goods by chrome lead colours unless such restrictions are also extended at the same time and to the same degree to the importation to this country and its colonies of such coloured goods, also to the dyeing trade of India, in which country very considerable quantities of goods are so dyed; one dyeworks alone being stated to turn out 20,000 lb. of yarn per day dyed with chrome lead colours." 4. "That the attention of merchants and their clients be called to the injurious effect of chrome lead colouring materials, and to the existence of others less injurious to health, producing similar colour effects, of which there are several."—*Chemical Trade Journal.*

## Mineral Production of Ontario in 1894.

Mr. Archibald Blue, director of the Bureau of Mines of Ontario, reports the mineral production of that province in 1894, the figures for 1892 and 1893, taken from the "Mineral Industry," being presented for comparison.

| Product. | 1892. | | 1893. | | 1894. | |
|---|---|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. | Quantity. | Value. |
| | | Dols. | | Dols. | | Dols. |
| Apatite .......... Tons. | 2,181 | 21,810 | 20 | 200 | .. | .. |
| Building stone .......... | .. | 870,000 | .. | 721,000 | .. | .. |
| Cobalt .......... Tons. | 9 | 3,713 | 19 | 9,400 | 4 | 3,500 |
| Copper .......... " | 1,936 | 232,135 | 1,431 | 115,200 | 2,748 | 195,750 |
| Gold .......... Oz. | (ore) 3,510 | 34,800 | 1,402 | 30,120 | 2,023 | 32,776 |
| Gypsum .......... " | 2,200 | 8,000 | 2,957 | 22,163 | 3,253 | 9,760 |
| Lime .......... Bush. | 2,600,000 | 350,000 | 2,700,000 | 364,000 | 2,150,000 | 280,000 |
| Mica .......... Tons. | 7 | 1,500 | 20 | 1,600 | .. | .. |
| Natural gas .......... M. cub. ft. | .. | 160,000 | 1,962,000 | 190,705 | 1,653,500 | 204,179 |
| Natural-rock cement .......... Bbls. | 54,155 | 38,580 | 74,353 | 63,567 | 55,323 | 48,774 |
| Nickel .......... Tons | 2,082 | 590,902 | 1,642 | 454,702 | 2,571 | 621,724 |
| Petroleum .......... Bbls. | 800,000 | 1,000,000 | 1,045,000 | 1,100,000 | 34,912,360 | .. |
| Portland cement .......... " | 20,247 | 47,417 | 31,924 | 63,848 | 30.580 | 61,060 |
| Salt .......... Tons | 43,387 | 162,700 | 47,988 | 150,000 | 35,215 | 115,551 |
| Silver ore .......... " | 10 | 732 | 501 | .. | .. | .. |
| Totals .......... | 3,529,724 | 3,522,289 | 5,869,257 | 3,286,505 | 38,847,577 | 1,573,074 |

—*Engineering and Mining Journal.*

## Canadian Mica.

The Canadian Section of the Imperial Institute has recently received through Dr. Dawson, the Director of the Geological Survey of Canada, a collection of specimens of mica from Quebec, illustrative of this particular industry in the province. Three varieties are represented in the collection, viz., *biotite* (or "black mica"), *phlogopite* (or "amber mica"), and *muscovite* (a potash mica, usually white). The first two varieties merge into one another, the *biotites* being essentially magnesia-micas containing much iron, while the *phlogopites* are magnesia-micas almost free from iron. Prior to 1890, Canadian mica was chiefly worked to supply the stove-making trade, but owing to the demand which has recently arisen for the mineral for electrical purposes, the mica industry of Canada has developed largely during the past five years. The darker colour of the magnesia-micas (*biotite* and *phlogopite*), while not affecting their value in the electrical trade, renders them less fitted for use in the construction of stoves than the clearer potash-mica (*muscovite*), while the frequency with which the latter is stained by the deposition of iron oxides between the *laminæ*, and its consequently inferior insulating power, militates against its fitness for electrical purposes. Most of the Canadian mica is exported to the United States, where it is used by manufacturers of electrical machinery. The bulk of that employed by the "Edison General Electrical Company" is Canadian mica of the amber-coloured variety. The following table, from the mineral and mining statistics published by the Geological Survey of Canada, shows the value of the total output, and of the total export of Canadian mica during the five years ending with 1893:—

| —— | Value of Total Production. | Value of Total Exports. |
|---|---|---|
| | Dols. | Dols. |
| 1889 | 28,718 | 30,597 |
| 1890 | 68,074 | 22,468 |
| 1891 | 71,510 | 37,590 |
| 1892 | 104,745 | 86,562 |
| 1893 | 75,719 | 70,081 |

The samples of mica recently sent to the Imperial Institute are all from the province of Quebec, and were obtained chiefly from the deposits occurring in the Laurentian rocks of the Valley of the Gatineau River, Ottawa County. The mines of the Vavasour Mining Association, Cantley, the Villeneuve Mica Mine, the mine of the Cascades Mica Company, and that of Messrs. Powell and Clemow, have supplied most of the samples shown in the section. The collection now exhibited is well deserving of a visit from manufacturers, and the Curator of the Canadian Section is in a position to give full information as to the prices of the several varieties of the material, as well as the names of the mines from which they may be procured.—*Imp. Inst. Jnl.*, April 1895, 155.

### ARTIFICIAL SILK AND THE TAX ON ALCOHOL.

Consul Germain, of Zurich, sends the following further details concerning the artificial silk produced by the process of Dr. Lehner, of Zurich :—

The process is patented in the principal European countries. Patent has also been applied for in the United States, and in the English colonies of North America, where a company, with a capital stock of 1,500,000 dols., is in course of formation. A company for the acquisition of the patent rights in European countries and the British colonies (except British colonies in North America), owned by Dr. Lehner, was formed in England last July with a capital of 108,000*l*. The patent rights were then purchased, Mr. Lehner receiving 32,000*l*. in cash and 36,000*l*. in fully paid-up shares, thus leaving 40,000*l*. working capital to carry on the manufacture of this artificial silk.

The intention was first to manufacture the raw material in England, but as a large quantity of alcohol is consumed in its manufacture, and the tax on alcohol in England is almost prohibitory for manufacturing purposes, the company decided to establish the factory in a country where spirits used for the arts, science, and manufacturing purposes are untaxed. The plant was therefore established at Glattbrugg, near Zurich, under the supervision and management of Dr. Lehner, who, in addition to being a heavy stockholder, receives a nominal annual salary of 600*l*. for his services. Here alcohol consumed for such purposes is untaxed.

The artificial silk is thus forwarded in a raw state to England, and there manufactured into textile fabrics of every description.

Dr. Lehner says that it is the intention to manufacture this artificial silk in America, provided alcohol used for its manufacture is tax free; otherwise, it will have to be manufactured in Switzerland and then forwarded to America as raw silk, to be there manufactured into textile fabrics. He also says that so far his English company has not come into competition with the real cocoon silk, his articles being mostly used to mix with cotton and wool, but, of course, there is no telling how sharp a competition this artificial article will bring against real silk in the future.—*U.S. Consular Reports.*

### CINNABAR IN TEXAS.

In the south of Texas within the Big Bend of the Rio Grande River, about 80 or 90 miles south of Alpine station, and 90 or 100 miles from Marfa station on the Southern Pacific Railway, the cinnabar occurs both in massive limestone and in a siliceous shale and a white earthy clay-like rock, and in part in a true breccia of greyish-white siliceous shale, dense and compact, imbedded and cemented in a red and chocolate coloured ferruginous mass, also dense and hard. The cinnabar is more generally crystalline than amorphous. There are also considerable masses of snow-white argillaceous rock, seemingly the result of alteration of shale by infiltration, in which cinnabar is found in minute crystalline grains spread in bunches here and there through the mass. In addition there are amorphous bunches of cinnabar found in the brecciated shale and limestones and breccia. This cinnabar is, however, not in hard masses like those of the New Almaden mine in California, nor is it in veinlets, as there found, traversing the rocks; but is soft and friable and has a light vermilion colour.

There is a second line of cropping of cinnabar a few rods north of the first in a mass of hard limestone. This is in a well-defined breccia of iron oxide, and the masses of cinnabar are closely associated with it. The cinnabar croppings may be traced a few feet each way, and the breadth does not exceed 18 in. or 2 ft. The author states that the conditions for working these deposits are not favourable. The brilliant colour of the ore would permit of its being used as vermilion; but there is no water near the place for concentrating it. Considerable ore could be taken out from the loose earth along the main croppings if water could be had to wash with. A supply of wood for fuel can be had along the Rio Grande, and could be delivered at the mines for probably 5 dols. or 6 dols. per cord.—*Eng. and Mining Journal.*

### NORTH CAROLINA MONAZITE.

Monazite is a phosphate of the rare earths, cerium, lanthanum, and didymium. It also contains thoria and silica, which are present in varying percentages. The mineral is subtranslucent, light yellow, or yellowish-brown or green, and has a resinous lustre. Its hardness is from 5 to 5·5, and its specific gravity 4·9 to 5·3. Its economic value lies principally in thoria, which it contains; this is used as one of the constituents in the manufacture of mantles for the Welsbach and other incandescent gas-lights.

The mineral is somewhat widely distributed, but has been found in commercial quantities only in Brazil, Siberia, Norway, and North and South Carolina in this country. The North Carolina area embraces between 1,600 and 2,000 square miles, situated in Burke, McDowell, Rutherford, and Cleveland counties. The principal deposits of this region are found along the waters of Silver, South Muddy, and North Muddy creeks, and Henry and Jacob's Forks of the Catawba river in McDowell and Burke counties; and the Second Broad river in McDowell and Rutherford counties, and the First Broad river in Rutherford and Cleveland counties. Some monazite is also found in Polk county, and along the western edge of Catawba, Lincoln, and Gaston counties.

The best crystallised specimens have been found at Milholland's mill and Stony Point in Alexander county. The monozite occurs in the sands and gravels of the stream beds, associated with other minerals, such as quartz, feldspar, hornblende, epidote, mica, magnetite, garnet, zircon, rutile, corundum, &c. The primary source of monazite is in the crystalline gneisses and schists, of which it is an accessory constituent. The material produced from the disintegration of the decomposed country rock is deposited in the stream beds, and undergoes, by virtue of a continual current and differences of specific gravity, a natural process of partial sorting and concentration. The richer portions of the stream deposits are thus, as a rule, found near the head-waters.

As the percentage of thoria is variable in different sands, the value of the mineral consequently varies accordingly, and must be determined by careful chemical analysis. Some monazite contains practically no thoria. It is stated that the transparent greenish and yellowish-brown varieties are usually the richest. The best North Carolina sands (highest in thoria) occur near Brindletown, Burke county, and in the northern part of Cleveland county. Some of the highest grade Brindletown sand runs from 1·00 to 6·60 per cent. of thoria; sand from Gum Branch in McDowell county is reported to run 3·30 per cent. thoria; some sand from near Shelley in Cleveland county contains 2·76 per cent. thoria.

The thickness of these stream-gravel deposits is from 1 to 2 ft., and the width of the mountain streams in which they occur is seldom over 12 ft. The sluice boxes used in separating it are about 8 ft. long by 20 in. wide by 20 in. deep. Two men usually work at a box, the one digging the gravel and shovelling it into the box, the other one working it up and down in the box with a gravel-fork or perforated shovel in order to float off the lighter sands.

These boxes are cleaned out at the end of the day's work, the cleaned monazite being collected and dried. If it contains magnetite it is treated with a magnet. It is then ready for packing and shipment. From 20 to 35 lb. of cleaned monazite sand per hand is considered a good day's work. The value of the best grades of sand is 6 to 7 cents per pound at the diggings.

During the past two years the following shipments of monazite sand have been made from this region :—

In 1893, 110,000 lb. at 6 cents at mines, 6,600 dols.; 20,000 lb. at 5 cents at mines, 1,000 dols.; total, 130,000 lb., 7,600 dols. In 1894, 460,000 lb. at $6\frac{3}{4}$ cents at mines, 31,050 dols.; 80,000 lb. at 6 cents at mines, 4,800 dols.; 6,855 lb. at 5 cents at mines, 342·75 dols.; total, 546,855 lb., 36,192·75 dols.—*Ibid.*

### The Tin Deposits of Durango, Mexico.

Tin has been found in Mexico at the following points :—Durango, Cacaria, and Potrillos, in the State of Durango; Canitas, Sain Alto, and Chalchiuites, in Zacatecas; Bolanos, Comanja, Teocaltiche, and Paso de Sotos, in Jalisco, and on the Ranchos de la Pena and San Jose de Estanos in the same State; at the Cerro de Zamorano, and in the Distritos de Chichimequillas and Bravo, in Queretaro; at the Cello del Chiquihuite, in Aguas Calientes; in the Distritos de Ures, Arizpe, and Saguaripa, of Sonora; at Catorce, Valle San Francisco, and on the Mesas de la Cruz and San Jose Buena-Vista, in San Luis Potosi, also near the Santuario del Desierto, in the cordillera extending south-east from the capital of the State, San Luis Potosi; at Guanajuato, Dolores, Villalpando, Hidalgo San Diego, and between Santa Rosa and La Fragua, in the State of Guanajuato.

Potrillos, an outlying ranch of the Guartimape, on the Sierra de San Francisco, a spur of the Sierra Madre, about 100 miles north of Durango, is 12 miles south-east of the famous Promontorio mine, which in recent years has been a large silver producer. The general altitude of the valleys of Potrillos is about 6,500 to 7,000 ft. In 1839 there was a considerable population in this region getting tin-stone from the stream-beds. The industry did not continue long, as the region was infested by Indians until 1867. After these were driven out a little mining was done, but the region was still very unsettled and no regular operations were followed.

The geology of the district is simple; the prevailing country is rhyolite and rhyolite-tuff, chiefly the latter, of recent origin. This is a greyish-white, soft rock, very much decomposed even at a depth of 150 ft. In the Candelaria mine this changed suddenly to a hard, brittle, purplish variety. Cassiterite occurs along the fault-planes in aggregations of nuggets and occasionally in bands of crystalline mineral, replacing the country rock between two sheeting planes. In the former class of ore there are all gradations from nests of pure mineral down to small particles, so the whole may not assay over 1 per cent. metal. The ore that has been mined, however, has generally shown from 3 to 10 per cent. of metal, and as thus found has been broken from breasts 3 or 4 ft. wide. The ore is found in pockets, never large, occurring in a series connected by thin stringers, and having a general dip to the west of about 45°. These ore bodies are poorly defined, passing into the barren country rock by insensible gradations.

The cassiterite is generally in botryoidal concretions. In colour it is oftenest black, but very frequently brilliant red and occasionally yellow. In the veins the tin ore is invariably associated with micaceous hematite. No evidence of Wolfram compounds have been noted in the ore or metal. Analysis of two lots of pig tin showed, however, 7·3 and 9·2 per cent. antimony, with 92·6 and 90·6 per cent. tin respectively. It is believed that the antimony is chemically combined with the cassiterite.

After Potrillos, the next extensive developments in Mexican tin fields were carried out in the Cacária district, about 40 miles north of Durango. In 1881 the property was taken in hand by the Durango Tin Mining Company, of St. Louis, and extensively explored, but later was abandoned as unprofitable and the mines reverted to the original owners. These mines are in the southern extension of the Sierra de la Candela. The physical characteristics of the region are identical with those of Potrillos. The most extensive developments were made in the Diablo mine, which was opened to a depth of 273 feet.

The third locality in the vicinity of Durango is the Cerro de Inlesia de los Remedios, about half a mile west of the city of Durango. A shaft was sunk 60 feet, but the veins proved too small and the mine was abandoned. The country rock and vein formation are identical with that of Potrillos. There is very little information regarding the other tin deposits in Mexico. Attempts have been made to work those at Sain Alto, and certain others at Guanajuato, but with what success is not known. In the Canton of Teocaltiche, in the state of Jalisco, mines were exploited extensively at one time. The mine, "Los Vallecitos" was opened to a depth of 30 metres, and for a length of 200 metres on the vein. Its product when at its best was about 900 lbs. of black tin per month, from which 6,000 lbs. of metal were obtained. The mines at Bolanos, also in Jalisco, are still worked in a desultory manner to supply local requirements.—*Ibid.*

### The Petroleum Supply of the Caucasus.

According to the *Moniteur Officiel du Commerce* the petroleum springs existing around Baku do not appear to have lost their prolific character, at all events in the districts of Balakhani-Salrundschi, Bibi-Eybat, and Romamy, where the petroleum industry is concentrated. In 1893 the production of mineral oil was 337,051,834 pouds (1 poud = 36 lb.); of this quantity, 324,763,197 pouds (13·6 per cent. more than in 1892) underwent treatment in the local refineries, the remainder having been used for purposes of fuel or lost. The increase arises chiefly from the fact that the springs, without the aid of pumps, supplied about one-third of the aforesaid total. The price of the unrefined petroleum has been affected by this abundant supply; it has varied from 2·75 copecks (1 copeck = 1 farthing approx.) per poud in winter to about 0·75 copeck in summer. In 1893 there were 38 springs and 458 wells with pumps. A set of pipes, from 75 to 150 mms. in diameter, and of a total length of 268 kilos., connecting the wells and the works, has permitted of the refining of about 1,440,000 pouds daily. There are only 85 refineries in work, and several have had but little to do, because in Russia, as everywhere else, the larger establishments are crushing out the smaller. The refineries have produced and exported the following quantities:—Refined petroleum, 85,633,791 pouds; lubricating oils, 6,232,740 pouds; benzene, 252,493 pouds; tar and gasoline, 437,620 pouds; and petroleum residues, 145,538,399 pouds.—*Ibid.*

### German Patent Office Statistics for 1894.

*Ding. Poly. J.* **295**, 160—164.

This article is a *résumé* of the official statistics of The Imperial Patent Office for 1894.

It is pointed out that a new arrangement, giving a broader and clearer view of the subject, has been adopted.

Table I.

Showing the Number of Patents Applied for, Granted, and Cancelled.

| 1. Year. | 2. Applications. | 3. Applications Published. | 4. Refused after Publication. | 5. Patents Granted. | 6. Patents Cancelled and Withdrawn. | 7. Patents Expired or Cancelled through Non-payment of Fees. | 8. Patents remaining in force at the end of the Year. |
|---|---|---|---|---|---|---|---|
| 1877 | 3,212 | 1,674 | .. | 190 | .. | .. | 190 |
| 1878 | 5,949 | 4,807 | 187 | 4,200 | 3 | 160 | 4,227 |
| 1879 | 6.528 | 4,570 | 406 | 4,410 | 17 | 1,813 | 6,807 |
| 1880 | 7.017 | 4,422 | 300 | 3,966 | 21 | 2,745 | 8,007 |
| 1881 | 7.174 | 4.751 | 313 | 4,339 | 24 | 3,703 | 8,619 |

TABLE I.—*continued.*

| 1. Year. | 2. Applications. | 3. Applications Published. | 4. Refused after Publication. | 5. Patents Granted. | 6. Patents Cancelled and Withdrawn. | 7. Patents Expired or Cancelled through Non-payment of Fees. | 8. Patents remaining in force at the end of the Year. |
|---|---|---|---|---|---|---|---|
| 1882 | 7,569 | 4,549 | 255 | 4,131 | 25 | 3,273 | 9,452 |
| 1883 | 8,121 | 5,025 | 318 | 4,848 | 30 | 3,740 | 10,535 |
| 1884 | 8,607 | 4,632 | 357 | 4,459 | 18 | 3,984 | 10,994 |
| 1885 | 9,408 | 4,456 | 358 | 4,018 | 25 | 3,947 | 11,046 |
| 1886 | 9,991 | 4,361 | 368 | 4,008 | 22 | 3,786 | 11,249 |
| 1887 | 9,904 | 4,221 | 356 | 3,882 | 34 | 3,587 | 11,512 |
| 1888 | 9,869 | 4,262 | 287 | 3,923 | 26 | 3,625 | 11,810 |
| 1889 | 11,645 | 4,962 | 247 | 4,406 | 15 | 3,973 | 12,732 |
| 1890 | 11,882 | 5,351 | 205 | 4,680 | 15 | 3,761 | 13,639 |
| 1891 | 12,919 | 5,989 | 199 | 5,550 | 23 | 4,435 | 14,735 |
| 1892 | 13,126 | 6,920 | 189 | 5,909 | 11 | 4,799 | 15,825 |
| 1893 | 14,265 | 6,957 | 210 | 6,430 | 12 | 4,949 | 17,299 |
| 1894 | 14,964 | 6,532 | 256 | 6,280 | 22 | 5,638 | 17,921 |
| 1877—1894 | 172,150 | 88,441 | 4,811 | 79,620 | 343 | 61,418 | .. |

To compare the number of patents granted with the number of applications, it is not sufficient to simply take the respective figures, as a number of applications—941 in all since 1877—have never been even considered, on account of the application fee not being paid, and, also, there are a number still under consideration, both of which ought to be included. When these are allowed for, it appears that 52·5 per cent. of the applications for patents are published, the rest having been either withdrawn, or refused, for some reason. Of the applications published, patents have been granted to 91·9 per cent., refused to 5·5 per cent., whilst 2·6 per cent. were withdrawn after publication.

About two-thirds of the applications are made through patent agents, the exact figures for the last four years being:

| | Per Cent. |
|---|---|
| 1891 | 65·69 |
| 1892 | 64·50 |
| 1893 | 66·30 |
| 1894 | 65·05 |

In these years about 28 per cent. of all applications were made on behalf of foreigners, and therefore of necessity through agents, so that about half the applicants residing in Germany have employed agents. The following table, which is an abstract of a very extensive one in the official publication, gives the applications grouped into subjects, of which there are 89 in the original ;—

TABLE II.

APPLICATIONS, &C., CLASSED UNDER VARIOUS INDUSTRIES.

| —— | Applications. | | Grants. | | Appeals | Grants. | Cancelled. |
|---|---|---|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. | 1894. | 1887 to 1894. | |
| Mining and smelting (Classes 1, 5, 18, 40) | 193 | 194 | 110 | 102 | 26 | 1,848 | 1,446 |
| Iron and metal working (Classes 7, 31, 48, 49, 67, 69, 87) | 758 | 823 | 428 | 405 | 109 | 5,004 | 3,738 |
| Motive power (Classes 10, 13, 14, 24, 46, 47, 60, 88) | 1,514 | 1,475 | 541 | 484 | 217 | 8,792 | 6,982 |
| Chemical industries (Classes 12, 16, 22, 23, 26, 62, 75, 78, 89) | 1,495 | 1,390 | 653 | 681 | 305 | 6,267 | 3,913 |
| Electricity (Class 21) | 603 | 575 | 246 | 229 | 89 | 2,862 | 2,166 |
| Agriculture (Class 45) | 519 | 527 | 240 | 223 | 57 | 2,902 | 2,325 |
| Art of reproduction and paper industry (Classes 11, 15, 54, 55, 57, 70). | 737 | 741 | 377 | 421 | 51 | 4,664 | 3,583 |
| Traffic and transportation (Classes 19, 20, 65, 81) | 882 | 812 | 340 | 411 | 101 | 4,762 | 3,733 |
| Textile and clothing (Classes 3, 8, 25, 29, 41, 52, 71, 73, 76, 86) | 1,235 | 1,153 | 532 | 545 | 150 | 6,996 | 5,346 |
| Foods and drinks (Classes 2, 6, 17, 50, 53, 64, 66, 79) | 1,142 | 1,053 | 385 | 450 | 134 | 5,863 | 4,618 |
| Haberdashery and domestic appliances (Classes 33, 34, 44) | 1,068 | 1,050 | 393 | 418 | 90 | 5,052 | 4,266 |
| Ceramic industries (Classes 32, 80) | 350 | 352 | 241 | 250 | 65 | 2,302 | 1,675 |
| Wood working (Classes 38, 43, 63) | 810 | 600 | 361 | 270 | 90 | 2,966 | 2,283 |
| Instruments and clocks (Classes 42, 83) | 562 | 500 | 281 | 333 | 36 | 3,939 | 3,217 |
| Building construction (Class 37) | 335 | 281 | 61 | 70 | 39 | 1,099 | 931 |
| Distribution of water (Class 85) | 198 | 206 | 85 | 94 | 22 | 1,144 | 920 |

Notices of opposition have been lodged in all classes during 1894, but most frequently in classes 12 and 22, both of which relate to chemical industry.

The effect of the registration of "designs" on applications for patents, is shown in the decrease, or non-increase, of the latter in 1891 and 1892. It is most marked in those groups, into which the so-called "articles of the season" come, for which the shorter and cheaper protection afforded by registering the design is sufficient.

### Table III.

Showing the Patents Cancelled, Arranged according to the Annual Fees for the Time, from July 1, 1877, to December 31, 1894.

| 1. | 2. | 3. Cancelled on Account of Non-Payment of Fee. | | 4. Patents Cancelled out of each Hundred. | |
|---|---|---|---|---|---|
| Annual Fee Marks. | Number of Patents on which this Fee has become due. | The Number of Years the Patents had run. | Patents. | The Number of Years the Patents had run. | Patents. |
| 30 | 79,112 | 1 | 4,859 | 1 | 6·74 |
| 50 | 65,684 | 2 | 16,232 | 2 | 22·53 |
| 100 | 49,245 | 3 | 17,694 | 3 | 24·56 |
| 150 | 28,177 | 4 | 8,195 | 4 | 11·38 |
| 200 | 17,037 | 5 | 3,902 | 5 | 5·42 |
| 250 | 11,208 | 6 | 2,185 | 6 | 3·03 |
| 300 | 7,935 | 7 | 1,352 | 7 | 1·88 |
| 350 | 5,440 | 8 | 873 | 8 | 1·21 |
| 400 | 4,054 | 9 | 590 | 9 | 0·82 |
| 450 | 3,081 | 10 | 402 | 10 | 0·56 |
| 500 | 2,331 | 11 | 302 | 11 | 0·42 |
| 550 | 1,736 | 12 | 205 | 12 | 0·28 |
| 600 | 1,288 | 13 | 189 | 13 | 0·26 |
| 650 | 894 | 14 | 107 | 14 | 0·15 |
| 700 | 652 | 15 | 50 | 15 | 0·07 |

In the second column of this table, it will be noticed that the first figure differs by 508 from the total number of patents granted, as given in Table I. This is explained by the fact, that in the latter patents, granted by the various German States, which have now been converted into Imperial patents, are included. As there was a fee of more than 30 marks already due on 508 of these, they could not be included in Table III.

The heading of column 2 is incorrect in so far as, that since October 1, 1891, the fee of 30 marks is not due on patents being *granted*, but before.

The greatest number of patents become void through non-payment of fees during the first three years, during which 53·83 per cent. are cancelled. The third year is the critical one, and in it nearly one-fourth are allowed to run out, probably because by this time the value of the patent can be judged.

After the fourth year the number cancelled decreases continually. Of all patents, 35 per cent. reach the fourth, 6·8 per cent. the eighth, 2·1 per cent. the twelfth year, and 0·83 per cent. are kept up for the full term of 15 years.

The statistics relating to oppositions, show that out of 50 cases which were still under consideration at the end of 1893, 8 were withdrawn, 22 ended in patents being granted, 18 in patents being refused, and 2 were left still unsettled. In 1893, 1,639 oppositions were lodged, of which 97 were either withdrawn or not proceeded with, either because they were held to be inadmissible, or for non-payment of fees. Of the 1,542 proceeded with, 25 of which are still unsettled, 1,163 were lodged before the publication of the application and 354 after. Of the former, 18 were referred back, 389 published, and 756 refused. Of the 389 applications which were published after opposition, patents have been granted to 357 and refused to 24, 8 cases being still undecided.

Appeals from the above decisions were lodged by applicants in 137 cases, 55 of which were successful and 82 dismissed.

The opposers appealed in 217 cases, successfully in 80 cases and unsuccessfully in 121 (in some cases there was more than one opposer). Since 1877, 1,647 actions to have patents declared void have been brought. Of these, 480 have been withdrawn, 162 are still being heard, and 1,005 have been decided. In 1894 the number of such actions was double that of the previous year, but it must not be assumed that the number of bad patents granted was doubled, as the number of patents cancelled is by no means proportional to the number of actions brought. In fact, the system of examination that obtains has been brought to such a state of excellence that, out of 10,000 patents granted, only 38 have been held to be wholly, and 30 partly, bad. Applications for the withdrawal of patents are very rare. Since 1877 only 128 have been made, of which 49 were not proceeded with, 34 were allowed, or partly so, and 30 dismissed. Appeals were lodged against these decisions in 25 per cent. of the cases. The following table relates to the registration of designs:—

### Table IV.

Registrations of Designs Applied for, Registered, Cancelled, and Transferred.

| Year. | 1. Applications. | 2. Registered. | 3. Considered, but not Registered. | 4. Still under Consideration at End of Year. | 5. Cancelled On Account of Withdrawal or Judge's Decision. | 5. Cancelled On Expiration. | 6. Prolonged on Payment of 60 M. | 7. Transferred. |
|---|---|---|---|---|---|---|---|---|
| 1891 (Oct. 1 to Dec. 31) | 2,095 | 1,724 | 4 | 367 | .. | .. | .. | 1 |
| 1892 | 9,066 | 8,456 | 141 | 836 | 67 | .. | .. | 90 |
| 1893 | 11,354 | 10,297 | 470 | 1,423 | 101 | .. | .. | 165 |
| 1894 | 15,259 | 13,673 | 731 | 2,278 | 130 | 1.372 | 475 | 293 |
| 1891—1894 | 37,774 | 34,150 | 1,346 | .. | 298 | 1,372 | 475 | 549 |

The figures relating to the registration of trade marks may be summarised as follows :—

From October 1 to December 31, 1894, 10,807 applications were made, of which 1,496 were registered, and 9,311 are still under consideration. Figures are next given dealing with the nationality of the patentees. Generally speaking, nearly 30 per cent. of the patents of each year since 1877 have been granted to foreign subjects, England coming first, in the matter of number, followed closely by the United States, and then by Austro-Hungary, France, Switzerland, Belgium, Russia, and Italy, in the order named.

Particulars as to the relative number of registrations of designs granted to subjects of the various German and foreign States are also given. Of the former, Prussia comes first with 60·5 per cent., the remaining North German States next with 24·4 per cent., and then the Southern German States with 15·1 per cent. Of the foreign States, Austro-Hungary comes first, followed by the United States, Great Britain, and Switzerland. The article concludes with remarks on the inventive activity of various countries, and on the income of the German Patent Office.—R. B. P.

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Month ending 31st March. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,788,300 | 1,411,870 |
| Chemicals and dyestuffs | 813,996 | 885,527 |
| Oils | 618,050 | 680,297 |
| Raw materials for non-textile industries. | 2,450,019 | 3,131,237 |
| Total value of all imports | 35,327,037 | 35,980,590 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 31st March. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,241,893 | 2,229,136 |
| Chemicals and medicines | 827,841 | 739,269 |
| Miscellaneous articles | 2,466,560 | 2,767,391 |
| Total value of all exports | 18,098,903 | 18,523,030 |

### IMPORTS OF OILS FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut ........ Cwt. | 26,015 | 13,065 | 32,020 | 14,074 |
| Olive ............ Tuns | 2,041 | 1,214 | 72,007 | 40,465 |
| Palm ............ Cwt. | 96,324 | 95,283 | 143,022 | 98,402 |
| Petroleum ........ Gall. | 14,008,835 | 18,801,423 | 216,877 | 293,010 |
| Seed ............ Tons | 2,202 | 3,795 | 55,828 | 73,169 |
| Train, &c. ........ Tuns | 1,877 | 1,766 | 35,245 | 29,114 |
| Turpentine ....... Cwt. | 6,799 | 17,183 | 6,463 | 53,659 |
| Other articles .. Value £ | .. | .. | 86,588 | 78,074 |
| Total value of oils ... | .. | .. | 618,050 | 680,297 |

### IMPORTS OF METALS FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper :— | | | | |
| Ore ............ Tons | 7,490 | 9,042 | 51,029 | 49,494 |
| Regulus ........ „ | 6,558 | 4,438 | 140,747 | 121,226 |
| Unwrought .... „ | 3,612 | 3,116 | 156,015 | 126,524 |
| Iron :— | | | | |
| Ore ............ „ | 418,969 | 353,277 | 285,286 | 203,514 |
| Bolt, bar, &c. ... „ | 3,209 | 1,705 | 23,646 | 12,838 |
| Steel, unwrought.. „ | 621 | 835 | 6,125 | 9,061 |
| Lead, pig and sheet „ | 15,935 | 15,583 | 148,352 | 148,856 |
| Pyrites ........... „ | 60,784 | 51,924 | 102,422 | 87,921 |
| Quicksilver ....... Lb. | 1,620,450 | 1,125,865 | 124,712 | 97,583 |
| Silver ore....... Value £ | .. | .. | 204,270 | 182,223 |
| Tin ............... Cwt. | 73,371 | 61,651 | 255,292 | 185,125 |
| Zinc .............. Tons | 3,777 | 4,224 | 60,895 | 58,840 |
| Other articles ...Value £ | .. | .. | 229,509 | 128,665 |
| Total value of metals | .. | .. | 1,788,300 | 1,411,870 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 7,126 | 8,737 | 6,283 | 6,175 |
| Bark (tanners', &c.) „ | 19,589 | 16,959 | 6,654 | 6,461 |
| Brimstone ........ „ | 28,652 | 46,360 | 6,916 | 7,541 |
| Chemicals...... Value £ | .. | .. | 122,978 | 91,541 |
| Cochineal ........ Cwt. | 320 | 623 | 2,003 | 4,077 |
| Cutch and gambier Tons | 1,862 | 3,124 | 42,962 | 67,285 |
| Dyes :— | | | | |
| Alizarin ...... Value £ | .. | .. | 18,614 | 30,808 |
| Aniline and other „ | .. | .. | 17,430 | 32,393 |
| Indigo ........... Cwt. | 16,340 | 23,223 | 324,157 | 436,548 |
| Nitrate of potash . „ | 35,741 | 13,706 | 33,001 | 13,322 |
| Valonia ........... Tons | 2,432 | 3,668 | 29,290 | 35,796 |
| Other articles... Value £ | .. | .. | 203,678 | 153,580 |
| Total value of chemicals | .. | .. | 813,996 | 885,527 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 6,027 | 4,365 | 10,517 | 10,726 |
| Bristles.......... Lb. | 145,689 | 237,099 | 23,869 | 33,302 |
| Caoutchouc...... Cwt. | 20,503 | 41,166 | 206,732 | 501 374 |
| Gum :— | | | | |
| Arabic......... „ | 5,107 | 5,970 | 12,657 | 13,440 |
| Lac, &c. ....... „ | 12,367 | 13,190 | 66,041 | 71,662 |
| Gutta-percha .... „ | 7,295 | 4,203 | 84,890 | 37,741 |
| Hides, raw :— | | | | |
| Dry............ „ | 48,504 | 48,380 | 111,910 | 107,262 |
| Wet ........... „ | 37,487 | 61,599 | 75,866 | 107,228 |
| Ivory ............ „ | 936 | 857 | 41,338 | 39,450 |
| Manure :— | | | | |
| Guano ......... Tons | 528 | 4,545 | 2,150 | 25,938 |
| Bones.......... „ | 7,182 | 9,171 | 34,173 | 39,492 |
| Nitrate of soda... „ | 11,089 | 12,788 | 102,170 | 109 983 |
| Phosphate of lime „ | 30,906 | 32,028 | 56,933 | 57,718 |
| Paraffin.......... Cwt. | 69,820 | 77,008 | 69,283 | 75,314 |
| Linen rags....... Tons | 1,692 | 2,257 | 17,874 | 19,165 |
| Esparto.......... „ | 21,240 | 16,590 | 94,104 | 70,283 |
| Pulp of wood .... „ | 23,142 | 19,066 | 114,547 | 92,792 |
| Rosin............ Cwt. | 77,234 | 216,397 | 14,459 | 56,012 |
| Tallow and stearin „ | 72,779 | 322,697 | 94,273 | 385,680 |
| Tar ..............Barrels | 869 | 1,922 | 372 | 649 |
| Wood :— | | | | |
| Hewn ......... Loads | 131,852 | 112.799 | 208,323 | 214,353 |
| Sawn .......... „ | 94,613 | 88,991 | 236,572 | 215,012 |
| Staves ......... „ | 5,722 | 3,397 | 31,364 | 21,027 |
| Mahogany ..... Tons | 7,090 | 4,169 | 54,967 | 33,760 |
| Other articles....Value £ | .. | .. | 684,651 | 791,814 |
| Total value ....... | .. | .. | 2,450,049 | 3,131,237 |

Besides the above, drugs to the value of 88,725*l.* were imported, as against 76,297*l.* in March 1894.

### EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 458,281 | 563,948 | 128,996 | 136,112 |
| Bleaching materials „ | 101,486 | 122,639 | 40,427 | 44,213 |
| Chemical manures. Tons | 35,758 | 26,723 | 266,071 | 202,451 |
| Medicines....... Value £ | .. | .. | 84,871 | 83,836 |
| Other articles ... „ | .. | .. | 307,476 | 272,657 |
| Total value .......... | .. | .. | 827,841 | 739,269 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 10,024 | 9,349 | 35,146 | 35,619 |
| Copper :— | | | | |
| Unwrought ..... „ | 26,605 | 50,806 | 58,955 | 109,893 |
| Wrought........ „ | 26,482 | 30,977 | 73,642 | 78,404 |
| Mixed metal .... „ | 34,037 | 26,227 | 76,413 | 54,101 |
| Hardware ..... Value £ | .. | .. | 154,416 | 149,713 |
| Implements....... „ | .. | .. | 102,630 | 99,981 |
| Iron and steel..... Tons | 196,309 | 205,707 | 1,453,506 | 1,521,315 |
| Lead ............. „ | 2,744 | 3,657 | 33,095 | 41,985 |
| Plated wares... Value £ | .. | .. | 20,006 | 24,951 |
| Telegraph wires „ | .. | .. | 113,423 | 19,598 |
| Tin ............... Cwt. | 11,202 | 8,913 | 41,513 | 28,531 |
| Zinc .............. „ | 13,970 | 12,746 | 9,794 | 8,115 |
| Other articles .. Value £ | .. | .. | 69,354 | 56,930 |
| Total value ......... | .. | .. | 2,241,893 | 2,229,136 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST MARCH.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 1,128,100 | 480,600 | 19,724 | 11,913 |
| Military stores.. Value £ | .. | .. | 136,491 | 183,607 |
| Candles.......... Lb. | 1,552,900 | 2,139,600 | 27,296 | 35,372 |
| Caoutchouc ..... Value £ | .. | .. | 95,328 | 99,251 |
| Cement.......... Tons | 36,411 | 28,616 | 60,633 | 46,184 |
| Products of coal Value £ | .. | .. | 116,870 | 134,704 |
| Earthenware ... „ | .. | .. | 115,950 | 151,117 |
| Stoneware ...... „ | .. | .. | 12,796 | 13,806 |
| Glass :— | | | | |
| Plate........... Sq. Ft. | 81,458 | 94,083 | 4,961 | 5,376 |
| Flint........... Cwt. | 6,950 | 7,594 | 15,304 | 17,410 |
| Bottles......... „ | 58,834 | 53,670 | 27,377 | 24,952 |
| Other kinds.... „ | 10,958 | 16,434 | 8,236 | 12,887 |
| Leather :— | | | | |
| Unwrought .... „ | 12,023 | 13,165 | 113,712 | 112,743 |
| Wrought ..... Value £ | .. | .. | 20,549 | 28,230 |
| Seed oil.......... Tons | 5,901 | 4,603 | 123,904 | 90,117 |
| Floorcloth ..... Sq. Yds. | 1.762,400 | 2,325,800 | 65 896 | 84,779 |
| Painters' materials Val. £ | .. | .. | 119,567 | 128,116 |
| Paper ........... Cwt. | 89,439 | 81,235 | 136,318 | 123,766 |
| Rags............. Tons | 5,042 | 4,978 | 27,918 | 30,980 |
| Soap............. Cwt. | 50,552 | 57,472 | 55,537 | 62,249 |
| Total value .......... | .. | .. | 2,466,560 | 2,767,391 |

# Monthly Patent List.

*** The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.**

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### Applications.

5843. C. Raleigh. Improved means applicable for use in the separation of solid matter from liquid. March 20.

5845. C. Raleigh. Improved means applicable for use in separating solids from liquids. March 20.

5865. J. B. C. Krohnke. Improvements in and relating to apparatus for filtering liquids. March 20.

6059. J. J. Tong and J. R. Wood. *See* Class XII.

6211. M. Arndt. Improvements in apparatus for weighing gases. March 26.

6231. H. Nehmer and F. Nehmer. Improvements in statical machines for lighting gas, ether, benzoline, and such like. March 26.

6491. J. Lee. Improvements in evaporating apparatus. March 29.

6823. W. Griffin and J. H. Dales. Improvements in methods and apparatus for cooling or condensing vapours or liquids, by the evaporation of liquids and the use of dry air for the same, for ice-making, distilling, and other purposes. April 3.

6868. H. Kropff. Apparatus for drying or dehydrating gypsum and other finely-divided materials. April 3.

7113. J. Bryson, J. Jones, and W. Fraser. *See* Class III.

7265. R. Urbanitzky. An improved melting and reducing furnace. Complete Specification. April 9.

7267. W. P. Thompson. Improvements in separating fluids of different specific gravity and in apparatus therefor. April 9.

7286. E. W. Kuhn. Improvements in and apparatus for sterilising liquids. Filed April 9. Date applied for 15th October 1894, being date of application in Belgium.

7390. J. Laidlaw. Improvements in centrifugal machines for separating fluids of different densities. April 11.

7425. H. Simmonds and J. Delaney. Improvements in kilns or furnaces applicable for burning lime and other minerals. April 11.

### Complete Specifications Accepted.*

1894.

7326. E. Hesketh and A. Marcet. Improvements in flasks or cylinders for containing gases under pressure or liquefaction or the like. April 10.

8545. C. G. J. Möller and P. Pfeiffer. Improvements in and relating to drying and evaporating apparatus. April 17.

9395. T. E. Pye and C. E. Scull. Improvements in valves or regulators for gas and chemical works. April 17.

10,523. J. F. Beins. An improved method of and apparatus for saturating liquids with gases. April 3.

10,906. A. Chapman. Improvements in apparatus for evaporating brine or other liquors or solutions, and extracting the salts or other solid matters therefrom. April 17.

20,061. J. Mitchell. Improvements in or relating to fastening devices for the doors of gas retorts. March 27.

1895.

2,540. E. J. O'Brien. Improvements in apparatus for separating fluids from solids. April 3.

3490. T. Labinal. Improvements in pumps for rarefying or compressing gases. March 27.

4680. G. C. Marks.—From E. Wanquier and Fils. Improved centrifugal apparatus for the continuous separation from liquids of matters in suspension therein. April 10.

## II.—FUEL, GAS, AND LIGHT.

### Applications.

5703. G. J. Altham. Improvement in fuel and the process of making the same. Complete Specification. March 19.

5730. H. H. Lake.—From E. N. Dickerson and J. J. Suckert, United States. An improved process of and apparatus for producing and liquefying acetylene gas. Complete Specification. March 19.

5732. W. P. Thompson.—From G. D. Bayaud, G. F. Perrenoud, and G. H. Harvey, United States. Improvements in or relating to the manufacture of oil from gas. March 19.

5860. G. Haycraft. Improvements in apparatus for use in the manufacture of artificial fuel. March 20.

6101. L. M. Bullier. Improved method of rendering acetylene and other gases rich in carbon suitable for lighting and heating purposes. March 23.

6158. F. L. Slocum. Improvements in and relating to scrubbing or purifying of gases and in apparatus therefor. Complete Specification. March 25.

6300. A. McDougall. Improvements in the treatment of coal to adapt it for more economic use as fuel and in the manufacture of gas. March 27.

6585. P. Douin and P. Kestner. Improvements in the combustion of gaseous fuel and apparatus therefor. Complete Specification. March 30.

6615. H. H. Lake.—From M. M. Rotten and Co. Improvements relating to the treatment of peat and to apparatus therefor. March 30.

6690. A. Besson. Improvements in incandescence gas-burners. April 1.

6777. E. Gearing. Improvements in acetylene generating and storing apparatus. April 2.

6870. D. W. Sugg. Improvements in incandescent gas-burners. April 3.

7113. J. Bryson, J. Jones, and W. Fraser. *See* Class III.

7160. W. H. Westwood, E. T. Wright, and W. W. S. Westwood. Improvements in the manufacture of enriched water gas, and in apparatus employed in the said manufacture. April 8.

7281. H. S. Elworthy and P. D. Henderson. An improved process and apparatus for the separation of carbonic-acid gas from the products of combustion or other mixed and less soluble gases. April 9.

7502. W. Thomson and H. Smith. Improvements in the manufacture of fuel. April 13.

7517. H. Simon. Improvements in and connected with the manufacture of gas. Complete Specification. April 13.

### Complete Specifications Accepted.

1894.

2914. V. B. Lewes. Improvements in and in apparatus for the manufacture or production of gas. April 17.

9274. E. Stauber. Improvements in the process of and apparatus for producing peat briquettes and the like. April 3.

9387. C. Schmitz. Improvements in or relating to the combustion of fuel. March 27.

10,772. A. J. Tempere. Process of deodorising petroleum and other hydrocarbons. April 10.

11,522. N. K. H. Ekelund. Apparatus for the manufacture of carbonised powder from peat, sawdust, and such like. April 10.

11,810. J. H. Lamprey. Improvements in apparatus for the rapid and economical production of ozone. April 17.

18,715. A. W. Summers. Fuel-saving compound. March 27.

22,184. C. W. Pinkney. Improvements in or connected with apparatus for the manufacture of gas from liquid hydrocarbons. March 27.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Application.

7113. J. Bryson, J. Jones, and W. Fraser. Improvements in or relating to retorts for the distillation of shale and other bituminous substances, or for the calcining of ironstone, lime, or other substances, also applicable to gas-producers. Complete Specification. April 6.

## IV.—COLOURING MATTERS and DYES.

### Applications.

5796. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. March 19.

5797. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture of colouring matters. March 19.

5861. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of colouring matters. March 20.

6162. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation, Germany. Improvements in the manufacture of direct-dyeing azo colouring matters. March 25.

6176. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs, and materials therefor. March 25.

6328. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co., Germany. The manufacture or production of dyestuffs. March 27.

6697. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of azo dyes of the benzidine and analogous series. April 1.

6967. F. E. Mafat. Process and apparatus for extracting the colouring matter from dyewoods. April 4.

7170. O. Imray.—From The Farbwerke vormals Meister, Lucius and Brüning. Manufacture of dyestuffs from substituted fluoresceins. April 8.

7237. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis and D. A. Rosenstiehl. Manufacture of azo colouring matters, dyeing unmordanted cotton in acid, neutral, or alkaline bath. April 9.

7498. J. Duxbury.—From E. A. Mitchell. An improved "kaki" dye. April 13.

7549. O. Imray.—From The Farbwerke vormals Meister, Lucius and Brüning. Manufacture of new substantive dyestuffs. April 13.

### Complete Specifications Accepted.

1894.

7422. J. Baruch and A. Goldsobel. Improvements in and connected with the manufacture of colouring matters. April 10.

9610. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters, and materials therefor. March 27.

10,854. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Improvements in the manufacture of colouring matters related to the indulines and eurhodines. April 10.

11,157. S. Pitt.—From L. Cassella and Co. The production of phenylamidoxynaphthalene sulpho acid, and of colouring matters deriving therefrom. April 17.

1895.

3854. J. Imray.—From J. Bierer and La Société L. Durand, Huguenin, and Cie. Manufacture of new blue gallocyanine colouring matters. April 10.

4985. H. Imray.—From The Basle Chemical Works. Manufacture of colouring matters of the group of the phthaleines. April 17.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

6045. J. R. Barlow and H. Duxbury. Improvements in the manufacture of coloured figured fabrics. March 23.

6293. J. Strakosch and A. Herzet. An improved process for cleaning off and carbonising the impurities adhering to wool, wool waste, and wool combings. March 27.

7044. R. J. Crowley and J. Chisholm. A means of rendering textile fabrics uninflammable. April 5.

### Complete Specifications Accepted.

1894.

10,337. H. Cohrs and J. Oesterreich. Process and composition for waterproofing textile materials or fabrics and finished garments. April 3.

10,450. H. F. Moreau and L. Canevet. The manufacture and production of a new kind of lace. March 27.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

### Applications.

6046. R. W. Thom. Improvements in or relating to keirs employed in bleaching textile and other materials. March 23.

6296. J. H. Sparks, A. Stockdale, and M. Liebert. A new or improved process or treatment and means for decolourizing or changing the colour of dyed or coloured animal and vegetable fibres and fabrics, and other fibrous materials or substances. March 27.

6445. J. A. O'Loughlin. Improvements in the production of white printed designs in conjunction with a certain dyed colour on textile fabrics and the like. March 29.

6446. J. A. O'Loughlin and A. Barclay. Improvements in the production of white printed designs in conjunction with a certain dyed colour on textile fabrics and the like. March 29.

6532. J. A. O'Loughlin. Improvements in the production of coloured printed designs in conjunction with a certain dyed colour on textile fabrics and the like. March 30.

6533. J. A. O'Loughlin. Improvements in the production of coloured printed designs in conjuction with certain dyed colours on textile fabrics and the like. March 30.

6534. A. Barclay. Improvements in the production of coloured printed designs in conjunction with certain dyed colours on textile fabrics and the like. March 30.

6969. W. Mather. Improvements in the treatment of textile materials and products in bleaching, washing, and otherwise operating upon them, and apparatus for that purpose. April 4.

### Complete Specifications Accepted.

1894.

7885. J. S. Lord and G. S. Lord. Improvements in machines for washing, scouring, mordanting, bleaching, sizing, and dyeing yarn in the hank. April 10.

9524. L. Schaefer. Improved method of and apparatus for marking patterns on fabrics. April 17.

10,391. F. A. Blair. Improvements in apparatus for dyeing or otherwise treating with liquids textile materials in a more or less manufactured condition. April 3.

18,258. E. Potter and Co., Lim., and J. Barr. Improvements in printing upon calico and other woven fabrics. April 3.

## VII.—ACIDS, ALKALIS, AND SALTS.

### Applications.

5651. H. Loesner. Process for separating chlorine from gases mixed therewith. March 18.

5662. C. Hoepfner. Improvements in the production of zinc chlorides. March 18.

5966. N. Bassett and W. von Baranoff. Improvements in the manufacture and production of phosphoric acid for use in the treatment of alkaline chlorides, or for other purposes. March 21.

6009. W. McD. Mackey and J. F. Hutcheson. Manufacture of sodic cyanide. March 22.

6711. A. R. Scott and T. Henderson. Improvements in purifying acetates. April 2.

6725. F. Hamer and A. G. Marshall. The production of nitric acid ($HNO_3$) and the nitrates of soda, of potash, and of lime. April 2.

6905. F. W. Passmore. Improvements in the manufacture of ammonium nitrate. April 4.

7171. H. Reichardt and J. Bueb. *See* Class XVI.

7193. A. Le Chatelier. Improvements in the production of blocks of salt. Complete Specification. April 8.

7273. H. K. Baynes and The Chemical and Electrolytic Syndicate, Limited. Improvements in and in apparatus for the decomposition of alkaline nitrates. April 9.

7287. J. Raschen and J. Brock. Improvements in the manufacture of chlorine and in the treatment of bye products of the said manufacture.

7288. J. Raschen and J. Brock. Improvements in the manufacture of ammonia and its salts from nitrogen-oxychlorides or nitrogen oxides. April 9.

7365. M. Schmeltzer and C. Aschman. Manufacture of a sulphuric alcohol and glycerine mixture and its application for tanning or preparing leather. April 10.

7436. H. S. Elworthy and P. D. Henderson. Improvements in methods of solidifying carbon dioxide, and of utilising the solidified substance. April 11.

7437. H. S. Elworthy and P. D. Henderson. Improvements in the manufacture of carbonic acid gas and in apparatus therefor. April 11.

7444. T. Twynam. Improvements in the fixation of atmospheric nitrogen for the manufacture of ammonia and for other purposes. April 11.

7560. C. Hoepfner. Improvements in the manufacture of chloride of zinc and other metal chlorides. April 13.

### Complete Specifications Accepted.

1894.

9250. R. Hodgson. Improvements in machinery or apparatus for obtaining salt from brine. April 17.

9782. A. Campbell and A. Walker. Improvements in utilising acid sulphates and acids, and in obtaining nitric acid and hydrochloric acid. March 27.

12,675. A. Staub. Improvements relating to the manufacture of sulphuric acid, and to apparatus therefor. April 17.

12,708. G. Dalton and T. B. Provis. *See* Class XVIII., C.

1895.

3477. W. P. Thompson.—From C. von der Linde. An improved process for obtaining acetic acid from pyrolignate of lime. April 17.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

6065. W. Storr and H. Debler. Process for the manufacture of a firmly adhering coating for keramic and glass ware fit for the reception of galvanically deposited layers of metal. March 23.

6237. E. Bohn. Improvements in enamelled or glazed bricks and tiles. March 26.

6401. W. P. Thompson.—From J. N. Gregg and C. C. Stouffer. Improvements in apparatus for the manufacture of wire glass. March 28.

7264. W. L. Wise.—From T. Lefevre and L. Michau. Improvements in the manufacture of glass plates. April 9.

### Complete Specifications Accepted.

1894.

10,117. E. M. C. Gondouin. Improvements in ovens or kilns for use in burning or baking articles of porcelain, earthenware and the like, and in apparatus for use in connection therewith. April 10.

1895.

5008. T. H. Stubbs. Improved method or methods of decorating tiles or the like. April 17.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

5724. H. C. W. Weyhe. Improved process and apparatus for the manufacture of hollow blocks or slabs for building purposes. March 19.

6737. E. Delorenzi. Machine for making automatically tiles paving of cement. April 2.

6866. P. Stolte. Improvements in building slabs or blocks. April 3.

6868. H. Kropff. *See* Class I.

7016. J. E. Fuller. An improved fireproof and waterproof material for roofing, sheathing, coating, filling, and like purposes. April 5.

7542. G. T. Jenkins. Improvements in artificial stone. Complete Specification. April 13.

### Complete Specifications Accepted.

1894.

6168. W. Horne. Improvements in the construction of fireproof buildings and rendering existing buildings fireproof. April 3.

8468. A. W. Keim. An improved material for wall-plastering, priming, casting, or the like, and process for producing the same. April 3.

9545. A. Bauchere. Improvements in continuous or running kilns for burning lime, cement, and other similar materials. March 27.

10,416. J. Briggs. Improvements in kilns for burning limestone, cement, and other similar materials. April 3.

10,607. J. P. Brasseur and N. Lambert. A process for the production of cement from furnace slag. March 27.

13,198. J. H. Lester. Improvements in treating certain waste materials to produce valuable products, such as plaster or stiffening, weighting, and whitening materials therefrom. March 20.

14,846. L. Mack. Improvements relating to the manufacture of cement from schist and bituminous marl. April 3.

1895.

324. J. Foster. Improvements in the construction of kilns for burning limestone, cement, and other similar material. April 10.

3561. J. F. Kleine. Improvements in fire- and damp-hollow blocks for use in the construction of fire and damp-proof ceilings, walls, and the like. April 17.

4491. J. F. de Navarro. Improvements in apparatus relating to the burning of materials used in the manufacture of cement, hydraulic limes, and similar substances, and for obtaining waste products therefrom. April 17.

## X.—METALLURGY, MINING, Etc.

### Applications.

5719. J. B. Torres. Improvements in metallurgical furnaces for the reduction, smelting, and refining of ores, metals, and alloys. March 19.

5720. J. B. Torres. Improvements in and connected with the manufacturing of aluminium alloys. March 19.

5789. W. H. Legate. Improvements relating to the coating or plating of aluminium with other metals. March 19.

5844. C. Raleigh. Improved means applicable for use in the precipitation of metals from solutions containing insoluble matters in suspension. March 20.

5935. J. Welby and A. Parks-Smith. Improved manufacture of gold leaf. March 21.

5958. C. G. T. Bennett, E. H. Shortman, and B. Bracey. Improved method of treating galvanizer's flux skimmings to recover ammonia and facilitate the extraction of the zinc, with apparatus for use therein. March 21.

6323. A. Reichwald. — From F. Krupp, Germany. Method or process of reducing metals or mixtures of metals containing oxygen. Complete Specification. March 27.

6431. A. Roger. A new process for the production of aluminium. Complete Specification. March 28.

6569. J. B. Torres. Improvements in forming alloys, and refining and reducing metals and alloys. March 30.

6673. H. J. Ridley. An improved method of and apparatus for coating metal plates with tin, terne, or other metals or alloys. April 1.

6802. J. S. MacArthur and J. Yates. Improvements in extracting gold and silver from ores and the like. April 2.

6844. T. Hampton. Improvements in the manufacture of steel. April 3.

6869. J. B. Torres. Improvements in and connected with the reduction, manufacture, and refining of metallic compounds, metals, and alloys. April 3.

7351. O. Imray.—From W. E. Corey, United States. Manufacture of compressed carbonized steel and armour plates and other articles therefrom. Complete Specification. April 10.

7379. J. Swinburne. Improvements in and connected with working aluminium and plating on it and with it. April 11.

### Complete Specifications Accepted.

1894.

427. G. Robson. Treatment of finely-divided substances, such as crushed ores, slime, tailings, and the like, for the separation and recovery of metals and compounds therefrom and apparatus therefor. April 10.

3680. J. Nicholas. Improvements in obtaining gold and silver from ores and other compounds, and apparatus therefor. March 27.

6783. H. G. Richardson. Certain improvements in the manufacture of iron and steel and other metals, and in apparatus to be employed in the said manufacture. April 10.

6914. P. Manhes. Improvements relating to the manufacture of nickel and cobalt. April 10.

6984. P. Manhes. Improvements relating to the treatment of nickel and cobalt ores. April 10.

8183. W. P. Thompson. From L. R. Bonehill and E. T. Gautier. Improved process and apparatus for extracting metals from their ores. April 3.

8370. B. P. Stockman. Improvements in the manufacture of steel and iron. April 3.

9878. C. T. J. Vautin. An improved process and means used therein for the production of metallic sodium and potassium from salts of the same. April 10.

10,197. C. T. J. Vautin. An improved process and means used therein for the production of metallic sodium and potassium from salts of the same. April 10.

10,249. G. Thomson. Improvements in obtaining gold and silver from ores, mattes, and other compounds. April 3.

11,138. F. Siemens. A method of protecting iron, steel, or other metal from oxidation during heating. April 17.

13,851. W. T. Gibbs. Process for the treatment of nickeliferous iron ores. April 17.

1895.

2493. J. Y. Johnson. From L. Pelatan and F. Clerici Improvements in treating ores or other substances or liquors containing gold or silver or both, and apparatus therefor. April 10.

3499. E. de Frey. An improved manufacture of gold foil for use in dentistry. April 10.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### APPLICATIONS.

5671. C. Langstone, B. Young, and A. van den Bogaerde Improved storage battery. March 19.

5868. H. Cardozo. An improved secondary battery. March 20.

5964. A. Holler. Improvements in the construction of galvanic battery-elements or cells. March 21.

5965. E. A. Allen. Improvements in or connected with electrolytic cells. March 21.

6163. W. A. B. Buckland. Plate for secondary voltaic battery. Complete Specification. March 25.

6180. H. A. V. Wirth. An improved process for the electro-plating or metallisation of wood. March 25.

6258. M. Stein and A. Wolf. Improvements in apparatus for the electrolytic decomposition or purification of liquids. March 26.

6565. H. Tee. Improvements connected with the electrolytic production of alkali and chloride from sodium chloride solution and other substances. March 30.

7108. O. Imray.—From La Société Anonyme Raffinerie Say. *See* Class XVI.

7119. H. Nolan. An improved method of electrolysing sea-water and the like for the production of disinfectants and deodorants. April 6.

7315. W. J. S. Barber-Starkey. Improvements in and connected with electrical storage batteries. April 10.

7364. J. Wetter.—From The Elektrizitats-Aktiengesellschaft vormals Schuckert and Co. Improvements in the electrolytic manufacture of alkali-chlorates. April 10.

7445. D. E. Hipwell. Improvements in accumulators. April 11.

7458. C. Kellner. Improvements in the electrolysis of metallic salts. April 11.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

9285. C. Kellner. Improvements in or relating to electrodes and method of manufacturing the same. April 17.

11,587. L. P. Hulin. Improvements in the process of and apparatus for the electrolytic decomposition of solutions and for the immediate separation therefrom of the liquid or dissolved electrolytic products. April 17.

22,965. W. P. Thompson.—From C. L. Coffin. Improvements in or relating to electrically heating and welding metals. April 17.

25,289. V. Ludvigsen. An improved primary battery. April. 3.

1895.

358. J. Wershoven. Improvements in electrodes for secondary batteries. April 17.

4245. G. Laura. Improvements in electrical galvanic batteries. April 10.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### APPLICATIONS.

5743. F. E. Coulter. Washing compound and method of preparing the same. Complete Specification. March 19.

6059. J. J. Tong and J. R. Wood. Improvements in apparatus for filtering oils and the like. Complete Specification. March 23.

6094. S. Wohle and A. C. Irwin. Manufacture of detergent. March 23.

6717. W. Ford and C. P. Maher. Soap. Complete Specification. April 2.

6801. J. E. Bedford and C. S. Bedford. An improvement in the process for preparing solid drying oils suitable for the manufacture of linoleum and other floor cloths. April 3.

7412 A. Luhn. A new or improved soap extract and a process for manufacturing the same. Complete Specification. April 11.

### COMPLETE SPECIFICATION ACCEPTED.

1894.

11,916. S. Rosenblum and F. L. Bartelt. Improvements in soap, oil, greases, petroleum, mineral, vegetable, fish, and animal fats and oils. April 3.

1895.

3615. E. Fahrig. Process of extracting fat from wool and other fibrous materials. March 27.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, ETC.

### APPLICATIONS.

5931. W. Lutwyche and W. B. Lutwyche. Improvements in translucent enamel. March 21.

6083. J. E. Campbell. Improvements in the manufacture of certain colours or pigments. March 23.

6281. A. W. Anderson. Improvements in furnaces and apparatus for the manufacture of oxide and carbonate of lead. March 26.

7204. W. H. Akester and H. H. Price. Improvements in the method of and apparatus for producing oxide of lead or compounds of lead for decorative or other purposes. April 9.

7363. A. Gutensohn and R. Matthews. An improvement in the manufacture of lead oxide. April 10.

7366. H. Kolker, B. Kolker, and H. Naphtali. Improvements relating to paints suitable for coating iron and other surfaces. Complete Specification. April 10.

### Complete Specifications Accepted.

1894.

10,676. E. F. Wailes. Non-conducting bituminous composition for protecting the surfaces of structures from waste or decay. April 10.

13,198. J. H. Lester. *See* Class IX.

16,381. J. McLintock. Improved quick-drying anti-fouling paint. March 27.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

5924. S. L. Evans. A new or improved tanning process. Complete Specification. March 21.

6692. F. Prelli and B. Demo. Improvements in or relating to the tanning of hides or skins. Complete Specification. April 1.

7365. M. Schmeltzer and C. Ascham. *See* Class VII.

7424. W. P. Thompson.—From E. Beckmann. An improved process for rendering gelatin or gelatinous bodies insoluble in water. April 11.

7555. A. Sinan, H. Sinan, and E. Gouin. An improved process for decolorising and clarifying tannic extracts. April 13.

### Complete Specification Accepted.

1894.

10,151. E. T. Day and T. W. Matthews. Improvements in the treatment of raw hide, and the subsequent use and application of the same. April 3.

## XV.—AGRICULTURE and MANURES, Etc.

### Applications.

6112. W. Hutchinson and A. H. Knight. Improvements in the preparation of basic slag for fertilising purposes. March 25.

7232. A. Deckers. A new or improved process for the manufacture of super-phosphates. April 9.

### Complete Specification Accepted.

1894.

11,296. G. H. Richards. A new or improved composition or compound. April 17.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

7108. O. Imray.—From La Société Anonyme Raffinerie Say. Improvements in the purification of saccharine juices by electrolytic treatment, and means employed for that purpose. Complete Specification. April 6.

7171. H. Reichardt and J. Bueb. Process for manufacturing cyanides out of molasses and lyes resulting from beetroot-molasses. April 8.

### Complete Specifications Accepted.

1893.

24,742. E. Shaw. Improved method of and apparatus for boiling sugar and glucose, either separately or mixed. March 27.

1894.

9880. F. E. V. Baines. Improvements in the treatment of rice or other raw grain or other starchy substances for the production therefrom of a material suitable for use in brewing or for other purposes. April 17.

10,956. R. Wilson. Improvements in the manufacture of starch. April 17.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

5780. P. Puvrez. Improved method of treating malt and grain in brewing and other operations. March 19.

6207. C. L. Hart. Process for the production of crypto-malt, so-called. Complete Specification. March 26.

7258. J. C. R. G. Boulet. An improved process relating to the industrial application of formaldehyde or formol for the preparation of malt, saccharification, fermentation, purification of leaven or yeast, preservation of residues, and in general for all operation relating to the production of alcohol, of leaven, and of all fermented products. April 9.

7286. E. W. Kuhn. *See* Class I.

7353. P. Puvrez and E. Leconte. Improvements in the manufacture of temperance beers or beverages. April 10.

### Complete Specifications Accepted.

1894.

9880. F. E. V. Baines. *See* Class XVI.

14,918. L. Prochazka. An improved process and apparatus for rendering soluble the albumenoids in mash and wort. March 27.

1895.

2264. E. Larsen.—From The Berliner Actiengesellschaft fur Eissengies serei and Maschinenfabrik vormals J. C. Freund & Co. Improvements relating to the malting and drying of grain and to apparatus therefor. March 27.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

### APPLICATIONS.

### *A.—Chemistry of Foods.*

5776. A. Eckardt. A new process of torrefying coffee. Complete Specification. March 19.

6257. J. L. Johnston and Bovril, Limited. A new or improved method of obtaining and preserving the soluble albumen of animal food. March 26.

7508. W. Fraser. New food preparations, liquid and solid for animal food. April 13.

### *B.—Sanitary Chemistry.*

5834. G. Mugna. Improvements in or relating to the purification of smoke and recovery of soot from the products of furnaces. March 20.

6632. J. Berry. Improvements in apparatus for mixing precipitants with sewage and the like liquids. Complete Specification. April 1.

### *C.—Disinfectants.*

6613. Brooke, Simpson, and Spiller, Lim., R. J. Friswell, and C. Mills. A new antiseptic and disinfectant and the processes for its manufacture. March 30.

7119. H. Nolan. *See* Class XI.

### COMPLETE SPECIFICATIONS ACCEPTED.

### *A.—Chemistry of Foods.*

1894.

21,224. W. Schwartz. Improved manufacture of cattle food. April 17.

1895.

146. J. Wetter.—From L. Hentzschel. Manufacture of a new or improved milk product. April 3.

### *B.—Sanitary Chemistry.*

1895.

1858. J. Warwick. Improvements in treating fume in lead works, applicable also to other metallic fumes and to coal smoke. March 27.

3272. M. F. Purcell. An improved process and means for the treatment and utilisation of sewage. March 27.

### *C.—Disinfectants.*

1894.

10,445. C. T. Kingzett. Improvements in sulphur candles or fumigators. April 10.

12,708. G. Dalton and T. B. Provis. A method of utilising certain by-products of iron and copper sulphides and other iron and copper ores for the production of persulphate of iron to be used as a disinfectant for the purification of sewage and for other purposes. March 13.

## XIX.—PAPER, PASTEBOARD, ETC.

### APPLICATIONS.

6999. J. P. Cornett. Improvements in or connected with the boiling of esparto or like fibrous material in the manufacture of paper. Complete Specification. April 5.

7209. G. Hibbert. Improvements in washing, breaking, and beating engine rolls for the manufacture of paper-pulp, which improvements are also applicable to other analogous purposes. April 9.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

### APPLICATIONS.

6596. M. Otto and A. Verley. Improvements in the manufacture of perfumes. March 30.

7169. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of assimilable iron compounds. April 8.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

9676. C. F. Cross and E. J. Bevan. Manufacture of cellulose acetate. March 27.

11,952. C. D. Abel.—From Haarmann and Reimer. Process for the manufacture of vanilline from iso-eugenol. April 3.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### APPLICATIONS.

5929. L. F. Dobler. Improvements in or relating to photography. Filed March 21. Date applied for August 27, 1894, being date of application in France.

7104. G. Selle. Improvements in the production of photographs in natural colours. April 6.

7188. B. J. B. Mills.—From A. Lumiere and L. Lumiere. An improved photographic process giving, without transfer, images with their half tints and the application of this process to photography in colours. April 8.

### COMPLETE SPECIFICATION ACCEPTED.

1894.

10,766. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Production of coloured photographic pictures by means of diazo and tetrazo compounds. April 17.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

5709. W. Hartig, jun. A flameless explosive for use in gaseous or dusty mines and the like. March 19.

6271. T. Hawkins, S. H. Hawkins, H. Hawkins, and The Donnithorne Gun Patents and Ammunition Company, Limited. A new or improved smokeless explosive or gunpowder. March 26.

6289. W. D. Borland. Explosives. March 26.

6327. H. R. von Dahmen. Improvement in blasting compositions. Complete Specification. March 27.

6905. F. W. Passmore. *See* Class VII.

### Complete Specifications Accepted.

1894.

9149. T. Tallyn. Railway detonating signal and apparatus. March 27.

11,458. R. E. Brown and C. O. Lundholm. Improvements in the manufacture of explosive compounds. April 17.

## XXIV.—PATENT UNCLASSIFIABLE.

### Complete Specification Accepted.

1894.

13,838. G. Hagemann. Improvements in the manufacture of artificial cork. March 27.

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| C. A. Mitchell, B.A. | XII., XXII. |
| Herbert Morris | III., IV., VII., XIII. |
| H. S. Pattinson, Ph.D. | VII., |
| H. T. Pentermann | XVI., XVII. |
| R. B. Pollitt | I., II., XXII. |
| J. C. Richardson | XI. |
| F. W. Renaut | Patent List. |
| A. L. Stern, D.Sc. | XVII. |
| Chas. Salter | I., II., III., XV., XVI. |
| H. Schlichter, Ph.D. | V., XV., XXI. |
| J. Shields, D.Sc., Ph.D. | Gen. Chem. |
| E. Sonstadt | III., VII., X. |
| G. W. Alvey Teanby | XVII. |
| Eustace Thomas, B.Sc. | XI. |
| L. T. Thorne, Ph.D. | II., III., XVII. |
| H. K. Tompkins, B.Sc. | X. |
| V. H. Veley, M.A., F.R.S. | Gen. Chem. |
| Prof. Jas. Walker, D.Sc., Ph.D. | Gen. Chem. |
| C. Otto Weber, Ph.D. | IV., XIII. |
| J. G. Wells | XVII., XX. |
| A. Wingham | X. |

## NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Thos. Tyrer has been nominated to the office of President; and Prof. T. E. Thorpe, F.R.S., has been nominated Vice-President under Rule 11.

Mr. T. Fairley, Mr. Boverton Redwood, and Sir H. E. Roscoe, M.P., F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. C. C. Hutchinson has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. Thos. Tyrer, nominated to the office of President.

Mr. Ivan Levinstein has been nominated an Ordinary Member of Council under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election to their respective offices.

Members are hereby invited to nominate fit and proper persons to fill four vacancies among the Ordinary Members of Council under Rule 18. Special nomination forms for this purpose can be obtained from the General Secretary upon application.

*Extract from Rule* 18 :—"No such nomination shall be valid unless it be signed by at least ten Members of the Society who are not in arrear with their subscriptions, nor unless it be received by the General Secretary, at the Society's Office, at least one month before the date of the Annual General Meeting, to the election to take place at which it refers. Nor shall any such nomination be valid if the person nominated be ineligible for election under Rules 12 or 15. No member shall sign more than one nomination form."

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The Annual General Meeting will be held in Leeds on the 17th, 18th, and 19th of July next. A detailed programme appears in this issue, and Members are reminded that it will greatly facilitate the arrangements if they will kindly inform the Local Secretary, on the enclosed form, as soon as possible, whether they intend to be present. Tickets of Membership will be issued with the Ballot List in the June number.

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### *Draft Programme.*

#### Wednesday, July 17th.

10 a.m.—Council Meeting.

10.30 a.m.—Annual General Meeting and President's Address at Yorkshire College.

1 p.m.—Lunch, followed by inspection of College Buildings.

3 p.m. to 6 p.m.—Visits to works; including the Monkbridge Iron and Steel Co., Burmantofts Pottery, and Messrs. Greenwood and Batley.

8.30 p.m.—Conversazione, by invitation of the Mayor of Leeds.

#### Thursday, July 18th.

The excursions will be divided between the *Leeds and Bradford* districts.

The *Leeds* group will include:—

Messrs. Tetley's Brewery; The Leeds Steelworks; Messrs. Jackson's Tannery; Messrs. Flitch's Leather Works; The Clarence Ironworks; Messrs. Barran's Clothing Manufactory; Messrs. Illingworth and Ingham's Timber Works; and (provided sufficient applications are received) Messrs. Breffitt's Glassworks at Castleford, and Coal-washing Machinery.

The *Bradford* group will include :—

Sir Titus Salt, Bart., and Co., Saltaire; Messrs. E. Ripley and Sons, Bowling Dyeworks; Messrs. John Smith and Sons, Ltd., Wool Combers and Spinners; Messrs. Grandage and Co., Dyeworks; Messrs. Pickles, Smithson, and Pickles, Ltd., Chemical Works; the warehouses of Messrs. A. and S. Henry and Co., Ltd., and Messrs. Milligan, Forbes, and Co.; and Messrs. Rule, Greenlees, and McEwan's Manufactory.

7.30 p.m.—Annual Dinner.

#### Friday, July 19th.

Excursion to Wharfedale, including Bolton Abbey, Burnsall, Barden, and Skipton.

9 p.m.—Smoking Concert, by invitation of the Priestley Club.

The above is subject to modification.

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Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

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### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows :—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10*s.* |
| To Subscribers | 12*s.* 6*d.* |
| To others | 15*s.* |

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## LIST OF MEMBERS ELECTED 23rd MAY 1895.

Arnold, Jos., 29, Broadwater Down, Tunbridge Wells, Paper Maker.

Brown, Wm., Pioneer Sugar Estate, Lower Burdekin, Townsville, Queensland, Chemist.

Cook, E. M., Room 40, 76, Park Place, New York, U.S.A., Chemical Manufacturer.

Lancaster, J. C., 12, Player Street, Alfreton Road, Nottingham, Engineering Works Manager.

Lane, Howard, Corporation Street, Birmingham, Consulting Mechanical Engineer.

Rau, Dr. H. M., 130/132, Pearl Street, New York, U.S.A., Chemist.

Reid, T. Anderson, Lostock Gralam, Northwich, Cheshire, Works Manager.

Robertshaw, C. Dawson, 13, Grange Avenue, Potternewton, Leeds, Analytical Chemist.

Rump, Ernst., The Leeds Phosphate Works, Limited, Hunslet, Leeds, Manager.

Sayer, H., 60, Lancaster Road, Carnforth, Lancashire, Analytical Chemist.

Stead, J. Christopher, Mitre Works, Cordova Road, Bow, E., Chemist and Manager.

Want, W. Phillip, 42, Bishopsgate Street Without, London, E.C., Pharmacist and Sub-Editor.

Wheelwright, Dr. E. W., The Oaklands, Warley, Oldbury, near Birmingham, Research Chemist.

Williams, David T., 22, Morgan Street, Hafod, Swansea, Analytical Chemist.

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## CHANGES OF ADDRESS.

Auer, H., l/o Garston; V: Sas Utca 10, Budapest, Hungary.

Bailey, W. P., l/o Ilford; all communications to c/o G. W. Welton, Rabida 21, Seville, Spain.

Black, Wm., l/o Romulus Terrace; 9, St. Edmund's Road, Gateshead.

Buchan, A., l/o Canning Town; Maude Cottage, Pellatt Grove, Wood Green, N.

Carswell, T. R., l/o London; 19, Cheetham Place, Cheetham Hill, Manchester.

Coleman, J. B., l/o Carlton; University College, Nottingham.
Crawley, A. H., l/o Westminster Road; 24, East Road, Moss Lane, Aintree, Liverpool.
Davis, H. J., l/o West 71st Street; 45, Wall Street, New York, U.S.A.
Endemann, Dr. H., l/o 25; 23, William Street, New York, U.S.A.
Gamble, D., jun., l/o Bryn Eithyn; Ratonagh, Colwyn Bay, North Wales.
Hammond, G. W., l/o Boston; Yarmouthville, Maine, U.S.A. (Journals).
Hart, H. W., l/o Rawtenstall; 23, Northern Grove, West Didsbury, Manchester.
Heron, Jno., l/o Battersea; Laboratory, 110, Fenchurch Street, E.C.; Journals as before.
Holland, Jos., l/o West Gorton; 70, Higher Ardwick, Manchester.
Isaac, T. W. Player, l/o Cavendish Place; 114, Marine Parade, Brighton.
Kawakita, M., l/o Tokyo; Werft Strasse 10, Moabit, Berlin.
Lawrance, H. A., l/o Gunnersbury; retain Journals until further notice.
McAlley, Robt., l/o Greenwich; Bankside, Falkirk, N.B.
McCann, Owen, l/o 419; 532, Old Ford Road, Bow, E.
Martius, Dr. C. A., l/o 28; 8, Voss Strasse, Berlin.
Miller, W. M., l/o Demerara; retain Journals until further notice.
Mole, H. B.; Journals to 2, Town Street, Shepton Mallet, Somerset.
Preston, E. S., l/o Weybridge; 57, Chancery Lane, W.C.
Roscow, J. F., l/o Littleborough; 59–61, Church Street, South Shore, Blackpool.
Saarbach, Dr. L., l/o Old Slip; 23, William Street, New York, U.S.A.
Shaw, F. W.; Journals to 99, Heapey Road, Chorley, Lancaster.
Smith, Jno. W., l/o Roslindale; Mass. Inst. of Technology, Boston, Mass., U.S.A.
Swan, J. W., l/o Bromley; 58, Holland Park, W.
Thew, Walter H., l/o Liverpool; Talbot House, Arundel Street, Strand, W.C.
Thorne, Dr. L. T.; Journals to Southampton Wharf, Battersea, S.W.
Waldstein, Dr. M. E., l/o Front Street; 44, Trinity Place, New York, U.S.A.
Wates, E. A., l/o India; 56, Breakspear's Road, St. John's, S.E.
Watson, C. S., l/o Glasgow; c/o Post Office, Croydon, North Queensland.
Weston, R. Spurr, l/o Louisiana; 21, Wyman Street, Brockton, Mass., U.S.A.
Wilder, F. L.; Journals to Villa Nova de Lima, Estado de Minas Geraes, Brazil.
Wilson, Wesley W.; Journals to Ardganagh, Ballsbridge, Dublin.

## CHANGES OF ADDRESS REQUIRED.

Hodges, J. F., l/o Tudor Park, Holywood, Co. Down.
Pilkington, G., l/o Old Market Place, Bury, Lancashire.

## Deaths.

Eckley B. Cone, Drifton, Pa., U.S.A. May 13.
Moffatt, Alex., 104, Bothwell Street, Glasgow.
Thomson, Dr. Murray, 44, Victoria Road, Gipsy Hill, S.E.
White, A., Horton Field, West Drayton.

## London Section.

THE CHEMICAL SOCIETY'S ROOMS, BURLINGTON HOUSE, W.

*Chairman:* B. E. R. Newlands.
*Vice-Chairman:* *C. C. Hutchinson.*
*Committee:*

*E. J. Bevan.*
W. G. Blagden.
E. Grant Hooper.
T. A. Lawson.
R. Messel.
H. de Mosenthal.
E. O'Neil.
S. Rideal.
*A. Gordon Salamon.*
A. Shearer.
Wm. Thorp.
*T. Tyrer.*
*Frank Wilson.*
Lewis T. Wright.

*Hon. Local Secretary:* John Heron,
74, North Side, Clapham Common, S.W.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. F. Cross, B. Blount, S. Hall, F. Napier Sutton, and F. G. Adair Roberts.

June 17th:—
Dr. Carl Pieper, of Berlin. "The German Patent Laws and their relation to Home and Foreign Inventions."

*Meeting held Monday, May 6th, 1895.*

MR. B. E. R. NEWLANDS IN THE CHAIR.

## THE USE OF HOT AIR IN DRYING.

BY E. M. COOK (NEW YORK).

For drying many materials, but especially those in lumps, grains, or powder, the use of hot air or gas is most convenient, and has many advantages over other methods of using heat. Wherever the nature of the material will allow of the direct use of the gases of combustion, the economy over the use of steam is very great; and, probably, in a well designed and constructed apparatus, the amount of evaporation will be nearly, if not quite, double that of the best steam-heated dryers.

In the use of steam there are several important losses, quite unavoidable, which, in the use of gas, can be either entirely obviated or strictly limited. Among these are:—

First, the usual imperfect combustion of fuel under boilers, and a consequent waste of fuel. In this country—the United States—a large number of analyses of flue gases show scarcely an instance in which there is a total absence of CO except it be accompanied by so much free oxygen as to indicate the admission of more than double the theoretical amount of air requisite for complete combustion.

Second, the loss of heat in the escaping chimney gases. This, even under fairly good management, will equal 25 per cent. of the entire heat generated; and with careless firing, particularly where boilers have to be pushed, as is too frequently the case, this will be exceeded.

Third, loss of heat in the transmission of the steam to the dryer, and in the apparatus itself, by radiation. To this is sometimes added loss by leakage into the dryer itself, which is difficult to detect and to remedy. The loss in this case is most serious.

Fourth, loss of heat in the condensed steam, discharged at 212° F. With steam of ordinary pressure, this will equal about 14 per cent. of the entire heat; while with exhaust steam or steam of low pressure the percentage is greater.

Even where, with the use of exhaust steam, there would seem to be a promise of great economy, the expectation is not realised. In the transmission of heat from radiating or conducting surfaces, such as those of steam coils, into air, a considerable difference of temperature must be maintained, or the transmission becomes so slow that the coils required to condense the steam must be of enormous extent where the operation is large. This involves in practice so low a temperature in the dryer, where exhaust steam is used, that drying goes on with diminished energy, and a large amount of apparatus becomes necessary; this in turn, demands considerable power to keep it in motion, large buildings to accommodate it, and, what is frequently of even more importance, a large area of valuable ground on which to place them. Taking into account all these items, together with the cost of maintaining the apparatus in repair and the back pressure on the engines, the use of exhaust steam is seldom advantageous. The cases where it may be allowed are those where the nature of the material limits the temperatures to such as may be economically got with exhaust steam, and that class known in the U.S.A. as "can" dryers, where paper or other fabrics are drawn over revolving, steam-heated surfaces.

The higher the temperature at which air used in drying is discharged, the greater the economy. In the use of air in drying, its function is twofold. It serves to carry to the material under treatment, the heat by which evaporation is performed; and it is also the vehicle for carrying away the vapour. These two functions, although distinct, require to be considered with reference to each other. It is well known that the capacity of air or gas for carrying vapour, increases rapidly with an increase of temperature, while the capacity for carrying heat does not so increase; the specific heat of air, it should be remembered, being but 0·238. At 72° F., the capacity of air for carrying aqueous vapour is about three times as great as at 42°; while at 132° it is more than 20 times, and at 172° more than 80 times as great. It follows that the amount of air necessary at such limited temperatures as can be applied to most substances, to carry to them the heat requisite for the evaporation of the moisture they contain, is more than sufficient to carry off the vapour when discharged at suitable temperatures.

The most important loss of heat in this method of drying —and in fact practically the only one, except loss due to radiation and leakage, which in a correctly designed and constructed apparatus is limited—is that of the heat contained in the air discharged with the vapour, which has performed no useful function. To some extent, this is one of those necessary wastes which we are obliged to accept, as it is seldom possible in a practical operation to realise the ultimate value of the energies employed. It is analogous to the loss in case of steam used in an engine, where we usually sacrifice the heat required to raise the water from its normal temperature to that at which the steam after use is discharged into the air. It is, however, relatively greater, as we have not, in air, the latent heat of vaporisation, of which, in the use of steam, we are able to avail ourselves. It is therefore worth while to enquire in what way we may limit this loss: the only one in which we may look for any considerable saving.

At high temperatures and great relative humidity or percentage of saturation, the air carries its greatest burden of vapour; and it will be found that under these conditions the air of the discharged mixture carries the least heat, hence the economy which results. Thus the relative amount of heat carried in the air of discharge, if fully saturated, at 122° and 172°, would be as 699 to 238[*]; these figures being a ratio, based upon an assumed normal temperature of 62°, but making no allowance for the moisture normally present. If a fair allowance be made for normal moisture, which at lower temperatures is important, we shall get a balance in favour of a higher temperature of discharge. Evaporation is, however, greatly retarded as the point of complete saturation is approached; and, if we can maintain a high temperature of discharge, it is not usually desirable to attempt a higher saturation than 0·50 or 0·60, in all but exceptional cases.

The expenditure of heat in evaporation is so great, relatively to the amount of air required at a high temperature, to carry the vapour, that to maintain a discharge of high temperature and small volume, we find that with a saturation even of 50 per cent., we must employ initial temperatures which are inconveniently high. Thus, as will appear from figures presently to be given, at a discharge temperature of 122°, 0·50 saturated, and assuming the normal moisture at 0·0075 (dew point about 50°) to carry off 1 lb. of vapour, we shall require 28·23 lb. of air; hence, to carry to the material operated on the requisite amount of heat, we must start at 288° F. But at a discharge temperature of 172°, with the same degree of saturation and normal moisture, we shall require only 4·46 lb., but to enable this smaller quantity to do the required work, we must heat it to 1223°. The first would be near the limit of safety for most materials, while it is obvious that only the most refractory would withstand the latter. If we attempt a discharge at a higher degree of saturation, the necessary initial temperature rises rapidly, as the required amount of air is thereby diminished; and it must not be overlooked that even to these temperatures must be added the heat requisite to make good that lost by radiation, and that imparted to the material itself. Let us consider a lower range of temperatures, say a substance which will not bear a higher temperature than 150°. In this case, as the loss of heat in the air of discharge increases rapidly as we descend in temperature, we will allow a saturation of 0·60; to maintain this with such an initial temperature as circumstances will admit, we find that we must discharge at about 92°, and at this low temperature of discharge, the heat carried by the air, and not utilised, is over 52 per cent. of that utilised in evaporation.

The following calculations illustrate how the initial temperatures above given are arrived at:—

Saturated mixtures of air and vapour will contain in each lb. of air, at 172°, 0·46338 lb. of vapour; at 122°, 0·08584 lb. vapour; at 92°, 0·03289 lb. vapour.

Assume the normal temperature of air and material to be 62°, and vapour present in the atmosphere at 0·0075.

To evaporate 1 lb. of water from 62° we require 1116 B.T.U. (1178 − 62), which is the equivalent of 4687·2 lb. of air, raised 1° in temperature, thus $\frac{1116}{0\cdot238} = 4687\cdot2$.

With a discharge temperature of 172°, 0·50 saturated, we must have, to carry 1 lb. of vapour, 4·46 lb. of air, thus $\frac{1}{(0\cdot46338 \times 0\cdot50) - 0\cdot0075} = 4\cdot46$. To carry the required heat our 4·46 lb. of air must part with 1051°, $\frac{4687\cdot2}{4\cdot46} = 1051$; and adding to this the discharge temperature, 172°, we get 1223° as the initial temperature required.

At 122° discharge, 0·50 saturated, we get, for carrying 1 lb. of vapour, 28·23 lb. air, $\frac{1}{(0\cdot08584 \times 0\cdot50) - 0\cdot0075} = 28\cdot23$; difference of temperature 166°, $\frac{4687\cdot2}{28\cdot23} = 166$; and adding to this the discharge temperature, 122°, we get 288° as the initial temperature required.

At 92°, 0·60 saturated, we get, required air, 81·73 lb., $\frac{1}{(0\cdot03289 \times 0\cdot60) - 0\cdot0075} = 81\cdot73$; difference of temperature 57°, $\frac{4687\cdot2}{81\cdot73} = 57$, and adding, as before, 57 + 92, we get 149° as the initial temperature required.

The heat expended in evaporation is in each case the same, 1116 B.T.U. But the heat lost in the air of discharge varies greatly, being at discharge 172°, 116·8 B.T.U.; at 122°, 338·1 B.T.U.; and at 92°, 583·6 B.T.U.:—$172 - (62 \times 4\cdot46 \times 0\cdot238) = 116\cdot8$; $122 - (62 \times 28\cdot63 \times 0\cdot238) = 338\cdot1$; $92 - (62 \times 81\cdot73 \times 0\cdot238) = 583\cdot6$.

These figures, which show the number of units of heat lost for every pound of water evaporated under the stated conditions, indicate the enormous waste of heat in large drying operations, as, for instance, in drying brewers' grains. To dry the grains from a mashing of, say, 2,000 bushels, would involve the evaporation of upwards of 80,000 lb. of water, and they cannot be safely subjected to a temperature much above 280°. Other materials will not bear even this temperature with safety.

How shall we maintain a reasonably high temperature of discharge, the necessary condition of economy, without raising the temperature of the intake to a destructive degree? This has been accomplished by the system of recirculating currents. This system was first referred to by B. F. Sturtevant, but its full significance does not seem to have been fully appreciated until recently. It has, however, been employed with most satisfactory economical results in many establishments in the United States, principally in connection with the woollen and other textile industries. In this system, a volume of hot air, several times greater than that necessary for carrying off the evaporated water, is circulated through the dryer, and is brought alternately in contact with the goods under treatment,. and with heated surfaces, giving up heat to the former and receiving it from the latter, which it should leave at the maximum temperature the goods will bear. This continuous circulation is effected by a fan-blower placed at any convenient point in the circuit, and a portion of the mixture of air and vapour at its maximum of saturation sufficient to carry off the vapour as fast as it is generated, is continuously discharged, and is replaced by an equivalent of normal air admitted to the source of heat. The amount of air discharged is regulated by suitable valves, and the condition as to saturation is thereby controlled, it being found desirable to maintain a somewhat high drying efficiency, even of the discharged portion. It will be seen that in this system the same air serves repeatedly as the vehicle of heat, and the heating of a large volume of new air for this purpose, carrying away in its escape a large quantity of unutilised heat, is avoided. The exit temperature being decided upon, the temperature of the drying current at its initial point, *i.e.*, where it first encounters the goods, will be determined by the relation of the volume of the discharged and recirculated currents, and may be adapted precisely to the particular requirements of the material under treatment. In the form thus briefly described this system has been very successfully applied. There are, however, under some circumstances, important difficulties which it does not meet. Many substances in drying evolve corrosive gases, which, if driven through a heater, rapidly destroy the heating surfaces; others throw off dust, which coats the surfaces, and, in addition to impairing their efficiency, char them and give off noxious and injurious odours. It is also entirely inapplicable in this form to the use of the gases of combustion, in which, as the entire heat generated by the fuel is introduced into the dryer, there is the highest economy.

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[*] These figures are obtained by mutiplying the respective differences between the temperatures given and the normal temperature 62, by the number of pounds of air in each case required to carry 1 lb. of water-vapour; thus (172 − 62) × 2·16 = 238, and (122 − 62) × 11·65 = 699.

To adapt it to these cases, and in fact all where the heat may be derived otherwise than from radiating surfaces, I have devised the improved apparatus described in this paper. Circulating the current repeatedly and continuously through the dryer and over the contained material, and discharging continuously a regulated quantity of the mixed air and vapour, I do not pass it over heat-imparting surfaces, but replace the expended heat by introducing into the system a fresh volume of hot air or gas, which must necessarily be the equivalent of the discharged portion. The recirculated mixture of air and vapour encounters and mixes with the incoming hot volume, and is brought to its maximum drying efficiency, in which condition, in a properly-designed dryer, it should be applied to that portion of the material which, having already parted with most of its moisture, relinquishes the remainder with greater difficulty. By varying the speed of the fan-blower, by means of which the circulation is maintained, and the amount of the discharge, the volume relation of the circulated and discharged air can be controlled, and the temperature at the initial point in the dryer be regulated. The fixed relations of temperature, the humidity of discharge remaining constant, are those of the intake and discharge, and the variable one, the maximum temperature within the dryer, which is controlled by the volume recirculated. Thus, with a discharge temperature of 172°, half saturated, and an intake of gas or air at 1223°, we can, by recirculating about five volumes, bring the initial temperature below 300°, and, by increasing the speed of the fan, as much lower as may be desirable. Similarly, in the case supposed above, where the maximum temperature is limited to 150°, we may, by recirculating a greater volume, realise the economy of a high discharge temperature, say 110° or 120°, and corresponding high temperature of intake, without exceeding the desired maximum.

We can only raise the temperature of discharge by increasing that of intake; but as the loss of heat at a discharge of about 170° is inconsiderable, it is not necessary to exceed 1200° F. in the intake, and where gases of combustion are used, we are enabled, without material loss of heat, to maintain a very great drying efficiency throughout the apparatus, the maximum humidity being but 0·50, which is greatly reduced at the initial point. The intake temperature being far below that of the ordinary gases of combustion, we are not limited in the amount of air admitted to the fires, as we are in the generation of steam, and by admitting a large excess, can ensure the perfect combustion of the fuel, and the important economy resultant therefrom. The velocity of the current over the material is also a factor of some importance, promoting evaporation and the efficiency of the apparatus.

An important feature in connection with this system, is the utilisation of the waste gases from a boiler or other furnace, which can be used with great advantage where the combustion is without visible smoke, or where the substance to be dried would not be injured by the discoloration and odours, such, for instance, as garbage and fertilisers. Where the chimney gases are sufficient, the gases from a supplementary furnace may be mixed with them; and the temperature being thus raised, the advantages of a small volume of discharge may be secured.

Having considered the method by which the energy provided for drying may be utilised, the equally important problem of how we shall handle our material so as to bring it into contact with the drying current remains. The entire question of drying may be viewed as a contest between the occupation of space and time, on the one hand, and the employment of apparatus and artificial heat, both costly, on the other. In dry climates, where time and space are unimportant, and labour cheap, crude materials may be advantageously dried by spreading them in the sun and turning them over repeatedly. Where land and manual labour are costly, we must resort to other methods.

The methods of handling textile fabrics, &c., are comparatively simple, and are so well known that it is scarcely necessary to refer to them. Goods in considerable pieces may be stretched from side to side, or up and down, in a drying chamber, in some cases moving automatically, the drying currents having access to them; or they may be passed over revolving heated surfaces, as in the well-known form of paper machine. In handling materials in lumps, grains, or powder, the problem is more difficult; and apart from revolving cylinders or fixed cylinders with revolving stirring devices, there are but few devices in practical operation. In the revolving cylinder apparatus, and that with stirrers, the heat is ordinarily delivered directly from conducting surfaces; and although air is sometimes used as an accessory, they are not really hot-air dryers.

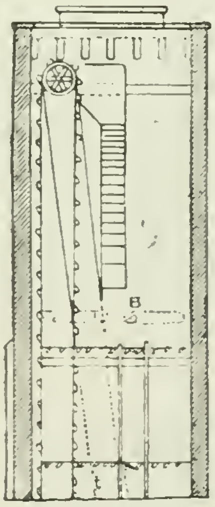
By far the most efficient device for moving material horizontally, is the well-known "apron" dryer. This consists of a series of superposed, endless aprons, having a slow, continuous motion, each alternate apron moving in opposite directions. Each apron projects slightly at alternate ends beyond its neighbour, and the material under treatment, being fed in a thin layer upon the upper one of a series, is slowly carried forward and deposited successively upon each in turn, and finally delivered at the bottom. The aprons are made of material suitable for the particular substance, and may be perforated; though this, in my opinion, adds little to their efficiency, as the air will always follow the lines of least resistance, which will not be through a layer of the material, however thin. To get a sufficient run, the aprons should have considerable length, and may be of such width as the weight and other properties of the material demand; by which considerations and that of space available, the number of aprons in a dryer is controlled. I have recently inspected such an apparatus in practical operation, in use for drying a chemical product, which cannot be subjected to a high temperature. The aprons are 11 in number, spaced 16 inches apart vertically, and are each 50 feet long and 6 feet wide, giving a total length of 550 feet; they move at a speed of 150 feet per hour, the substance being retained in the dryer nearly four hours. They are made of cotton cloth, enclosed in a tight wooden casing, and supplied with air, moved by a fan-blower over steam coils. The air enters at about 195°, and is discharged at about 135°. Its humidity at discharge is not measured, but from these figures, even making no allowance for losses by radiation, &c., its saturation cannot exceed about 0·18. Obviously this is not an economical application of heat, but as the material contains but little water, this may be of minor importance. The apparatus is considered a fairly satisfactory one, but there is no doubt that by the introduction of the recirculating system, both its economy and efficiency would be promoted.

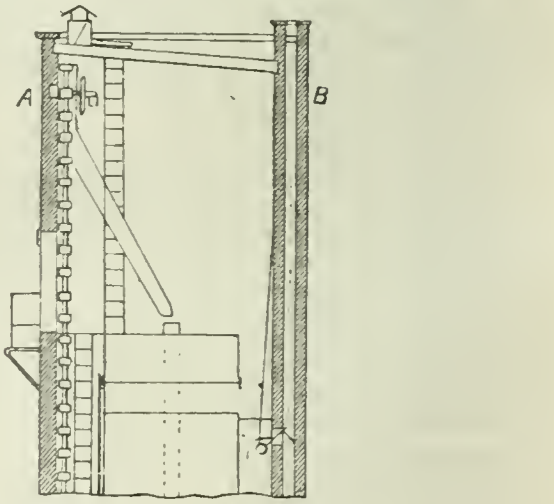
Another dryer of this kind is also in use in Brooklyn, N.Y., for drying brewers' grains. This material carries, fresh from the mash-tub, from 75 to 80 per cent. of water. As the saturating liquor carries in solution a large amount of valuable food constituents, it cannot be pressed without sacrifice. It constitutes when dry a food of high economical and commercial value for cows and horses; the experiments of the New Jersey Agricultural Experiment Station show that, for the latter, its value is fully equal to that of the best oats, pound for pound. As a food for cows it is largely used wet; but as it is subject to rapid fermentation and decomposition, in which condition the milk produced from it is exceedingly undesirable as a food, most of the States have stringent laws against feeding cattle with it in that condition; and, in consequence, much of it produced in summer, especially in the larger cities, is given or even thrown away to get rid of it.

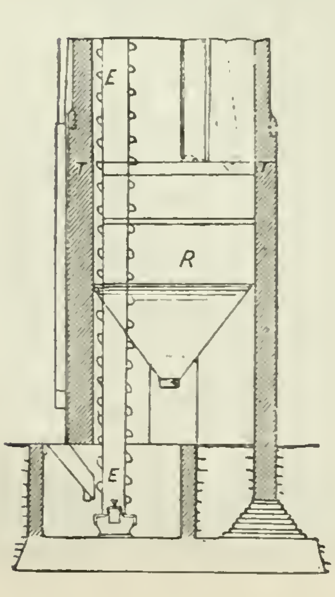
It is obvious that with so large an amount of water to eliminate, and the comparatively low value of the dried grains, utmost economy in drying is imperative. The apparatus in question is on a large scale, having a capacity of about 150 bushels of wet grains per hour, which should produce something more than 2,000 lb. dry; this would require the evaporation per 24 hours of over 17,000 galls. (U.S.A.) of water. It consists of 10 aprons, each 12 ft. wide by 50 ft. long, spaced about 24 in. apart, and contained in a substantial brick structure nearly 30 ft. high. The aprons are of wire cloth, varying, from the uppermost to the lowest apron of the series, from 8 to 14 meshes to the inch. The motion is at the rate of 6 to 8 ft. per minute, giving from 75 to 90 minutes for the transit of the material, which is automatically fed in a very thin layer upon the uppermost apron. The gases, liberally tempered with air in the combustion chamber, are admitted to the dryer at temperatures which, perhaps, vary at the different openings of communications, but was said not to exceed 300°, above which point grains are likely to be scorched. The discharge temperature varies under different conditions of the grains as to moisture, and of the atmosphere, but was said to average 160° to 170°; this indicates a low degree of saturation.

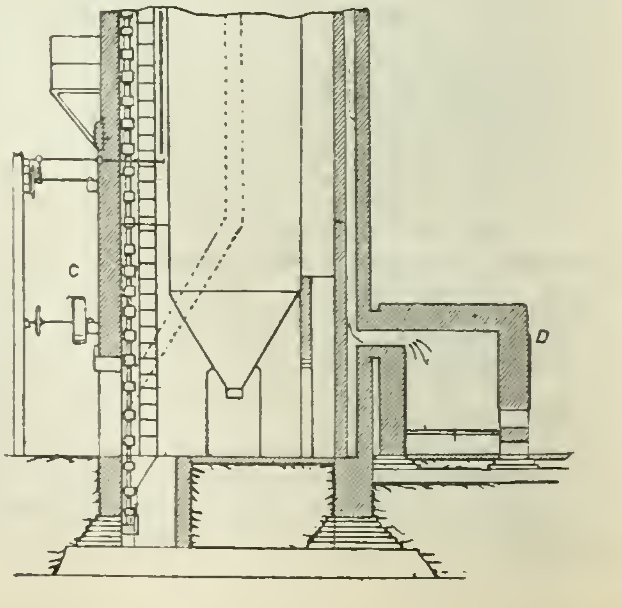
But in any attempt to move material horizontally, for drying, unavoidable drawbacks are encountered. Amongthe most serious of these are:—First, the difficulty of controlling horizontal currents of hot air in a chamber of considerable dimensions, which is much increased by the presence of obstructions, moving or stationary. It is found that the current will be principally confined to the upper part of the chamber, and any material near the bottom will be but little affected. This difficulty increases with the height and length of the chamber, and can only be partially remedied by especially locating the positions of the inlet and discharge openings, or by admitting air of different temperatures at different heights in the chamber. Second, the influence of the wind, which, when in an adverse direction, has a tendency to drive the current back, causes great irregularity in the drying, and occasionally almost entirely checks it. Third, the amount of power required to keep in horizontal motion a considerable weight of apparatus and material; and lastly, and by no means the least important where land is valuable, the large space required for dryers of this class.

In a vertical chamber or flue the tendency of an ascending current is to diffuse itself uniformly throughout its section; and the presence of obstructions favours and promotes this; also, if the chamber is of considerable height, the natural





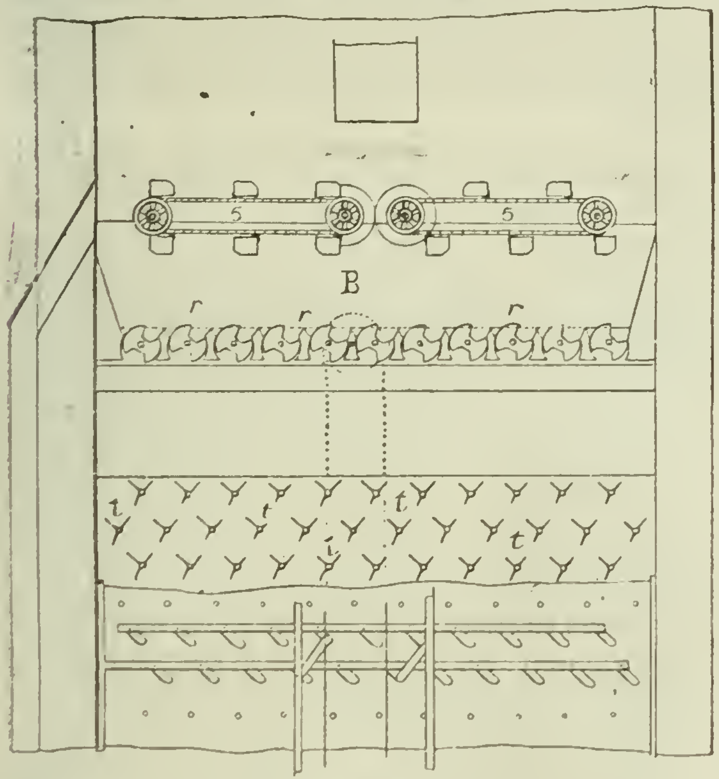


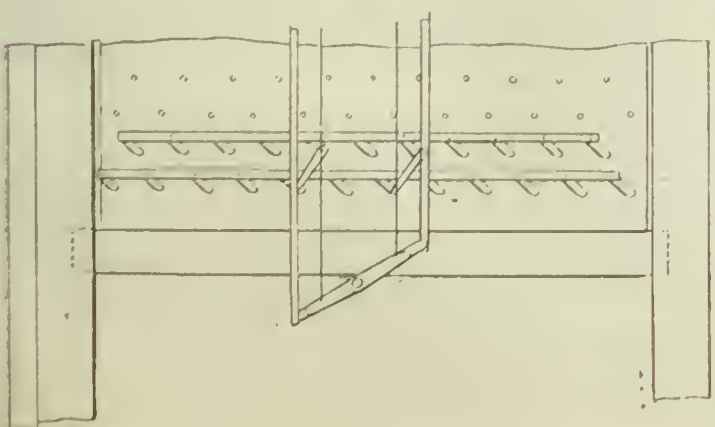


draught of a heated column will materially assist its ascent, and the direction of the wind will have little or no effect upon it.

The desideratum, then, for handling granular material successfully, is a device by which it shall be caused to descend through such a chamber, by a regulated, methodical descent, at such a rate as shall suffice for its drying, and it must be divided into small portions, and frequently turned over, to allow of access of the drying current to all its particles. The material will descend by its own weight, and as we shall only have to control or retard its descent, the power required to do this will be inconsiderable.

In the apparatus which I have devised and constructed for embodying these ideas, the containing tower T is of brick, enclosing on the ground a space of 10 feet by 13 feet, and is about 80 feet high; a considerable and perhaps unnecessary portion of the height being utilised for the automatic feeding bin B, and a receiving bin R at the bottom for the dried grains. The drying chamber proper is over 40 feet in height, and is furnished with 690 receptacles or trays for the material, arranged in 60 tiers, so placed that those in each tier, break joint or alternate in position with those in the tiers above and below. These trays *t*, shown in the enlarged detail, are 8 feet long, made of galvanised sheet iron, having three wings or blades 3½ ins. wide, radiating from a common centre. These blades form three troughs, of which two have an angle of 105°, these being the working troughs to be alternately filled with the material, the third trough being dormant. For some materials, a cruciform tray is convenient, and for corrosive materials or those liable to discoloration, a wooden construction can be substituted. The trays or receptacles are provided with axles and cranks, and the crank pins being united by rods into a common system, as shown in the larger detail, the whole may be simultaneously oscillated and the contents "dumped." Alternate oscillations in opposite directions will present in turn each of the working troughs of all the trays to receive the falling material, at the same time discharging the contents of the other troughs into the troughs of the tier below; thus, at each oscillation causing the entire contents on the dryer to descend one step or stage, where it is allowed to remain at rest, awaiting the next oscillation or dumping. The journals of the trays are carried in bearings in a structure of thin cast-iron plates, which is spaced at opposite ends some 2 ft. from the brick wall of the tower; this space adjoining the furnaces, with which it is in communication by means of openings controlled by valves, and forms the channel of flue for the return circulation. It also communicates with a receiving chamber, below the trays, by means of a large (90 in.) fan blower, which maintains the circulation. A similar space at the opposite end has no function in connection with the circulation, from which it is shut off, but serves as a working chamber for the cranks and their connections, and also contains the elevator E by means of which the wet material is delivered to the automatic feed bin B at the top.





The feed bin is provided with a simple levelling device, to spread the grains received from the elevator spout, and an overflow to indicate when it is full. Its bottom is formed of oscillating receivers *r*, each oscillation delivering to the trays below a measured quantity of the material, say, four bushels. A rock-shaft carried through the brick wall, to which an intermittent motion is given, communicates simultaneous motion by means of attached levers and connecting rods, to both the trays and the feed bin bottom. By tilting the trays as described alternately in opposite directions, the material descends step by step from the feed bin to the bottom of the dryer, arriving after such interval as may be necessary at the bottom, thoroughly dried. The intervals between the oscillations may be varied from time to time to suit different conditions of the substance under treatment.

The capacity of a dryer depends upon the length of time the material remains under treatment, and this in turn upon the amount of water to be eliminated, but almost as much upon the facility with which a material will part with its moisture. Thus, if you place upon your desk pieces of clay and of soap, of equal weight, and equally charged with moisture, in a few days' time the clay will have become so dry that you may crumble it with your fingers and blow it away. In as many months the soap will still retain much of its moisture. It is therefore impossible to closely estimate the capacity of a dryer for any material, on the basis only of the moisture contained. In drying brewers' grains, containing 75 per cent. of moisture, I find that three hours is ample, allowing for oscillations at intervals of three minutes. This gives at 20 dumps of four bushels each per hour, 80 bushels; or for a pair of dryers working 24 hours, 3,840 bushels; the labour required for two dryers, two men, being no more than for one. It should be borne in mind that this is for unpressed grains, containing 75 per cent. of water. It is quite practicable, by the use of bag presses, to reduce the water to 50 per cent. or even less, and the capacity of a dryer would be increased threefold, and that of a pair of towers of the dimensions described would be say, 11,500 bushels per 24 hours, of wet grains. The space required for such a pair of dryers would be about 50 by 45 ft.

As the solids carried off in the expressed liquor far exceed in value, not merely the cost of recovering them, but of the entire drying, in addition to which is the cost of the pressing, it is obviously uneconomical to press grains before drying them; this is only done because the apparatus employed heretofore fails to dry them without pressing. The grains from the mash-tub will seldom contain more than 25 per cent. of solids; the expressed liquor may be safely averaged at 7 per cent., though under not very heavy pressure this will be exceeded. Assuming these figures, and that out of 100 lb. wet grains 50 lb. of liquor is pressed, the dry solids in the liquor will be 3½ lb., *i.e.*, 14 per cent. of the original. At moderate estimate for dry grains of 16 dols. per ton, 14 per cent. would be 2·24 dols., which is more by 50 per cent. than the entire cost of drying.

The apparatus said to be in most general use in Great Britain and on the continent of Europe for drying brewers' grains and also to some extent in America, and which I therefore take for purposes of comparison, as an approved representative of this class of dryers, consists substantially of a steam-jacketed cylinder, within which is a revolving steam drum, carrying stirrers, for agitating the material. It differs from the dryers of the same class in details of construction, principally in having a device by which the grains are pressed, and a portion of the liquor expelled, before they enter the cylinder; thus obviating the necessity of separately performing this operation. I am not informed what amount of fluid is thus disposed of, it probably varies considerably; I have been told that, with grains fresh from the mash-tub, it is as much as 50 lb. to 100 lb. of grains; which would leave the residue containing still about 57 per cent. of water. The capacity of each cylinder is stated to be $12\frac{1}{2}$ bushels of wet grains per hour, but in another statement 2 lb. dry grains per minute, which is about 25 per cent. less. A plant has lately been erected in New York to accommodate 40 of these dryers, with the necessary appurtenances of boilers, engines, &c. This covers a plot of ground 100 ft. by 200 ft., which is said to have cost, including preparation of the site, over 100,000 dols. When fully occupied and continuously working, it will dry per day about 12,000 bushels of wet grains, which is only 500 bushels more than the capacity for pressed grains of the pair of dryers described above, occupying 50 ft. by 45 ft. The necessary presses would require little, if any, increased space, as they could be conveniently placed on a higher level.

The labour, exclusive of handling the dried grains, is stated to be two engineers, two firemen, and two feeders, as against one engineer and one fireman with my apparatus, both for night and day turns.

The expenditure of fuel is stated to be 40 lb. coal to produce 100 lb. dry grains. Assuming that the grains as they enter the cylinder after pressing contain 60 per cent. of water, which is perhaps in excess of the fact, the amount of water to be evaporated per 100 lb. of dry grains would be 150 lb.; hence the evaporation is only $3\frac{3}{4}$ lb. of water per lb. coal. In the uses of the gases of combustion direct, the loss in the air of discharge being limited by my system of recirculation, it is well within limits to claim an evaporation even in excess of that in a steam boiler; say, from 8 to 10 lb. per lb. fuel, when using anthracite or coke as fuel. Experience on a large scale, in the horizontal dryer described, shows that the use of the gases of either anthracite or gas-house coke imparts no odour whatever to the grains, but has a slight bleaching effect.

### DISCUSSION.

The CHAIRMAN having invited discussion,

Mr. HENRY G. WATEL said that the paper opened up so wide a field of discussion that it was difficult to deal with it in the short time at disposal. The first point of importance was the temperature at which the air to be used was discharged from the heater. He had made a number of experiments, the result of which was to prove that, using a 36-in. fan for blowing in, or a similar fan for exhausting, with a consumption of 12 lb. of gas coke per hour, one could add 100° F. to every 1,000 cub. ft. of air per minute up to the necessary temperature, as proved by experiments ranging over eight days. He had further made experiments on the evaporative power of the hot air thus produced, and found that with air coming from the heater at 250° F. and striking upon a cotton screen kept moistened by throwing water upon it from a pump, it was difficult to keep the screen wet; at the same time the air after passing through the screen was at 140° F. This led to the consideration of the dampness of this air when discharged into the surrounding atmosphere. He had not statistics on that point with him, but they would be found in an admirable set of hygrometrical tables prepared by Mr. Ferrel, Chief of the U.S.A. Signal Service. Assuming that the air entered the heater at a normal temperature, and left it at 240° F., one could readily imagine that it would greedily pick up any moisture that it met with. In the above case with a 36-in. fan, one could hardly keep the screen wet. Different substances, however, required different methods of drying; for instance, photographic plates would not bear drying in air at a high temperature, and he had had to devise special means for dealing with them. On the other hand, starchy matters could not as a rule be successfully treated by cool air. Everything pointed, therefore, to the importance of the temperature of the discharge. Mr. Hutchinson had spoken chiefly of experiments dealing with the drying of brewers' grains. This substance was particularly easy to treat by dry air, and was therefore rather outside the question. Members were probably aware that Mr. Fouché had also for many years advocated a system of drying by hot air, using vertical pipes for heating the air. He had demonstrated that vertical pipes had a much better radiant power for heating air than horizontal pipes, and the speed of the air current was also most important. To sum up: the important points to be borne in mind were the temperature at which the air was admitted, the loss of heat which it sustained in the drying chamber, its speed therein, and the temperature at which it made its exit. If the latter were superior to that of the outside air (the heating having been performed in a vertical apparatus) the efficiency and results would be as near perfection as could be obtained.

THE CHAIRMAN drew attention to the great difference between the results obtained by the author of the present paper and those of Mr. Watel, communicated to the Society in the year before last. The author claimed at best an evaporation of 8 to 10 lb. of water from brewers' grains per lb. of fuel, which would agree with the usual results obtained from a boiler. Mr. Watel had, however, claimed an evaporation under favourable circumstances of as much as 220 times the weight of fuel, and although he (the speaker) had pointed out the discrepancy between this and the best results obtained from a multiple-effect apparatus, it had been insisted on that the figures given were correct. Then the author spoke of using the same air over and over again.

Mr. HUTCHINSON dissented, and said that there was a special method of dealing with the air different from the Sturtevant system.

The CHAIRMAN, continuing, said that, granting this, there still remained a certain amount of moist air which was sent through the apparatus over and over again. If it were desirable to lower the temperature of the heated air entering the apparatus it would be better to do this by admitting a certain amount of fresh and comparatively dry air instead of heating up the air that had already been charged with moisture by passing through the apparatus. He had applied the hot air system experimentally to the drying of sugar-cane diffusion chips, and had found that the only heat which could be economically used was that resulting from waste flue gases. But in the case he had in view, the amount of work to be got out of them was so small, and the power needed for driving the fans was so enormous, that there was little or no advantage in making use of the hot air method. The author of the paper had stated that the product of drying brewers' grains was "equal to the best oats." He presumed that assertion was based upon its analysis, and of course it could similarly be shown that sawdust was adapted for cattle food. As a matter of fact, however, it was obvious that grains which had been stewed at boiling temperature for several hours, and from which the brewer had extracted all he could, were not likely to contain much nutritive material.

Mr. C. C. HUTCHINSON, in reply, said it was a misconception to suppose the same air was used over and over again for the purpose of evaporation; that, of course, would be attempting the solution of the problem in an impossible and absurd way. Certain portions of the air were circulated through the apparatus over again; but on each circulation a fresh volume of unsaturated air was added and there was a large accession of heat. This fresh quantity of air at a high temperature increased the temperature of the recirculated volume, and its hygroscopic capacity, so that when the mixture was passed up the apparatus and out of the top a volume of cooled saturated air equivalent to the volume of hot air admitted escaped, and carried with it the large quantity of water evaporated. The function of the old air was much the same as that of an intermediate receiver between the cylinders of a compound engine, namely, to keep the temperature during a particular cycle as even as possible, to prevent great variations between the two ends of the apparatus, and to minimise the losses the author had clearly pointed out would be due to using a large volume of fresh air.

* * *

## THE ESTIMATION OF ALKALINE SALTS IN FIRECLAYS, MANURES, ETC.

BY ALEXANDER CAMERON, F.C.S.

As in the determination of potash and soda in fireclays, manures, &c. by the usual methods, the accuracy of the results depends in great part on the volatility of the alkaline salts obtained, my first step was to determine the volatility of the various salts of potash and soda.

I first experimented with the sulphates and chlorides of potash and soda (see this Journal, 1894, 1094).

I also experimented on the volatility of the alkaline carbonates by heating a mixture containing 0·2 grm. of each of the carbonates of potash and soda in a platinum capsule, but no loss was experienced up to the temperature of dull redness over a Bunsen flame. At bright redness there was a loss of 0·37 per cent. in 10 minutes, when the loss ceased. Over the blow-pipe flame there was a loss of about 7 to 9 per cent. every 10 minutes.

My next series of experiments was made with the view of finding out whether the ordinary method of determining alkaline salts by treating the aqueous solution with barium hydrate to remove phosphoric acid, lime, &c., then with ammonium carbonate to remove the excess of barium hydrate added, filtering, evaporating, and igniting off the ammonium salts, and weighing the alkalis, gave correct results; and, further, whether these results were affected by weighing the alkalis as sulphates, carbonates, or chlorides.

It has been alleged by makers and mixers of manures that the total amount of the potash and soda salts added are not determined by chemical analysis.

The information gained during the carrying out of the experiments above referred to was of very great use to me, having supplied exact information as to the rate of volatility of the various salts of potash and soda at certain temperatures.

In order to obtain trustworthy and accurate knowledge as to the value of the barium hydrate process, I prepared an artificial manure perfectly free from alkalis, then added known quantities of potash and soda and endeavoured to recover them.

For this purpose it was necessary, first of all, to prepare pure phosphate of lime. This I did by adding to a solution of phosphate of ammonium a solution of calcium chloride, in its combining proportion. After the precipitated phosphate had been thoroughly washed, it was dissolved in hydrochloric acid, and re-precipitated by the addition of ammonia in slight excess. This precipitate was again filtered, thoroughly washed, dried, separated from the filter, and gently ignited. To a weighed quantity of this phosphate I added a weighed quantity of pure concentrated sulphuric acid in its combining proportion, with the object of forming a soluble phosphate of lime. The operation was carried out in a moderate sized flat-bottomed beaker about 3 or 4 ins. in diameter, the sulphuric acid being added to the phosphate of lime and thoroughly incorporated by stirring, the mixture being allowed to stand on the top of a water oven for about four hours and occasionally stirred.

I did not determine the exact amount of soluble phosphate in the mixture thus obtained, as its quantity was large and sufficient for my purpose, and the free sulphuric acid in the preparation, though high, did no harm to my experiments, except by increasing the amount of barium hydrate required for its precipitation, and, if anything, diminishing the accuracy of the results.

This soluble phosphate was then treated for alkaline salts, but none were found to be contained in it.

The pure sulphates of potash and soda, which were the same as those used in the above volatility experiments, were dried over the blue flame of an argand burner to make sure that all water had been eliminated.

I then added to 1 grm. of the phosphate of lime, rendered soluble, 0·1 grm. of sulphate of potash, and 0·1 grm. of sulphate of soda, and then proceeded to estimate the amount of these salts recoverable by the process known as the barium hydrate process, using just sufficient saturated solution of barium hydrate to precipitate the phosphate of lime and sulphuric acid present.

Reference may here be made to the tables giving some representative results obtained.

Using only a small excess of barium hydrate, and subsequently of ammonium carbonate solution, I recovered 0·2005 grm. of the mixed sulphates of potash and soda, against 0·2 grm. added, while after estimating the potash by Tatlock's process, in the mixed sulphates recovered, multiplying the chloroplatinate precipitate by 0·193, and calculating the result to sulphate of potash, 0·0985 grm. of sulphate of potash was obtained in place of 0·1 grm. added.

As it has been alleged that a large excess of barium hydrate prohibits accurate results being obtained, I next investigated that point.

To the same quantities of phosphate of lime and alkaline sulphates I added, of barium hydrate solution, double the quantity used in the previous experiment, thus ensuring a large excess, and producing a large precipitate with the carbonate of ammonia afterwards added. There is, of course, a possibility of a loss of alkaline salts through their being held up by this precipitate. The results, however, 0·2010 grm. of the mixed sulphates, and 0·0995 grm. of sulphate of potash, as against 0·2 and 0·1 grm. added, give me confidence in saying that a large excess of barium hydrate does not necessarily interfere with the estimation of alkaline salts. Needless to say that such a large precipitate requires ample washing, until a portion of the filtrate, on being tested, gives no precipitate, or only a slight milkiness with sulphuric acid, due to sulphate of barium.

Nor does treble the quantity of barium hydrate solution, if added, affect the estimation, except that the precipitate with ammonium carbonate is unnecessarily large and inconvenient. In this case the results were 0·2005 grm. of the mixed sulphates, and 0·0987 grm. of sulphate of potash recovered, against 0·2 and 0·1 grm. added.

Turning now to the method of estimating alkaline salts by weighing as carbonates, I found that this method was equally trustworthy in its results, 0·1980 grm. of mixed sulphates were present, as calculated from the carbonates, from which 0·0985 grm. of sulphate of potash was recovered.

The other method in use is the chloride method. Calculating the chlorides obtained to sulphates, the results showed 0·1907 and 0·2090 grm. of the mixed sulphates recovered in two experiments, containing 0·0972 and 0·0997 grm. of sulphate of potash respectively, as shown in the table appended hereto.

Two difficulties in the performance of this estimation are, first, to know when to stop heating the chlorides, all the ammoniacal salts having been driven off, and, secondly, because the hydrochloric acid employed to convert the alkalis into chlorides causes a fuming when heated, which, as the mixed chlorides also fume when volatilising, prevents the heating being continued till the fuming altogether ceases.

Though I have performed a good many estimations of the alkalis by the chloride method I have failed to satisfy myself that I know when the heating should be discontinued. This accounts for the variation in the results above stated.

I also object to this process on account of the time required for the heating to drive off the ammoniacal salts and excess of acid. While in the case of the sulphate and carbonate methods the heating may be accomplished in one to two minutes, in the case of the chlorides it takes about two to three hours, which is a serious consideration in this, at best, somewhat lengthy estimation.

There is also in the case of the chlorides a great risk of loss by decrepitation of the salts whenever heat is applied, and to prevent loss thereby is always very troublesome, and requires constant careful attention.

In the case of the sulphates and carbonates there is no real difficulty, the carbonates fusing easily, and the ammonia salts they contain volatilising completely; while in the case of the sulphates the free sulphuric acid and salts of ammonia added are easily expelled by careful heating with a Bunsen flame, after the salts have been evaporated to dryness on a water-bath, without danger of any loss.

It is better in all cases, after getting rid by filtration of any insoluble matter precipitated during evaporation, to take the alkaline salts in a water oven to dryness. By so doing any risk of loss by decrepitation on application of heat is minimised.

As the sulphates and carbonates of potash and soda are practically non-volatile at ordinary temperatures, the heating may be continued at dull redness for periods of half a minute till no further loss in weight is noted, the remaining salts being reported as pure.

It has been stated with reference to the sulphate method that the presence of magnesia leads to high results being obtained. To determine the truth of this theory I added 0·1 grm. of sulphate of magnesia to the quantities of pure alkaline sulphates and phosphate of lime taken for previous determinations, using only a small excess of barium hydrate solution in the separation. The results show that magnesia has no effect on the determination of alkaline salts by the sulphate method, for the same amount of alkaline sulphates were recovered as were introduced, viz., 0·2 grm., of this 0·1007 grm. of sulphate of potash was found, 0·1 grm. having been actually added.

COMPARISON OF RESULTS.

| Conditions. | 0·1 Grm. each of $K_2SO_4$ and $Na_2SO_4$ added. | | | | | |
|---|---|---|---|---|---|---|
| | Sulphate Method. | | Carbonate Method. | | Chloride Method. | |
| | $K_2SO_4+Na_2SO_4$ found. | $K_2SO_4$ found. | $K_2SO_4+Na_2SO_4$ found. | $K_2SO_4$ found. | $K_2SO_4+Na_2SO_4$ found. | $K_2SO_4$ found. |
| Using a small excess of $Ba(OH)_2$ ....... | 0·2005 | 0·0985 | 0·1980 | 0·0985 | 0·1907<br>0·2090 | 0·0972<br>0·0997 |
| Using double the quantity of $Ba(OH)_2$. | 0·2010 | 0·0995 | .. | .. | .. | .. |
| Using treble the quantity of $Ba(OH)_2$. | 0·2005 | 0·0987 | .. | .. | .. | .. |
| 0·1 grm. $MgSO_4$ added, using a small excess of $Ba(OH)_2$. | 0·2000 | 0·100 | .. | .. | .. | .. |

The conclusions I have come to as the result of these experiments are:—

1. That the barium hydrate process is thoroughly reliable for the estimation of alkaline salts in manures, &c., whether a moderate or large excess of barium hydrate be added, or whether magnesia be present or not.

2. That the sulphate method is to be recommended on account of its simplicity, accuracy, and rapidity.

3. That the carbonate method may also be employed with equally good results.

4. That the chloride method, on account of its troublesome nature and less reliable results, cannot be recommended.

### DISCUSSION.

The CHAIRMAN said that some of the author's results were new to him; for instance, those showing that there was a loss when alkaline sulphates were heated over a Bunsen burner. If that were the case all the determinations of ash in sugars would be more or less inaccurate. His own experience with regard to heating sulphatic ash did not agree with that of the author, and he thought he might say that there was no such loss, whether the heating lasted for five minutes or five hours. No doubt there was some reason for this abnormal result in Mr. Cameron's working; but, notwithstanding this, his paper was of a suggestive character, affording food for thought, and would be of considerable interest to those members who especially devoted themselves to the analysis of soils and clays.

## Liverpool Section.

UNIVERSITY COLLEGE, BROWNLOW STREET

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*Meeting held Wednesday, May 1st, 1895.*

MR. EUSTACE CAREY IN THE CHAIR.

## NOTES ON THE EFFICIENCY OF ELECTROLYTIC APPARATUS.

BY FERDINAND HURTER, PH.D.

ELECTROLYSIS as a manufacturing operation has made rapid strides. Since I had the honour of addressing this meeting as its chairman, seven years ago, on the subject of electrolysis, much has been accomplished. A review of the many inventions which have since come to the front would form an interesting and useful paper.

I shall not touch upon the electrolysis of common salt in particular. Nor am I prepared to bring before you the subject which at present interests me most and which with the help of my friends and assistants I hope to clear up still further, viz., the relation between the *current efficiency* and the *migration of the ions.* I hope to communicate some results on this subject next session.

I wish to bring before you a few notes on the efficiency of electrolytic apparatus generally and to give the results of such methods and measurements in connection with the determination of this efficiency as we have worked out at the central laboratory of the United Alkali Co.

The commercial value of any electrolytic process depends firstly, upon the cost at which the electrical energy can be produced, and secondly, upon the efficiency of the apparatus which serves to transform the electric energy into potential chemical energy, *i.e.*, the electrolytic cell.

The commercial value of an electrolytic process depends further on the first cost of the apparatus, the cost of maintaining it, the length of its life, and finally, upon the amount of manual labour involved in the several transformations of energy, which together constitute the process.

It is therefore an exceedingly difficult problem to judge between several processes. As regards the apparatus for the production of electrical energy all these costs are fairly well-known and have been frequently discussed in the pages of our Journal.

As regards the first cost of the apparatus for transforming electrical energy into potential chemical energy, *i.e.*, the first cost of an electrolytic cell, this can be fairly well ascertained; but the cost of maintenance and the length of life of an electrolytic cell are in most cases unknown and very problematical items.

In appraising the commercial value of their electrolytic processes, many inventors are usually satisfied when they have stated the amount of the produce which may be obtained for a certain amount of work done.

American inventors usually state the number of horse-power hours required per pound of soda, &c., produced.

On the continent the reverse mode of statement is often met with, viz., the number of pounds obtained per horse-power day.

It is, of course, immaterial which of these modes of stating results is adopted, they are both indefinite, owing to the indefinite nature of the term "horse-power." We have British horse-powers, French horsepowers, indicated horse-powers, break horse-powers, and electrical horse-powers, so that it appears to me better to state the produce obtained per kilowatt, or *vice versâ*, the number of kilowatts used per kilogram of the article to be produced. Thus the indefiniteness of the term "horse-power" is avoided.

The mere statement of the number of kilowatts used in the production of the article in question is not, however, a sufficient indicator of the degree of perfection of an electrolytic process, even from the electricians point of view.

It is known that the mechanical work consumed in a cell depends both on the general construction of the cell and the polarisation or back electromotive force. Suppose we had a cell which requires (V) volts to drive (A) ampères through it, and that the back electromotive force is ($e$) whilst the resistance is (R), then we have, by Ohm's law:—

$$A = \frac{V - e}{R}$$

The watts consumed will be:—

$$AV = A^2R + Ae$$

but if only the fraction ($a$) of the ampères passing produce useful chemical change, then the watts consumed per electro-chemical equivalent of change is given by the expression:—

$$\frac{AV}{a} = \frac{AR + e}{a}.$$

The inverse of this last expression, viz.:—

$$\frac{a}{AR + e}$$

may be called the efficiency of the cell and the process. It indicates the amount of chemical change obtained per watt.

It depends first of all upon the current efficiency ($a$) on the resistance of the cell (R), and upon the electromotive force ($e$). But it also depends upon (A) the amount of current which is passed through the cell.

The electrical efficiency of the cell is, however, better represented by the fraction:—

$$\frac{a\,e}{AR + e} = \frac{a\,e}{V}$$

which indicates the fraction of energy utilised, for chemical change in the cell. The production of the fraction ($a$) of the electro-chemical equivalent of any substance requires theoretically ($a\,e$) watts, whilst the cell requires for that, the application of one ampère and ($AR + e$) volts or ($AR + e$) watts.

There is, of course, nothing new in these formulæ for the efficiency of the process, but they are well calculated to show that the mere statement of the produce per horse-power is no satisfactory criterion of an electrolytic cell.

Let us suppose that we had before us two cells for the electrolysis of a salt solution; where the back electromotive force is about 2·3 volts. Let one cell be well constructed, say with only 0·001 ohms resistance, assume the other badly constructed, and to offer a resistance of 0·05 ohms. It is quite possible, with these cells to produce the same quantity of material per kilowatt, we have only to choose the number of ampères, so that in both cells the product AR is equal, *i.e.*, we must pass through the bad cell one-fiftieth of the number of ampères which are passed through the good cell.

This shows how very much the process and the cost of the apparatus depend upon the construction of the cell, and how very erroneous the judgement of a process might be, which depended solely upon a statement of the produce per horse power, or still worse, upon a mere statement of a low terminal voltage.

It is therefore necessary to know the three essential factors, the current efficiency, the electromotive force of polarisation and the resistance of the cell.

Unfortunately it is not a very simple matter to precalculate these factors for any given case, and we are unable to predict the working of a given process in a given cell with precision, hence experiment alone can decide the value of a cell.

The current efficiency ($a$), I have made the subject of special investigations, and I shall probably give such results as I may then possess next session. At present there is no method of ascertaining the current efficiency, except by measuring the current used and the quantity of substance obtained.

If we could remove the products of the electrolysis as rapidly as they are formed, the current efficiency would always be numerically equal to one, *i.e.*, we should obtain the exact electrochemical equivalent of the material corresponding to the current employed.

But this instantaneous removal of the products has not been accomplished to perfection in any cell. The nearest approach I know is Castner's cell for the decomposition of salt where the efficiency is often 90 per cent. to 95 per cent. In that case, the removal of the metallic sodium from the sphere of action is accomplished by the moving cathode of mercury. All other cells I have seen have much lower efficiencies, and in none of them has the continuous removal of the products been accomplished. In most cases it has been attempted to improve the current efficiency by the interposition of several diaphragms.

I have shown that one of the causes of small current efficiency must be looked for in the phenomena of migration. These phenomena were investigated by Hittorf in the years 1853 to 1859.

Their theoretical importance has only comparatively recently been recognised, and their technical importance is only just dawning upon us. In his investigations, Hittorf frequently separated his electrodes by four or five diaphragms, and no diaphragm nor any number of them will be able to compensate that loss of efficiency which arises from the phenomena of migration. The only remedy for this is to be found in the instantaneous removal of the products of the electrolysis.

The other important factor is the electromotive force of polarisation ($e$), the back electromotive force.

It is now recognised that this cannot be accurately calculated from the thermochemical data of the reactions which take place, since the relation between the electrical and chemical energy are not necessarily those of equality. The electromotive force of polarisation may, however, be approximately estimated as a minimum, by the usual calculations from the thermochemical data of the reactions. Extreme care is, however, necessary in the choice of data. I have come across many great errors made by men fairly well acquainted with thermochemistry.

Grave errors are generally avoided, by considering not what takes place in the cell, but what would have to be done with the products of the electrolysis, in order to form backwards the raw material employed.

This will be better understood by an example.

To calculate the back electromotive force for the electrolysis of a salt solution, we do not consider how the chloride of sodium is split up. We consider how from the products of the electrolysis, we can form backwards the sodium chloride.

These products are: chlorine, hydrogen, and sodium hydrate.

We recombine the gaseous chlorine with the hydrogen, absorb the HCl in water, and neutralise the sodium hydrate in solution. The thermochemical data for this change are:—

| | Calories. |
|---|---|
| H, Cl | + 22·00 |
| HCl, aq. | + 17·32 |
| NaHO, HCl, aq. | + 13·74 |
| Total | 53·06 |

Multiplying this by the approximate constant 0·04, we obtain 2·12 volts for the electromotive force of polarisation. This must be considered a minimum.

When a mercury cathode is employed, the products of the electrolysis are sodium amalgam and free chlorine. We should have to bring the chlorine in contact with the amalgam to produce NaCl, and redissolve this in water.

The data would be:—

| | Calories. |
|---|---|
| NaHg = Hg + Na | − 21·600 |
| Na, Cl = NaCl | + 97·690 |
| NaCl, aq | − 1·18 |
| Total | + 74·91 |

and multiplying by 0·04 gives 2·99 volts.

All these calculations never produce absolutely certain results, and it is better to measure the electromotive force of polarisation directly.

This we do now by the following method. Through a long trough we pass a current between two electrodes. Between these electrodes we insert another very small auxiliary electrode (the position is immaterial) which we connect with the anode through a voltmeter of 1,000 ohms resistance, observe the instrument, and then connect with the cathode through the same voltmeter, taking another reading. The potential difference between the terminals of the cell is also measured. Let $V_t$ be the volts between the terminals of the cell, $V_a$ the difference of potential between the auxiliary electrode and the anode ($V_k$) the potential difference between the auxiliary electrode and the cathode, then the electromotive force of polarisation for the electrodes and electrolytes under observation is found to be:—

$$e = V_p = V_t - (V_a + V_k).$$

The following are a few examples of such measurements. The distance of the auxiliary electrode from the anode is given as fraction of the length of the cell.

(1.) Electrolyte: dil. $H_2SO_4$ sp. gr. 1·17.

| Distance of Auxiliary Electrode from Anode. | $V_t$. | $V_a$. | $V_k$. | $V_p = e$. |
|---|---|---|---|---|
| 0·33 | 5·4 | 1·45 | 2·00 | 1·95 |
| 0·33 | 7·55 | 2·05 | 3·65 | 1·85 |
| 0·66 | 7·55 | 3·65 | 2·05 | 1·85 |
| 0·33 | 5·80 | 1·40 | 2·45 | 1·95 |

(2.) Electrolyte: conc. KCl solution.

| Distance of Auxiliary Electrode from Anode. | $V_t$. | $V_a$. | $V_k$. | $V_p = e$. |
|---|---|---|---|---|
| 0·33 | 6·40 | 1·50 | 2·75 | 2·15 |
| 0·66 | 6·40 | 2·4 | 1·75 | 2·25 |
| 0·33 | 8·70 | 2·25 | 4·20 | 2·25 |
| 0·66 | 8·70 | 3·85 | 2·60 | 2·25 |
| 0·33 | 10·30 | 2·80 | 5·15 | 2·35 |
| 0·66 | 10·30 | 4·90 | 3·30 | 2·20 |

For the large scale the following methods are available:—

(1.) Either we pass the normal current through the cell under examination, and after the cell has arrived at its normal condition, we interupt the current and measure immediately afterwards the electro-motive force with a volt-meter.

In this way we find the value of ($e$) usually too small. On Castner's mercury cell the back electromotive force so measured is 3·15 volts.

(2.) Or we pass through the cell successively currents of very different magnitude, and determine the potential difference at the terminals of the cell. Let $A_1$ and $A_2$ be the number of ampères passed, and $V_1$ and $V_2$ the two potential differences in volts at the terminals, then—

$$e = \frac{V_1 A_2 - V_2 A_1}{A_2 - A_1}$$

If possible, it is best to make three observations, one with a smaller current than the normal one, and one with a greater. The electro-motive force ($e$) is not found as absolutely constant, but increases with the current.

I prefer the latter method, because the same observations allow us to calculate the last of the factors in the formula for the efficiency, viz., the resistance.

We find the resistance—

$$R = \frac{V_2 - V_1}{A_2 - A_1}$$

The resistance of a cell is capable of fairly accurate pre-calculation, provided we know with sufficient accuracy the form and details of construction of the cell, and the specific resistance of all the materials, but the latter condition is seldom fulfilled, and when we do know the resistance of the materials it is often very difficult to calculate accurately the resistance of the cell owing to its peculiar form.

To approximately calculate the resistance of cells of any form, I calculate the resistance of the electrodes, on the assumption that the current has to flow through the electrode from its connected end to the opposite end, and I take one-third of this resistance as the actual resistance of the electrode.

The resistance of the liquid in the cell is calculated from the distance of the electrodes and their areas, the specific resistance of the electrolyte being given. When the form and size of the electrodes is not equal, the calculation becomes troublesome.

The calculation of the resistance of the diaphragms, if there are such, is almost impossible, since diaphragms are not to be obtained of such uniform character that an accurate average value can be given for their specific resistance.

The resistance of a cell is chiefly due to the resistance of the electrolyte and to the diaphragms, the resistance of the metallic parts being almost negligible. Therefore the cell has to be so constructed that the electrodes are very close together. Mr. Castner has ventured in his cell to make the distance between the electrodes very small indeed, the total resistance of his cell being only = 0·0015 ohms.

As the resistances of liquids decrease with temperature, the resistance of the cell is, of course, very much depending upon temperature as well. A cell filled with concentrated solution of potassium chloride will allow just double the current to pass at 80° C. as at 20°, with the same number of volts at the terminals.

For the determination of the conductivity of electrolytes Kohlrausch's method is, of course, the very best, and it is extremely easily handled. We use the method also for the determination of the resistance of diaphragms.

By means of this method we find that the conductivity rises almost proportional to the increase in the temperature. We find the conductivity of nearly saturated $KCl$ solution, of $NaCl$ solution, of $KHO$ and of $NaHO$ solutions can be expressed very accurately by the following formulæ. For absolute temperature, T :—

For $KCl$ $C = 0{\cdot}04263\,T - 9{\cdot}924$ (3 mol. per litre).
$NaCl$ $C = 0{\cdot}055\,T - 13{\cdot}87$ (5 mol. per litre).
$KHO$ $C = 0{\cdot}0767\,T - 18{\cdot}308$ (3 mol. per litre).
$NaHO$ $C = 0{\cdot}093\,T - 23{\cdot}76$ (5 mol. per litre).

The resistance of diaphragms seems to be affected in the same way by temperature, at any rate, cells which we have observed on the large scale increase their conductivity exactly in conformity with the above rules for the liquids. As the diaphragm is that part of the cell which usually offers the most resistance, we must conclude that the diaphragms have no special law. This is what one would expect.

From all this it will be seen that the predetermination of the resistance of a cell is not a very simple matter, and that it would be preferable to have some mode of measuring the resistance of the cell. I have, together with Mr. Auer, frequently attempted to use Kohlrausch's method for that purpose, but we have failed to obtain good results with the means at our disposal. The best result we ever got we obtained by coupling four cells two in series and the two pairs coupled again in series but with opposite electrodes, so that the electro-motive force of the one couple compensated the electro-motive force of the other couple. The minimum to be observed in the telephone was, however, very undecided.

With a comparing resistance of 0·1 ohm we found the resistance of the four cells to be 0·056 ohm at 7° C. The same cells were then coupled in series, and the resistance and back electro-motive force determined by varying the current passed through the cells. The following observations were made :—

| Ampères. | Volts at Terminal. | Temperature. |
|---|---|---|
| | | ° C. |
| 52 | 12·30 | 7 |
| 84 | 14·35 | 7 |
| 101 | 15·25 | 7 |

From these results we calculate the resistance to be 0·06 ohm. This result is more trustworthy than the other. The electrolyte was a solution of potassium chloride, and the above observations give for the four cells together $e = 9{\cdot}17$ the polarisation, or for one cell 2·29 volts, which result is almost identical with that found above by the small scale method in the glass trough.

As is well known, almost the only useful material for anodes among the metals is platinum. Platinum will not serve, however, for the electrolysis of solutions which evolve chlorine. For such electrolytes carbon is the usual anode employed. The specific resistance of carbons varies very much, and so does their resistance to disintegration. As there are but few reliable measurements published, I append a table of our experiments made with carbons. All of them are artificial plates and rods meant to serve as anodes, I have brought some of the specimens here for your inspection; they do not increase one's confidence in the indestructibility of carbon. The test to which they were put was, however, an exceptionally severe one, specially designed to show in a short time what would otherwise probably have taken a much longer time to accomplish.

The density of the various samples was calculated from the weight and their dimensions, the specific resistance was ascertained by measuring the potential necessary to drive a given current through the rod. The results represent the resistance of a rod of one metre length and of one square centimetre cross-sectional area. The area exposed to the electrolyte, the loss in thickness, &c., are given in English inches, because we had no micrometer-screw divided into millimetres.

For the sake of comparing the wear of the plates, they were inserted into a solution of caustic soda as electrolyte, themselves being the anode, iron plates of equal dimensions forming the cathodes. The several cells so constructed were placed in series, and a current of about 1 ampère per square inch of exposed carbon surface was passed through the cells for a certain length of time, about 6 hours.

Only such of the carbons were used for one experiment which had approximately the same area.

| Carbons. | Density. | Specific Resistance. | — Inches Area used. | Ampère-Hours. | Ampère-Hours per — Inch. | Inches Loss in Thickness per 100 Ampère-Hours. |
|---|---|---|---|---|---|---|
| A, artificial ............................ | 1·19 | 2·24 | 52 | 346 | 6·6 | 0·42 |
| B, „ ............................ | 1·15 | 5·77 | 45 | 346 | 7·6 | 0·39 |
| C, „ ............................ | 1·73 | 1·84 | 21 | 34·6 | 1·6 | 1·40 |
| D, „ ............................ | 1·57 | 1·57 | 42 | 346 | 8·1 | 1·12 |
| E, „ ............................ | 1·55 | 2·22 | 4·7 | 34·6 | 7·4 | 1·46 |
| F, „ ............................ | 1·53 | 2·28 | 5·4 | 34·6 | 6·4 | 1·95 |
| G, „ ............................ | 1·49 | 0·889 | 6·09 | 72 | 6·0 | 0·425 |
| H, artificial, electrically heated ....... | 1·49 | 0·66 | 4·2 | 31·6 | 8·2 | 0·72 |
| I, „ „ „ ....... | 1·35 | 0·337 | 6·78 | 72 | 6·0 | 0·46 |
| J, „ „ „ ....... | 1·37 | 0·391 | 5·07 | 72 | 6·0 | 0·54 |
| K, „ „ „ ....... | 1·52 | 0·461 | 5·00 | 72 | 6·0 | 0·82 |

The thickness of the plates was measured in at least 20 places by means of a micrometer screw before the experiment began, and was remeasured in the same places after the experiment was completed. The decrease in the thickness thus ascertained was then divided by the current density per square inch, and the number of hours which the experiment lasted and the number so obtained, × 100, is given in the table as loss per 100 ampère-hours per square inch.

It will be noticed that those carbons which conduct well are more liable to disintegration generally, but when the carbons have undergone a special heating by a powerful current or in an electrical furnace they resist disintegration better, and their conductivity is much improved.

I suppress the names of the makers of these carbons; there are both English and continental makes among the samples.

When carbons are used as anodes they form a sensible part of the resistance; the metallic parts of the cell do not contribute sensibly to it. On the other hand, the resistance of diaphragms is in no case a negligible quantity, and in many cases a very considerable part, if not the greatest part, of the total resistance of the cell. As a rule, the less the resistance of a material the less efficient is it to prevent ready diffusion of the liquids.

Experiments we have made with coarse sand show that the resistance of it is really the resistance of the liquid which fills its interstices. If the resistance of a liquid is measured in a glass tube and afterwards dry sand is put into the tube and the resistance is measured again it is found to have increased by an amount nearly due to the reduction of the cross-section of the liquid by reason of filling the space with sand.

It has recently been proposed to use thin boards of wood as diaphragms for cells in which sodium chloride is to be converted into caustic soda and chlorine. Mr. M. Muspratt has undertaken to examine a number of different woods for their resistance when used in thin sheets of one-eighth or one-sixteenth of an inch in thickness.

The following table gives his results :—

Resistance in Ohms per Square Foot.

| Thickness | 0·0625″ | 0·125″ |
|---|---|---|
| Common deal | 0·130 | 0·284 |
| Teak | 0·351 | .. |
| Baywood | 0·061 | 0·161 |
| Beech | 0·080 | .. |
| Walnut | 0·332 | 0·620 |
| Oak | 0·336 | 0·600 |
| Ash | 0·146 | .. |
| Pitch pine | 0·376 | 0·800 |
| Poplar | 0·114 | 0·230 |
| Yellow pine | 0·196 | 0·398 |

The resistances in this table refer to the timber saturated with a solution of sodium chloride which had the specific resistance, 0·575 (*i.e.*, a cube of one decimeter would offer a resistance of 0·575 ohms between two opposite faces). When measured immediately after soaking in the solution the resistance was found very much greater. Only after an immersion of four months duration was the resistance found not to decrease appreciably. The results given are those found after four months.

For comparison with those resistances I append the resistance of a diaphragm of porous portland cement and of parchment paper:—

| | |
|---|---|
| Portland cement, 0·375 in. thick, per sq. ft. .... | 0·0340 |
| Parchment paper, specially prepared „ .... | 0·0376 |

From the results of the table it will be seen that the resistance of the wood is approximately proportional to the thickness. The resistance of wood is so great that sheets of only 0·006 in. would have to be used to equal a Portland cement diaphragm of 0·375 in. thickness. A current density of 10 ampères per square foot would demand an electromotive force of from 1·5 to 3·5 volts to overcome the resistance of the diaphragms only.

I cannot conclude this paper without acknowledging the careful work done in connection with ascertaining the polarisation by Dr. Zahorski, in connection with the resistance of carbons by Mr. Wareing, and generally by Mr. Auer. Most of the work has been done in connection with investigations of patented inventions for the United Alkali Co., whose directors have courteously permitted the publication of these results.

## DISCUSSION.

Mr. JAMES HARGREAVES said the question of migration of ions seemed to him to be certainly incomplete. The late Mr. Bird and himself had tried many variations of the ordinary electrolytic cell, with and without diaphragms and suspended curtains, some of which had been patented by others both before and since, and every result was in seeming agreement with the hypothesis in question. They found, however, that the results varied somewhat by varying osmotic conditions, and at last they settled the question of back diffusion by taking the cathode and one side of the diaphragm out of the solution altogether, and introduced such conditions of temperature and moisture as experience suggested, when they obtained results altogether different from those obtained in the cells with submerged cathodes. The liquid shown to the members contained 3·07 parts of Na in combination with Cl to every 100 parts in the state of carbonate. The current efficiency in producing it was 81 per cent. In an experiment which Dr. Hurter had described at a meeting of the Liverpool Physical Society, 4·75 mols. of NaOH were obtained united with 0·25 mols. of NaCl or 100 of NaOH to 4·1 of NaCl. With that production there was a current efficiency of 10—16 per cent., so that they had a somewhat purer material with a current efficiency of five to eight times as great, and with that greater efficiency there had been no trouble with formation of chlorates, hypochlorites, &c. He considered his observations were sufficient to dispose, if not of the orthodox hypothesis, at least of Dr. Hurter's deductions. But the case was not concluded; the efficiency he (Mr. Hargreaves) had quoted was the mean efficiency; the efficiency at the moment of concluding the operation would be only 4 per cent. The solution before them was washed off the cathode as it was formed, so that the efficiency at the concluding moment would be barely 3 per cent., according to Dr. Hurter's hypothesis, or say $\frac{1}{27}$th of what was actually obtained. The sample before them was no attempt at a "record," and was not a laboratory product; better results than this had been obtained. Another point was the manner of diffusion of water through the diaphragm. In the ordinary cell the water passed with the current into the cathode cell. It would be expected to flow in still larger quantities when there was a considerable hydrostatic head, owing to the anode cell being full of liquid, and the cathode side of the diaphragm being unsubmerged. As a fact, however, when the diaphragm was of proper texture, and was not ruptured, the water in the anode compartment remained constant, and in some carefully conducted experiments by Mr. Bird, where only dry salt was added to the anode compartment, they found it possible to cause an increase of liquids, although the increase had to be made against hydrostatic pressure. In some of their work they had made sodium carbonate by injecting $CO_2$ into the cathode space; that gave a higher duty than when making caustic. There again the verdict would, without further investigation, he thought, have been given against the results actually obtained. $CO_2$ ought to have passed into the anode cell and diluted the Cl; the actual result was that the Cl contained less $CO_2$ than when making caustic. In caustic making, the carbons wore away, a portion going to form carbonic acid, while, when making carbonate, the carbons were not perceptibly attacked. When carbonate was made, there was less chlorate produced in the anode cell, in fact a crowd of phenomena were continually cropping up which he thought the migration hypothesis gave them no power to predict.

Dr. F. H. Bowman said he believed that in electrolysis they had still a great deal to learn. He quite endorsed all that Dr. Hurter had said in regard to the theory of it, but the moment one tried to put it into practice to get a commercial result, one was confronted with a number of difficulties the theory did not provide for, and it was in the overcoming of those difficulties that electrolysis as applied commercially would alone prove succesful. He did not take the same view as Mr. Hargreaves, that it was absolutely necessary to remove the electrolyte from one side, the cathode side of the diaphragm, nor with Dr. Hurter, that they were better without a diaphragm, as he was afraid it was a necessity. A combination he thought would get over the difficulties hitherto met, and he hoped at some future time to present the section with some researches he had made himself; then he would be able to lay before them facts and figures. He would ask Dr. Hurter to tell them the amount of wear and tear per ton of caustic there was on the carbon poles.

Mr. F. G. Baily remarked that in the fundamental theory of the electrolytic cell, Dr. Hurter had mentioned a difficulty in the calculation of the electro-motive force of the cell from thermo-chemical data. That was due to the omission in the calculations of the thermal changes which took place in the cell. If he used two electrodes of the same metal, he would find that the thermo-chemical data would be pretty accurate, but if he used electrodes of different materials, he would find that there was a certain amount of difference of potential between the carbon and liquid, and the lead, or iron, and liquid, and that those differences of potential did not cancel each other. He did not know of any experimental values for those temperature variations. With regard to the migration of the ions, Dr. Hurter had on another occasion shown that the efficiency of the cell was very much lower than unity when under usual conditions, and he (Mr. Baily) had subsequently shown that one could almost repeat those conditions, still keeping the efficiency of the cell at unity. He thought that was the point that Mr. Hargreaves meant to bring out—that it was not necessary that the efficiency of the cell should be diminished. By neutralising the effect of the migration of the ions by an actual flow of liquid, one could keep up the efficiency of the cell to unity, and he thought that was a promising principle on which to construct cells. He found that by constructing a cell, not for commercial purposes, but with special arrangements for arresting the movement of the soda, he was able to obtain in one case 99 per cent. of the theoretical yield of the chlorine required. He measured both the caustic formed and the hydrogen given off, and they both came out within $\frac{1}{2}$ per cent. of the theoretical yield, according to the current passed. He thought this explanation showed that the results which Mr. Hargreaves considered so satisfactory, instead of being contradictory, were actually based upon the true theory of the cell. Dr. Hurter's results of tests on the relation between density, conductivity, and lasting properties of carbons, did not seem to lead to any definite connection.

Dr. Hurter here remarked that he could not connect them; they were quite disconnected.

Mr. Baily, in conclusion, asked according to what processes the carbons had been prepared.

Dr. Hurter, in reply, said that many of Mr. Hargreaves' remarks did not refer to the paper he had read that evening, but seemed to criticise a paper read before the Liverpool Physical Society a year or so ago. He had really intended to go into the question of current efficiency and migration that evening, but circumstances beyond his control had prevented him; moreover, he could not possibly have done justice to that subject that night. As he meant to bring that subject before them again next session, he did not think it was worth his while to go deeply into it that evening.

Nothing which either Mr. Baily or Mr. Hargreaves had said would in the slightest degree upset anything contained in his paper read before the Physical Society. If the products of the electrolysis were removed from the cell as fast as they were produced, the current efficiency would always be 100 per cent., but in cells such as he criticised in his inaugural paper of 1893 and 1887, nothing approaching such a result was obtainable. The experiments quoted in his 1893 paper were made with a view to test an American process for the electrolysis of common salt. In order to produce pure caustic solution, that inventor placed pure brine on one side and pure sodium hydrate on the other side of the porous diaphragm of his cell. The experimental answer to his question as to the efficiency of such an arrangement was that the efficiency was very poor. Having done the experiment, he (Dr. Hurter) did not feel satisfied with recording that result in his notebook, but thought about it, and the paper of 1893 was the outcome of his thoughts. He did not know whether Mr. Hargreaves had read the researches of Hittorf on migration; probably, if he had, he would give up all doubt as to the existence of the phenomena of migration. Mr. Baily had said that he stopped migration, but it was well known that electrolytes only conducted by means of migration, and if that were stopped, the current would cease. The cell which Mr. Hargreaves described, and the results he had obtained, were not at all a contradiction of the theory of migration; on the contrary, they were in perfect harmony with it. First of all his chlorine was said to contain less carbonic acid when making carbonate than when making caustic; that was quite what would be expected from the theory. The ion OH travelled much faster than the ion $CO_3$; that would account for a better efficiency, for less oxygen at the anode, and for a longer life of the carbon. The fact that the chlorine was only 97 per cent. by volume, and the average efficiency of the cell was only 81 per cent., showed that migration of that sort went on of which he (Dr. Hurter) had spoken in his paper of 1893. The theory of migration was supported by a great number of different phenomena, and could not be dismissed lightly. As an example of the technical importance of the phenomena of migration he would mention zinc chloride. Supposing, in a cell with porous diaphragm, zinc chloride were to be electrolysed, by consulting Hittorf's transport ratios it would be at once evident that, for every equivalent of chlorine evolved at the anode, 1·08 equivalents of chlorine would be transported from the cathode to the anode, and that the solution in the anode compartment would hardly change in concentration. That was a point which might give some experimental trouble to those who did not know Hittorf's results.

With respect to Dr. Bowman's question as to the rate of wear of the carbons per ton of caustic made, he could not say what that would be. The experiments he made were only comparative among themselves. No one would dream of using such current densities in actual practice as he had used for these experiments. There was no connection between the densities of the carbons and their other properties that he could trace. Generally the carbons which had been heated by an electric current to a high temperature had the least resistance. One of the samples shown had a peculiar graphitic appearance, but he was assured by the manufacturer that not a particle of graphite had been used in its manufacture.

# Manchester Section.

ROOMS OF THE CHEMICAL CLUB, VICTORIA HOTEL.

*Chairman:* R. Forbes Carpenter.
*Vice-Chairman:* *Edw. Schunck.*
*Committee:*

G. H. Bailey.
*F. H. Bowman.*
G. E. Davis.
C. Dreyfus.
H. Grimshaw.
*P. Hart.*

J. M. Irving.
*E. Knecht.*
I. Levinstein.
W. H. Perkin, jun.
Sir H. E. Roscoe, M.P.
W. Thomson.

*Hon. Local Secretary:*
J. Carter Bell,
Bank House, The Cliff, Higher Broughton, Manchester.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman:* P. Hart. *Committee:* R. S. Dale, M. J. Langdon, and E. Schunck.

*Meeting held Friday, May 3rd, 1895.*

MR. R. FORBES CARPENTER IN THE CHAIR.

## EXPERIMENTS ON THE PINK COLORATION PRODUCED DURING THE DEVELOPMENT OF ANILINE BLACK ON COTTON.

BY R. J. FLINTOFF, F.C.S.

In a previous communication to this Society I pointed out that magenta was sometimes formed during the development of aniline black on cotton, without endeavouring to explain the reason of its formation.

It will doubtless be remembered that Dr. Dreyfus drew my attention to the researches of Rosenstiehl, who concluded that the pink colouration produced during the "ageing" process resulted from traces of acid left in the cloth after bleaching. With a view to ascertain the part played by acid in the cloth during the process I made some further experiments.

In all of these the aniline black printing paste contained the same ingredients to that given in my previous paper, with the exception that the para-toluidine was omitted. This was essentially a mixture of the ortho and para compounds, but contained a larger proportion of the latter.

It was added in the former case for the time being as a matter of necessity, to produce a certain effect in the printing colour. In these experiments I substituted commercial aniline oil which possesses many advantages over the other mixture.

I might add that the pink appearance was first noticed during the printing of goods, whilst my later trials have been made with fents.

Firstly, I determine to try the effect of printing cloth containing different quantities of acid. Accordingly four fents were taken from bleached cloth and treated as follows:—

*No.* 1.—Saturated with a very dilute aqueous solution of hydrochloric acid containing 1 c.c. of HCl solution at 32° Tw. in 10 litres of water, squeezed and dried.

*No.* 2.—Treated in a similar manner only saturated with a solution of hydrochloric acid containing 1 c.c. HCl solution at 32° Tw. in five litres water.

*No.* 3.—Same as No. 1 only.

1 c.c. of HCl solution at 32° Tw. in 2·5 litres. This fent was "tender" after drying.

*No.* 4.—Treated with a very dilute solution of sodium carbonate, containing just enough of the alkali to give it an alkaline reaction. After agitating the fent in this solution to insure the neutralisation of any free acid still remaining in the cloth; it was well washed with water to remove all traces of the alkaline carbonate and any traces of salts of sodium that might have been produced, and finally dried.

Great care was taken that this fent did not become contaminated with acid vapours in the after processes.

These were all printed in the aniline black, and dried, divided and aged separately, half being aged in the open in a small steaming box and half being wrapped in flannel before "ageing." In not a single case could any trace of the pink coloration be found, and although these experiments were made several times with varying quantities of acid, the result was always the same. From these cases it would therefore appear that acid on the cloth is not the primary cause of the pink stain.

I decided now to turn my attention to the printing colour itself and to vary the quantity of aniline and aniline hydrochloride, always adding them mixed in the same proportion as they existed in the original colour.

Accordingly, unprepared bleached fents were printed with aniline black pastes containing 5 per cent., 20 per cent., and 50 per cent. more aniline salts than the original one, dried and aged in a similar manner to the first fents. To my surprise those which had been wrapped in flannel and aged were stained with the pink coloration. The one containing 5 per cent. more aniline hydrochloride showed hardly any traces of it; but the others were distinctly tinted and it was the most apparent in the one containing the greatest amount of aniline salts. It was entirely absent from those fents which had been aged in the open, and hence it seems that confining the gaseous products evolved during "ageing" is necessary for the phenomenon to take place. Further experiments were made to obtain this pink coloration on cloth known to contain no free acid. For this purpose, two fents of bleached cloth were treated as No. 4 in the first series, so as to eliminate all traces of acid, printed with the aniline black containing the 20 per cent. more aniline hydrochloride, dried and aged.

The result was exactly the same as in the former case, only the pink coloration was not so distinct.

Finally, two more fents were taken, one treated with acid and the other as described previously to remove any traces of free acid in the cloth; printed and aged separately in a similar manner to the preceding ones. In both cases the pink coloration was produced; but in the case of the acid fent it was darker and more clearly defined. As a result of these experiments I draw the following conclusions:—

Firstly, that the pink coloration results owing to an excess of aniline hydrochloride in the printing paste, and by excess is meant an amount more than is required by the oxidising agent present for the conversion of its equivalent quantity into black.

Secondly, that it is necessary for the printed cloth to be aged in such a manner as to confine any gaseous products that may be evolved.

Thirdly, that traces of acid in the cloth favour and accelerate its formation; but the acidity of the cloth is not a condition absolutely necessary for the production of this phenomenon. It may be presumptious of me to take a rather different view of this matter to a chemist of such high repute as Rosenstiehl; but in the face of my experiments no other course is open.

From this data it seems easy to explain the formation of this pink stain in the one batch of goods referred to in my original note; by supposing that this batch was printed in a black paste containing more aniline than the rest. The man who was responsible for weighing the correct amount of aniline hydrochloride having made a mistake and used too much. This explanation appears to me to be nearer the truth than by supposing traces of acid left in the cloth after bleaching to have been the primary cause; because as this batch was "soured" and washed at the same time as the other goods for the same process, it would be rational to make the deduction that traces of acid would remain in all. And, therefore, that all these printed goods would exhibit the same appearance after "developing," which was not the case.

Since writing this description of my experiments, I have received, through the kindness of Dr. Dreyfus, a detailed account of Rosenstiehl's researches on the same subject.

He develops the black on goods by hanging for a comparatively long time in a hot room, the atmosphere of which is charged with the vapours of aniline and toluidine. These goods are aged, therefore, practically under the same conditions as the fents in my trials, only to produce a similar medium in the latter case it is necessary to use an excess of aniline in the printing paste and to confine the products evolved during oxidation. The only difference in our deductions is that he attributes the stain to traces of acid actually existing in the cloth; while from my experiments it is evident that this pink coloration can be produced on cloth quite free from any traces of acid.

It is quite obvious that if the cloth is in contact with a medium containing aniline and toluidine in a gaseous state, there must also be acid vapours present to combine with the bases before the pink coloration can become evident. I, therefore, suggest that the acid is produced during the ageing process, the slighest trace of which would suffice to produce the result. This may be easily proved by folding filtering paper, which has previously been saturated with litmus solution, along with a black printed fent in the flannel, when the litmus is in some places more or less discharged leaving the edges distinctly reddened. In other places it is seen that traces of acid have acted upon it; but no discharging effect is produced showing that here little or no oxidation has taken place. I have also made experiments to determine, if any relationship existed between the different appearances of the fibre and the humidity of cloth; but on this point was unable to arrive at any definite conclusions.

Cloth which had passed twice through the usual bleaching operations and then submitted to a further scouring in boiling soap solution still gave the pink stain.

It is not necessary, therefore, to suppose the existence of an acid or a foreign substance on the cloth in order to explain the formation of the red; although as shown by these experiments the presence of the former does favour the partial oxidation of the aniline.

It now only remains to explain the different appearances of the cloth. I think these may easily be accounted for when it is understood that the atmosphere of an ageing compartment cannot be homogeneous; also, as I pointed out in my previous note, owing to the manner of hanging the goods for development there will be an unequal diffusion of the gases through the cloth at different parts of its surface.

### Discussion.

Mr. Dreyfus submitted the following communication he had received from Mr. Rosenstiehl, in relation to the former paper of Mr. Flintoff:—

"What I have made clear in my work on the subject is—

"1. Acids give always the pink coloration on cotton in an atmosphere of aniline vapours.

"2. Besides the acids, there are on the cotton substances which intervene also in the formation of the red. I have left the question, undecided to know whether this is due to the fibre itself or to a foreign substance not removed by the operations of bleaching.

"According to Weber, this later hypothesis would be the correct one, as he affirms that by bleaching under pressure with resin soap, the pink coloration is not taking place (see bulletin de la Soc. Indust. de Mulhouse, Vol. LIV., page 61, and Vol. LVI., sittings of the Committee, page 11, at the end of the volume).

"This as far as the *rôle* of the cotton.

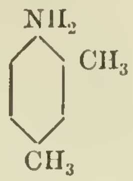
"As to the colouring matter, I found it was magenta.

"The *rôle* of the alkaloids is also investigated; paratoluidine does not give the coloration when pure.

"Orthotoluidine gives a deep coloration.

"Aniline gives it also; I did not find any aniline that did not give it, but in all these anilines I could find the presence of orthotoluidine. I have never succeeded in preparing any aniline that did not give the characteristic reaction of the orthotoluidine. In 1871, when I made this research, the presence of orthotoluidine sufficed to explain the formation of the red. To-day its presence is not sufficient theoretically.

"Paratoluidine should be present; but I have shown that a whole series of homologues of the paratoluidine can replace it, amongst them α-meta-xylidine—



which is at the same time ortho- and para-toluidine, and gives the colour reactions of both amines. The presence of traces of α-meta-xylidine would explain all. As only traces of red are formed, an infininitesimal amount of this amine would be necessary to produce the colorations."

Mr. Flintoff, in reply to Mr. Dreyfus, stated that the acid necessary for the formation of the pink coloration was produced as a product of decomposition during the development of the black, and was not necessarily a result, as Rosenstiehl suggested, of imperfect washing after bleaching. He further contended that the different appearances of the cloth were owing to certain peculiar conditions under which the black was developed, and these conditions were referred to in detail in his paper.

## NOTES ON EXPERIMENTS WITH LIQUID GAS ENRICHERS.

BY T. STENHOUSE, F.I.C., F.C.S.

During the last few years many gas managers, instead of using Cannel coal, have raised the quality of the gas obtained from ordinary coal to the required standard by using liquid enrichers. These have been vaporised by steam in various kinds of carburettors. Generally the gas is improved two or three candles in this way. There is, however, a great difference in the few published statements respecting the value of the various hydrocarbons commonly in use—especially of carburine and benzol. Probably there is as great a difference between the privately circulated results believed to have been obtained at various gasworks where enrichers of this class are employed. Dr. Bunte, for instance, makes the rather wide statement that between 7 and 9 grains of benzol vapour will improve 1 cub. ft. of gas between 4 and 5 candles.

This is equal to an improvement of 1 candle in over 30,000 ft. of gas by 1 gall. of benzol.

In a letter to the Journal of Gas Lighting (February 19, 1895) Mr. Hunt of Birmingham stated that 1 gall. of benzol enriches 9,500 ft. 1 candle, and that 1 gall. of carburine improves 2,800 ft. to the same extent.

In an interview with Mr. Wm. Young of Peebles, a report of which occurs in The Gas World for January 26, 1895, this gentleman credited a gallon of benzol with an enrichment value of only 4,500 candles, and carburine with being only one-fourth as effective. These statements are so greatly at variance that a gas-manager, wishing to select some enricher of this kind for his gas, must be not a little perplexed and scarcely able to calculate what the cost will be.

Of course, it is quite possible that gases of the same illuminating power may so differ in composition that no particular enricher will have exactly the same improvement effect upon them. This, however, cannot account for the enormous differences just noticed.

With a view of ascertaining the relative values of a few enrichers for coal-gas, I have recently made some careful experiments with several liquids, but principally with carburine of 0·680 sp. gr., and commercially pure benzol. The gas used was of about 16 candle-power and was improved from 1 to 2 candles. The photometer employed was the ordinary 60 in. open bar photometer at the Rochdale gasworks. A Methven 2-candle screen replaced the candles so as to avoid any trouble with the latter during the tests. The gas, after leaving the meter, was by-passed through two flasks with short lengths of glass tubing. The first flask it entered was a small one, holding a quarter of a litre, the other had a capacity of two litres. The inlet tube reached nearly to the bottom of the small flask, while the outlet tube only just passed through the cork. The tube arrangement was reversed in the larger flask — the gas entering at the top and leaving at the bottom. The lower part of the small flask was heated on a water-bath, and the liquid enricher allowed to fall in drop by drop. In this way the gas was enriched each time a drop entered and became volatilized, but as the gas immediately passed into and became diffused through the larger flask, there were only very slight variations in the illuminating power of the improved gas when the enricher was added uniformly for about 15 minutes. With a few trials it was soon ascertained at what rate the liquid, whatever it was, must be added to give one or two candles enrichment and allow accurate readings to be taken at the photometer. The liquid enricher was measured from a burette with glass tap, and passed into the flask at the required rate. After the gas had been improved to a suitable extent and was burning at the proper rate, the liquid in the burette was carefully read off, and a test, lasting say half an hour, was made.

With an arrangement of this kind it is not at all difficult to watch the photometer disc and regulate the supply of the enricher, so that the illuminating power of the gas shall remain fairly steady at one value, say at 18 or 19 candles as may be required. Certainly the difference between the readings is not greater than what is experienced when using candles in the ordinary way while testing unenriched gas. With the addition of one drop of benzol from the burette about every 20 seconds, one can get an improvement of about 2 candles when the gas is burning at 5 cub. ft. per hour. Between two and three times as much carburine is required to give the same improvement.

Added in this way practically all the liquid is vaporised under the influence of heat and the stream of gas playing over the bottom of the small flask. Even with enrichers containing small quantities of dense hydrocarbons there is a mere stain left in the flask after an hour's test. Under these circumstances one may safely rely on obtaining the full duty from the liquid under examination, as it is practically all turned into vapour and carried directly into the flame, the illuminating power of which is being determined. As the flame is never more than equal to 18 or 19 candles in these tests the gas is never saturated with the added vapour, and consequently will have no tendency to deposit anything either in the larger flask or in the short length of tubing leading to the Argand burner. It may here be remarked that at Rochdale, where carburine has been employed as an enricher during the last two or three years, Mr. T. Banbury Ball, engineer and manager of the gasworks, has not found that any of the liquid has condensed in any of the syphon boxes attached to the mains, notwithstanding the severe frost of last winter.

Working in the way just described the following results have been obtained with the respective liquids :—

| | Gas enriched 1 Candle by 1 Gallon of the Liquid. |
|---|---|
| | Feet. |
| Benzol (chemically pure) | 13,300 |
| Benzol (90°) | 12,500 |
| Carburine (0·680 sp. gr.) | 5,700 |
| Common petroleum spirit of 0·700 sp. gr. | 4,300 |

Of these liquids, the two important ones are commercially pure benzol and carburine or light petroleum spirit. Their composition is well understood. As the specific gravity shows a gallon of the former contains about 2 lb. more real matter than the latter. Besides that, the molecular structure of the benzol molecule is such that, of all the liquid hydrocarbons known, it is the one which may be expected to break up most readily into that wonderful acetylene of which we have heard so much lately, and which, according to some authorities, puts everything else in the shade as a light producer.

Benzol is a liquid which is being produced more plentifully every year from the gas and tar obtained from coke ovens. It was recently estimated that 50,000,000 galls. of benzol could be obtained from the 30,000,000 tons of coal annually coked in Great Britain, if the coking were done in closed ovens. There is, therefore, every probability that this most useful liquid will be available in the near future in greater quantities. It is already a rival of carburine, and may soon supersede it altogether for enriching ordinary gas of 15- or 16-candle power. So long as benzol can be purchased at 1*s.* per gall., it is, in my opinion, decidedly preferable to carburine, even at the lowest price at which the latter has yet been sold. Volume for volume it is about $2\frac{1}{4}$ times as efficient as a gas enricher, and there is less loss and danger from evaporation during transit. The temperature at which benzol volatilizes is also a convenient one, as ordinary steam heat is all that is required. The amount of benzol vapour which common coal gas can permanently retain, viz., over 50 grains per cubic foot at 0° C. is greater by far than anything required to enrich low-quality gas to any reasonable extent. If used in a rational way, there is therefore no need to fear that the added benzol will be condensed and deposited in the gas mains.

## ON THE VULCANISATION OF INDIA-RUBBER.

BY CARL OTTO WEBER, PH.D.

In my first paper on this subject, read before this Society about a year ago, the vulcanisation of india-rubber by means of chloride of sulphur was exclusively discussed. The result arrived at in that paper was that the process of vulcanising india-rubber with chloride of sulphur was not a substitution process, as had been generally assumed, but consisted in the formation of addition products of those two compounds. I further pointed out that the highest addition product of india-rubber and sulphur monochloride was a compound of the empirical formula $C_{10}H_{16}S_2Cl_2$, while on the other hand, a compound, $(C_{10}H_{16})_{10}.S_2Cl_2$, containing only one-tenth the quantity of chloride of sulphur of the before-mentioned highest addition product, was nevertheless found to contain no uncombined or unvulcanised india-rubber. From this fact I concluded that $C_{10}H_{16}S_2Cl_2$ and $(C_{10}H_{16})_{10}.S_2Cl_2$ represented the terminals of a series of polyprene chlorosulphides, the terms of which differed from one another by $S_2Cl_2$, or a multiple thereof. As a further conclusion I gave that the molecular weight of india-rubber could no longer be taken as $C_{10}H_{16}$, but would have to be put as at least $C_{50}H_{80}$, with a possibility of even being higher. These statements have been subjected to criticism first by Thomson and subsequently by Henriques, but neither of them succeeded in controverting the above statements on grounds derived from the results of their own investigations of this extremely difficult subject. The objection that my investigation showed no sufficient proof of the homogeneous character of the compound $(C_{10}H_{16})_{10}.S_2Cl_2$ must be admitted, though it does not in the least affect my above repeated conclusions. On the other hand, the homogeneity of the compound $C_{10}H_{16}S_2Cl_2$ cannot be reasonably doubted, although the usual means of demonstrating it (melting point, boiling point) fail, owing to the refractory physical properties of that compound. Since reading that paper I have further prosecuted this investigation and very considerably extended its scope. The results will shortly be published in the scientific journals; but already now I may say that they bear out in every detail my formerly expressed views regarding the nature and molecular formula of india-rubber, which latter has been determined on a number of india-rubber derivatives by means of the well-known vapour-tension method of Beckmann.

In following up these results it appeared to me desirable to examine also the action of the monobromide and the monoiodide of sulphur upon india-rubber.

Sulphur monobromide not being a commercial product it was prepared by dissolving sulphur in bromine. The data obtainable regarding the preparation of this compound in a state of purity being very scanty, a few words on this point may perhaps prove useful to others. On adding sulphur to bromine in equimolecular proportions and allowing the mixture to stand for some time, products are obtained which seem to contain both free sulphur and free bromine. In order to have no free sulphur in the final product it is therefore necessary to use an excess of bromine, and I found it advisable to use a rather considerable excess. Under these conditions the complete solution of the sulphur takes place very rapidly. To remove the excess of bromine distillation seems to be a ready means, as its boiling point is so very low as compared with that of the sulphur monobromide. It was, however, found, in accordance with the statements of earlier observers, that by distillation under ordinary as well as under reduced pressure the sulphur monobromide suffers partial decomposition, so that after having distilled off all free bromine a product is obtained which again contains more or less of free sulphur. Distillation in a current of dry air yields no better result, but by using carbonic acid instead, at a temperature not exceeding 80° C., a compound of exactly the composition of $S_2Br_2$ is obtained as soon as the current of carbonic acid ceases to carry any more bromine into the condenser connected with the distillation flask. Preparing the sulphur monobromide in this manner on various occasions I found no difficulty in obtaining it always of exactly the theoretical composition. It has been questioned whether sulphur monobromide as a definite compound has any real existence. That this is the case I have no doubt, although this compound is almost completely decomposed on distillation at its boiling point, which lies between 190° and 200° C. We must remember that even sulphur monochloride on distillation invariably suffers a slight decomposition. But the chief reason for my opinion regarding the chemical nature of sulphur monobromide is derived from its behaviour against india-rubber.

If we add to a solution 25 grms. of pure and absolutely dry india-rubber in 700 c.c. of benzene, dried by distillation over metallic sodium, a solution of 60 grms. of sulphur monobromide, prepared as above described, a reaction between the two dissolved compounds very soon begins, the solution rapidly gelatinising, and also exhibiting a not inconsiderable rise of temperature, accompanied by slight evolution of hydrobromic acid. The latter being detrimental to the product of the reaction, it was found necessary to cool the two solutions before mixing them to a temperature of 4° or 5° C. In this case the temperature of the mixture never rises above 12° C. The mixture, after standing two or three hours, is found to form a light brown and perfectly transparent quasi-solid mass. It is turned out of the beaker into a spacious mortar, rapidly crushed with the pestle, and immediately transferred into a vessel containing 3 litres of pure benzene. The excess of sulphur bromide passes into solution. The whole is then thrown on a silk-gauze filter and washed with warm benzene until the washings are free from bromine. To remove any free sulphur which might possibly be contained in the product upon the filter, it is pressed between filter-paper, and subsequently for several hours in Soxhlet tubes, extracted with carbon bisulphide. Finally, to remove the bisulphide from the extracted product the latter is placed in a filter and washed with warm alcohol until the filtrate is found to be absolutely free from bisulphide. Placing the product in a flask, covering it well with alcohol, and distilling the latter off on the water-bath, as I formerly recommended for similar purposes, would, of course, have been preferable, as being more expedient and requiring very much less alcohol, but it was found to be impracticable owing to the extreme sensitiveness of the product against temperatures above 40° C. As a matter of fact, it was observed that already the washing with warm benzene involved a loss of hydrobromic acid. The product completely freed from carbon bisulphide is pressed between filter-paper and dried at a temperature not exceeding 30° C. In spite of these precautions it was found impossible to obtain a compound analogous to the formerly-described polyprene chlorosulphide $C_{10}H_{16}S_2Cl_2$, namely, containing sulphur and bromine in the same proportions in which they form sulphur monobromide. I showed in my first paper* that polyprene chlorosulphide on heating readily gives up most of the chlorine it contains in the form of hydrochloric acid, and the same, only in a much higher degree, is also true for polyprene bromosulphide, which, in fact, gradually seems to lose hydrobromic acid even at ordinary temperatures.

The analysis of the product obtained as above described, and dried *in vacuô* at 16° C., gave the following figures:—

| | —— | | Calculated for $C_{10}H_{16}S_2Br_2$. |
|---|---|---|---|
| C | 50·60 | 50·44 | 33·33 |
| H | 6·01 | 5·99 | 4·44 |
| S | 26·66 | 26·68 | 17·78 |
| Br | 16·41 | 16·47 | 44·44 |

The same product, dried at 50° C., contained 27·58 per cent. of S and 13·65 per cent. of bromine.

In the first instance these figures show that although the product of the reaction of sulphur monobromide upon india-rubber certainly is a polyprene bromosulphide, yet its composition is very different from that of the formerly described polyprene chlorosulphide. Indeed, at first sight, it appears as if these two compounds were constituted in an utterly different manner, and that consequently the reaction between sulphur bromide and india-rubber proceeded on rather different lines from that of sulphur chloride. I think, however, that I am able to show that this difference is more apparent than real, and is simply caused by the great instability of the bromosulphide, which begins to lose hydrobromic acid almost as soon as it is formed.

If we heat the polyprene bromosulphide with an excess of aniline for two or three hours on the water-bath, then dilute with much alcohol, filter, and wash the filter residue thoroughly, first with warm alcohol, then with ether, we obtain a substance which in its outward appearance cannot be distinguished from the bromosulphide. Its analysis gave the following figures:—

| | —— | Calculated for $C_{10}H_{14}S_2$. |
|---|---|---|
| C | 60·84 | 60·61 |
| H | 7·14 | 7·07 |
| S | 31·94 | 32·32 |

This substance is therefore absolutely free from bromine. But the most important part about it is that its composition answers very accurately the formula $C_{10}H_{14}S_2$, in other words, this compound is identical with the polyprene sulphide I obtained from polyprene chlorosulphide, and it is thus evident that whatever difference there is between the chlorosulphide and the bromosulphide of polyprene, they are certainly formed by strictly analogous chemical reactions, and are identical in constitution. The deficiency of bromine in the bromosulphide does not point to a constitutional difference in the two compounds, but must be the result of a secondary reaction of the normal bromosulphide $C_{10}H_{16}S_2Br_2$.

This conclusion is based upon the above given analyses and the following consideration: That in the formation of both the chlorosulphide and bromosulphide of polyprene for each molecule of india-rubber the same number of molecules of respectively chloride and bromide of sulphur take part is proved by the fact that both those compounds lead to the same polyprene sulphide. Of course there is just a bare possibility that sulphur dissolved in bromine might possess sufficient reactive energy to combine with india-rubber dissolved in benzene, but such a reaction could nevertheless not be realised, as the affinity of the free bromine to india-rubber is certain to exceed that of the dissolved sulphur, so that at best we could in this wise only obtain a mixture of polyprene bromide and polyprene sulphide. Such a mixture, however, could be easily separated into its constituents by means of chloroform, which readily dissolves the polyprene bromide, but has not the slightest effect upon the bromosulphide. I have satisfied myself that treatment of the polyprene bromosulphide with chloroform fails to extract from it the slightest quantity of polyprene bromide.

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* This Journal, 1894, 14.

Nevertheless, the fact that such a stable compound like $C_{10}H_{16}Br_4$ is easily obtainable, while the compound $C_{10}H_{16}S_2Br_2$ can, as it seems, not exist, at any rate not at temperatures above zero, without losing most of its bromine in the form of hydrobromic acid, is very remarkable, and difficult to explain. I have attempted to prepare the bromosulphide at temperatures of − 5° and − 10° C., but I have never succeeded to purify these preparations and obtain them suitable for analysis without loss of hydrobromic acid on the filters and in the desiccator. The many specimens of bromosulphide prepared at different times all showed this great deficiency in bromine, the percentage of which varied between 13 and 19 per cent.; the percentage of sulphur in the compound at the same time always varying in the inverse direction. Whichever of these different preparations was treated with aniline, in every case the normal polyprene sulphide, containing in the average 32·13 per cent. of sulphur ($\pm$ 0·22 per cent.) was obtained.

To calculate from the above given analysis of the bromosulphide the empirical formula of that compound is of little interest, apart from giving an approximate idea as to the degree of decomposition the product has suffered at the time of its analysis. In making this calculation we shall have to bear in mind that with each bromine atom the normal bromosulphide loses in forming that bromosulphide which we actually obtain, one atom of hydrogen is also withdrawn from the organic radical of the bromosulphide. The quantity of hydrogen thus lost, though very small in percentage, is nevertheless distinctly noticeable in the above analyses, which very fairly agree with the formula $C_{10}H_{14}S_2Br_{\frac{1}{2}}$. Of course this formula is only a bare expression of the analytical data, and is not intended in any way to express the molecular weight of the bromosulphide. In my first paper ou the present subject I propounded $C_{50}H_{80}$ as the most probable molecular formula of polyprene, $(C_{50}H_{80})_2 \cdot (S_2Cl_2)_{10}$ as that of the saturated polyprene chlorosulphide. Accordingly, $(C_{50}H_{80})_2(S_2Br_2)_{10}$ would be the formula of the normal polyprene bromosulphide, and the corresponding formula of the bromosulphide actually obtained would therefore have to be put at about $(C_{50}H_{72})_2 \cdot S_{20}Br_5$. The above quoted analyses agree very well with this formula, but I wish it to be understood that I do not consider the bromosulphide I obtained to be a definite compound; indeed, I have already shown that it is not, as the percentage of bromine it contains is so very variable. But at the same time I wish to emphasize the important fact that, in spite of its varying percentage of bromine it contains, and may be converted into the same polyprene sulphide $C_{10}H_{14}S_2$ or, rather $(C_{50}H_{70})_2S_{20}$, which is also the product of the elimination of the chlorine from polyprene chlorosulphide $(C_{50}H_{80})_2(S_2Cl_2)_{10}$. This leaves absolutely no doubt that the bromosulphide I analysed is a product derived from a compound $(C_{50}H_{80})_2(S_2Br_2)_{10}$ by the loss of hydrobromic acid, and the formula deducted from the results of that analysis, although not the formula of a definite compound, clearly shows that the bromosulphide I obtained, at the time of its analysis, had already lost approximately 15 out of possible 20 molecules of hydrobromic acid.

This instability of the polyprene bromosulphide sufficiently explains why all the experiments undertaken with a view to testing the suitability of sulphur monobromide as a vulcaniser for practical purposes were eventually abandoned as unpromising. If the bromine was eliminated in its elementary state sulphur bromide would prove of very high value for vulcanising purposes, indeed it would then be far preferable to sulphur chloride. But the fact that the bromine is evolved as hydrobromic acid, the hydrogen of which is taken out of the india-rubber itself, thus very materially altering the constitution of the latter, no doubt constitutes the objectionable feature of sulphur bromide as a vulcaniser.

However, all the above experiments were carried out with considerable excess of sulphur bromide, and the reacting quantities of polyprene and sulphur bromide were in the proportion of 100 parts of the former to 164 parts of the latter. In the practical process of vulcanisation such proportions are out of question, not more than from 3 to 5 per cent. of combined sulphur producing fully vulcanised articles. To obtain such a percentage of sulphur in vulcanised goods not more than about 17 grms. of sulphur bromide are required for 100 grms. of india-rubber. It is conceivable that under these condition a vulcanisation product might be formed containing sulphur and bromine in the same proportions in which they occur in sulphur bromide. To test this point 0·80 grm. of sulphur monobromide were added to a solution of 5 grms. of pure india-rubber in 500 c.c. of benzene. After 6 hours' standing the solution began to show signs of gelatinising. After 9 hours' standing every trace of free sulphur bromide had disappeared.* The very thin jelly obtained was treated in the manner repeatedly described. All the washings and extractions being done with cold liquids. The product ultimately obtained weighed 5·81 grms. and possessed the properties of well vulcanised india-rubber, although it was distinctly less resilient than india-rubber cured under the same conditions with an equivalent amount of sulphur chloride. On analysing this product it was found to contain—

| | —— | Calculated upon Molecular Weights. |
|---|---|---|
| | Per Cent. | |
| S | 3·91 | 32·00 |
| Br | 9·82 | 80·36 |

Thus we see that in saturating india-rubber with sulphur bromide to a fraction only of its total capacity for that compound, the reaction proceeds without any complication in exactly the same manner in which I showed it to proceed with sulphur chloride. On heating this normal polyprene bromosulphide to temperatures above 30° C. it begins to lose hydrobromic acid, getting harder at the same time. Exposed for 15 minutes to a temperature of from 70° to 80° C. it losses practically all its bromine. At this temperature the corresponding chlorosulphide remains perfectly unaffected. I have no doubt that the stability of polyprene chlorsulphide at temperatures at which the bromosulpide suffers rapid decomposition is also closely connected with the observation I made some time ago, that while polyprene hydrochloride is a surprisingly stable compound, polyprene hydrobromide is so unstable that it was found impossible to obtain it of denfiite composition. It is therefore quite evident that sulphur bromide or any vulcaniser in which compounds of bromine play the part of sulphur carrier has a very unpromising futuie.

In passing I wish once more to revert to the question of the chemical nature of sulphur monobromide itself, upon which the behaviour of this compound against india-rubber sheds some new light. If $S_2Br_2$ is not a chemical compound it would merely represent a solution of sulphur in bromine. Although it would be a most remarkable fact that the sulphur in this solution should be capable of combining with india-rubber, a reaction which in any other known solvent it is incapable of, the possibility of such a reaction, if it cannot be proved, nevertheless exists. But then we certainly would have to expect the free bromine, in which the sulphur is supposed to be dissolved, also to react upon the india-rubber, forming the well defined bromide $C_{10}H_{16}Br_4$ discovered by Gladstone and Hibbert. Though highly improbable, but still within the range of possibility, we might then obtain a product the analysis of which would lead to figures more or less agreeing with those of a compound $C_{10}H_{16}S_2Br_2$, *i.e.*, normal polyprene bromosulphide. In spite of this we would in this case really have a mixture of $C_{10}H_{16}S_2$ and $C_{10}H_{16}Br_4$. However, the latter, polyprene bromide, being a remarkably stable compound, such a mixture would have not the least tendency to split off hydrobromic acid under anything like normal conditions, a behaviour which, on the other hand, we found characteristic of the above described bromosulphide. Further, Gladstone and Hibbert's polyprene bromide being easily soluble in chloroform in which polyprene sulphide is insoluble, a mixture of the two, on treatment with chloroform, should be decomposed into the insoluble sulphide and a solution of the bromide. But as I have already stated treatment of the bromosulphide with chloroform effects not a trace of such a separation. Of course it might still be argued that polyprene sulphide and polyprene bromide might combine with each other, forming a bromosulphide of the nature of a double salt. But the readiness with which the bromosulphide loses its bromine would then appear most anomalous, indeed, the very notion of a double compound in which the components are far more unstable than when by themselves is an absurdity. These considerations leave no doubt that sulphur monobromide is a definite chemical compound.

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* The tardiness with which in dilute solutions sulphur bromide acts upon polyprene is very remarkable; with sulphur chloride under exactly identical condition the reaction requires about 22 minutes for its completion.

I mentioned above that sulphur monobromide had been tried on a practical scale as a vulcanizer, but was found unsatisfactory and inferior to the sulphur monochloride. There seems to be no evidence, however, of sulphur monoiodide ever having been tested as to its vulcanizing capabilities. This no doubt is due to two circumstances chiefly, regarding this compound. In the first instance it is a solid body, and, further, it is generally considered not to be a compound at all, but simply a more or less homogeneous mixture of sulphur and iodine. This contention is usually thought to be supported by the fact that the supposed sulphur iodide already on heating on the water bath gives off dense fumes of iodine, so that eventually sulphur in a practically pure state remains behind. As a matter of fact this decomposition occurs even at ordinary temperatures, by exposing the substance to the atmosphere in an open vessel, or by washing it with water. I doubt, however, very much whether any of these reactions proves what they purpose. It is well known that even sulphur monochloride on distillation loses chlorine, while sulphur monobromide under the same conditions loses large quantities of bromine. The instability of sulphur iodide is therefore only what might be expected. On the other hand the considerable amount of heat evolved on the union of sulphur and iodine, and especially the fact that a mixture of ethyl iodide and sulphur monochloride yields sulphur monoiodide in crystaline form is strong evidence for the consideration of sulphur iodide as a chemical instead of a mechanical or physical compound. However that may be, I considered it of some interest to examine the behaviour of the real or supposed sulphur iodide towards india-rubber. I prepared the sulphur monoiodide by heating in a water bath in sealed tubes an intimate mixture of sulphur and iodine in molecular proportions. The mixture quickly liquefies with evolution of heat, and on cooling forms a black crystaline mass which can easily be reduced to the state of a fine powder. This product is soluble in chloroform and bisulphide of carbon, the solutions exhibiting the characteristic colour of solutions of iodine. I leave it undecided as to whether this is evidence of merely dissociation is solution or of the nonchemical nature of the supposed sulphur iodide.

To a solution of 5 grms. of pure india-rubber (Parà) in 200 c.c. of chloroform, a solution of 15 grms. of this sulphur iodide in 200 c.c. of carbon bisulphide was added. After several hours standing the solution showed not the slightest alteration, but on allowing the mixture to stand until the following morning it was found to be converted into a soft jelly. This was crushed in a mortar and in a Soxhlet extractor for three consecutive days, extracted with carbon bisulphide until the runnings were found to be absolutely free from either sulphur or iodine. The precaution was taken to keep the contents of the Soxhlet tube during the nightly intervals well covered with carbon bisulphide. The product thus apparently freed from iodine on immersion into absolute alcohol yielded, to my surprise, a further considerable quantity of iodine but no sulphur. It was therefore washed on the filter with warm alcohol until every trace of iodine had disappeared. The carefully dried product thus obtained forms a drab-coloured friable mass, which was found to be as insoluble in all solvents as the formerly described chlorosulphides or bromosulphides of polyprene. On analysing this compound I found it to contain not only sulphur, but also a considerable percentage of iodine, which is rather surprising, considering the statement first made by Gladstone and Hibbert,* that "It has little or no action on caoutchouc dissolved in chloroform." No doubt it might be argued that sulphur iodide might combine with india rubber when iodine itself would not. But, on the other hand, the observations I brought before you in this and the former paper regarding the properties of the chlorosulphide and the bromosulphide conclusively show that the presence of sulphur in these compounds not only lessens but actually reduces their affinity to the halogens. This is particularly, forcibly, illustrated by the bromosulphide of polyprene, which loses its bromide so readily that its composition in that respect is quite indefinite, while on the other hand polyprene bromide, $C_{10}H_{16}Br_4$, is an extraordinarily stable compound. We are therefore justified to expect that if the iodine of sulphur iodide combines with india rubber along with sulphur a polyprene iodide must exist of a far more stable nature than the polyprene iodosulphide. Indeed, I succeeded in preparing a polyprene iodide by the direct action of iodine upon a solution of polyprene in chloroform.†

The analysis of the above-described polyprene iodosulphide gave the following figures :—

| | | |
|---|---|---|
| C | 71·65 | 71·62 |
| H | 9·48 | 9·51 |
| S | 6·05 | 6·01 |
| J | 12·61 | 12·73 |

The most notable feature of these figures is the fact that the absolute weight of iodine contained in a molecule of the substance amounts to twice as much as the absolute weight of the sulphur. This very probably explains the fact that the iodosulphide, although its percentage of sulphur is not very much above the values attained in practical vulcanisation, nevertheless forms a mass devoid of any elasticity, in fact, is an easily friable compound. This shows very plainly the unfavourable effect of halogen in general in the cold vulcanising process, which is also practically recognised by manufacturers, who know the disastrous results attending vulcanisation with a chloride of sulphur containing dichloride of sulphur, $SCl_2$, or in the parlance of the manufacturer, free chlorine. Now, although our iodosulphide contains twice as much iodine than sulphur, there is really a deficiency of iodine. If $S_2I_2$ added itself to the polyprene without any complication, an iodosulphide with 6 per cent. of sulphur ought to contain about 24 per cent. of iodine. We, therefore, see that either our iodosulphide lost one-half of its iodine, analogous to the bromosulphide, as hydroiodic acid, or we would have to conclude that $S_2I_2$ acts upon polyprene in a different manner from sulphur chloride or sulphur bromide. I have never been able to detect hydroiodic acid as an immediate product of the reaction of a solution of sulphur iodide upon a solution of polyprene, although in the course of the subsequent purification of the product of the reaction, polyprene iodosulphide, evolution of hydroiodic acid is invariably observed. But the proportion of sulphur and iodine in the iodosulphide being 2 atoms of sulphur to 1 atom of iodine, this absence of hydroiodic acid amongst the products of the primary reaction would mean that a solution of sulphur monoiodide is at least partly dissociated into free iodine and free sulphur, and that both the remaining quantity of undissociated sulphur iodide and the dissociated, *i.e.*, free sulphur, act upon the polyprene. The first of these two propositions, the dissociation of the sulphur iodide, is indeed highly probable, if we remember that the solution of this compound in carbon bisulphide exhibits exactly the appearance of a solution of free iodine. But our second proposition which would mean that free sulphur dissolved in carbon bisulphide is capable of combining with india rubber, in other words, vulcanising it, appears highly improbable, although Henriques* arrived at an exactly similar conclusion in the investigation of an altogether different question. I have made a great many attempts to realise this reaction, but invariably without success. The united solutions of sulphur and polyprene after weeks' standing contained not a trace of polyprene sulphide. On prolonged heating of this mixture on a reflux condenser small quantities of insoluble flakes are often obtained, but they contain sulphur only by way of occlusion and not in combination. These insoluble flakes simply consist of the insoluble form of pure india rubber, which already Gladstone and Hibbert found to form on heating solutions of pure india rubber in chloroform without the presence of sulphur.

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* J. C. S. 1888, 685.

† Full details of this investigation I intend to publish shortly elsewhere.

This absence of hydriodic acid amongst the immediate products of the reaction between sulphur iodide and india rubber, together with the above shown inertness of sulphur in solution, makes the question as to nature of the reaction by which for 4 atoms of sulphur only 1 atom of iodine of the sulphur iodide acted upon india-rubber, a very perplexing one. But it occurred to me that a satisfactory explanation of this anomaly might be derived from the well-known action of hydroiodic acid upon unsaturated hydrocarbons and their derivatives, to which it adds its hydrogen with formation of free iodine. This would explain the above spoken of absence of hydroiodic acid amongst the reaction products, the assumption being that this acid, though being formed to an amount equivalent to the deficiency of iodine in the iodosulphide, at once producing the above-mentioned hydrogenation with regeneration of the iodine. Of course, I am well aware that this action of hydroiodic acid generally takes place at higher temperatures only, but this refers to hydroiodic acid in aqueous solution, while in this case the reaction would occur with anhydrous acid, and this acid, moreover. acting in *statu nascendi.* I hope that on the completion of an investigation on the iodides of polyprene I shall be able to throw some more definite light on this difficult subject.

On adding to the mixed solutions of polyprene and sulphur† a small quantity of iodine, the solution at once assumes the well-known beautiful pink coloration. This coloration soon changes into a dull orange, and, after a few hours' standing, into a pale brown tint. The cause of this change of coloration might be thought to be due to the formation of polyprene iodide, but the examination of the solution showed this to be not the case. As a matter of fact, polyprene iodide will only form in the presence of a large excess of iodine in the form of a concentrated solution, conditions which are absent in the above experiment. We must therefore make the only possible and almost certain assumption that the change of coloration is due to formation of some sulphur iodide. But this sulphur iodide has not the slightest vulcanising effect upon the dissolved india-rubber. This appears surprising, considering that I demonstrated above the capability of sulphur iodide of forming a polyprene iodosulphide with india-rubber. But the action of even a strong solution of sulphur iodide upon a solution of india-rubber is extremely slow, and with increasing dilution of the solutions rapidly reaches a vanishing point. Indeed, already the sulphur monobromide, although it is a very energetic reagent compared to sulphur monoiodide, shows a similar behaviour. On adding to a solution of 2 grms. of india-rubber in 500 c.c. of chloroform 2 grms. of sulphur bromide, no action occurred, and, after several days' standing, the sulphur bromide was still in the free state. Chloride of sulphur, under the same conditions, also shows a distinctly retarded action, though in less than an hour every trace of free chloride has disappeared. Thus we see that the energy with which respectively the chloride, bromide, and iodide of sulphur act upon polyprene is proportionate to the similarly decreasing intensity of the reaction of respectively chlorine, bromine, and iodine upon polyprene. The action of chlorine upon india-rubber, no matter how diluted the solutions may be, is so violent that so far all attempts failed to obtain the addition product of these two substances, substitution always taking place simultaneously. The action of bromine is far more moderate and easily confined to the formation of addition products, even when working with comparatively concentrated solutions of polyprene and using the bromine undiluted. The action of iodine, lastly, is so slow that polyprene iodides have been pronounced to be non-extant. Indeed, their formation can only be induced by the use of highly concentrated solutions and using a large excess of iodine.

Now, from these observations it might appear as if sulphur iodide as a vulcanising agent for practical purposes deserved even less attention than sulphur bromide, upon which I already pronounced unfavourably. Certainly, for the cold curing process, as at present practised with sulphur monochloride, sulphur iodide can not be taken into account, owing to its slow action, and, more still, to the high molecular weight of iodine, which, in spite of the small number of iodine atoms possibly retained in combination with the india-rubber, results in a very high percentage of halogen in the polyprene sulphide, which imparts to the vulcanised article properties that would render it unfit for commercial purposes. But, as is well known, the so-called cold-curing process is only one of two modes of using sulphur chloride for vulcanising purposes. Another process, shortly termed "vapour cure," and in which the article to be vulcanised is exposed to the vapour of chloride of sulphur, is much used for curing thin sheet-rubber or cut sheet-rubber and articles made from it, especially tobacco pouches. In many cases this "vapour cure" gives results much superior to the "cold cure," especially so if it is carried out in such a manner as to maintain a constant ratio between the volume of the vapour of chloride of sulphur and the volume of air the former is diffused in. For this reason, it may be worth while to inquire whether this "vapour process" might not with advantage be employed both with sulphur bromide and with sulphur iodide. I have made numerous experiments in this direction, but the results are in the highest degree unfavourable. In this there is indeed nothing to be surprised at, if we remember that sulphur monobromide, on distillation or evaporation in an air current, undergoes decomposition, a behaviour which is still more marked in the case of sulphur iodide. Consequently, we cannot get the undecomposed vapour of either the bromide or the iodide to act upon the india-rubber, but only an atmosphere containing in the one case almost exclusively free bromine and in the other nothing but free iodine.

The polyprene iodosulphide I described above, it is needless to remark, is not a definite compound, not even in the limited sense in which I called the before-described polyprene bromosulphide a definite compound. If we eliminate the iodine from the iodosulphide, by heating it with aniline, or better in this case with quinoline, we obtain a polyprene sulphide containing only 6·93 per cent. of sulphur, whereas the chlorosulphide and bromosulphide of polyprene yield a polyprene sulphide containing over 32 per cent. of sulphur, and exactly answering the formula $C_{10}H_{14}S$. Of course, this difference is due to the iodosulphide in the first instance being not an addition product of the same degree of saturation as either the chlorosulphide or the bromosulphide. The iodosulphide not being a definite compound, the polyprene sulphide resulting from it cannot be a definite compound either. But this, of course, does not mean that neither the iodosulphide nor its corresponding sulphide are bodies belonging to no definite class of chemical compounds. They must be considered as mixtures of two iodosulphides and two corresponding sulphides respectively, the constitution of which is exactly analogous to that of the normal chlorosulphide and its corresponding sulphide, though they may and no doubt do represent substitution products of a lower order than the last-named compounds. Similar indefinite compounds, but which indeed are mixtures of definite compounds in unknown proportions, are obtained on the bromination of citrene under certain conditions, when both a dibromide and a tetrabromide are obtained as a mixture, the analysis of which would lead to a quite irrational formula. In this case, however, we are in a position to separate this mixture into its components, which in the case of the iodosulphide and its sulphide we cannot do, owing to its insolubility in all solvents. For this reason, we can only obtain a definite compound by reaching the maximum point of saturation, as in the polyprene chlorosulphide $C_{10}H_{16}S_2Cl_2$. Intermixture of less-saturated compounds at once leads to apparently indefinite compounds, all the more so if, as in the case of the bromosulphide or the iodosulphide, complications through loss of halogen in the form of hydrogen haloid arise.

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* J. C. S. 1888.

† The solution contained in 200 c.c. 1·84 grms. of india-rubber and 14·6 grms. of sulphur.

This evolution of halogen haloid has, of course, nothing to do with the question as to whether vulcanisation with the sulphur haloids is an addition process pure and simple, as I contended all along, or a substitution process, as Burghardt, Fawsitt, and Terry held it to be. That polyprene is a highly unsaturated compound, has been amply proved by Gladstone and Hibbert (this Journal, 1888), so that before substitution could take place addition products of a degree of saturation would have been obtained containing quantities of halogen and sulphur four or five times in excess of what is aimed at in practical vulcanisation. The elimination of hydrogen haloid from our various compounds is no doubt the same process which results in the formation of Gladstone and Hibbert's polyprene pentabromide. Polyprene, as shown by these authors, contains three ethylene bonds for $C_{10}H_{16}$, and therefore should form an addition product $C_{10}H_{16}Br_6$, but the pentabromide $C_{10}H_{15}Br_5$ is obtained instead, not by substitution, but by the spontaneous breaking up of the addition product, whereby bromine, in the form of hydrobromic acid, is split off. This behaviour is very often observed in highly unsaturated hydrocarbons. The analogous decomposition of acetylene tetrabromide into tribromethylene $CHBr_2.CHBr_2 = CHBr : CBr_2 + HBr_2$ is a familiar instance.

Already the investigation of the action of sulphur chloride upon polyprene showed that the vulcanising action of that compound is a function of its sulphur only. This becomes even more plain in the case of sulphur bromide and sulphur iodide, where the halogen is so losely held that its percentage in the vulcanised compound is variable in the highest degree. But whether there be any halogen left in these compounds, or whether it be completely taken out of it, their state of vulcanisation is utterly unaffected thereby. It is therefore really the sulphur of the sulphur haloids and not their halogen, as Thomson contended, which causes their vulcanisation through conjugation of two or more molecules, a reaction which the monovalent halogens are incapable of. The very drawback, indeed, of the "cold vulcanising" process consists in the fact that the halogen, which in this case is only a means of obtaining sulphur in a form of high reactive energy, also takes part in the reaction forming an unavoidable and rather objectionable encumbrance of the vulcanised polyprene. Any process enabling us to take advantage of the readiness with which the halogen derivatives of sulphur produce vulcanisation, but which at the same time confines their action to the combination of the sulphur only with the polyprene, would mark an important progress in the vulcanisation of india-rubber goods, for it would mean the removal of the above unquestionable drawback of the "cold cure" and also do away with the comparatively high temperatures required for vulcanisation according to what is called the "dry heat cure" or "steam cure" process.

This might appear impossible, but it will be seen that it is not, if we remember how easily halogenated sulphides of polyprene lose their halogen, so that if vulcanisation with them was effected, instead of in the cold, as at present, at such temperatures at which the halogen is split off, only the sulphur would remain in combination with the polyprene. I admit at once that with sulphur mono-chloride such a process is scarcely feasible, for it would be almost impossible to employ it satisfactorily in solvents kept at the temperature at which the polyprene chlorosulphide loses its chlorine, *i.e.*, about 90° C. To mix pure sulphur chloride with the india-rubber is, of course, out of the question. Sulphur monobromide seems to lend itself much more favourably to such a process as it parts much more readily with its halogen. But even in this case the use of a hot vulcanising solution would be an unmitigated nuisance and also in this case mixing the rubber at the outset with pure sulphur bromide is not to be thought of. On the other hand I have already stated that the use of sulphur iodide in the "cold cure" process is impossible owing to the tardiness of the reaction and in hot solution, though greater activity is at first obtained, the compound is extremely unstable, iodine constantly escaping, so that in a short space of time only a solution of practically pure sulphur remains behind. However, owing to this chemical inertia of sulphur mono-iodide it is possible to incorporate it into india-rubber mixings in the dry state without the least perceptible action, and on subsequently raising the temperature to about 80° C., vulcanisation takes place with extraordinary rapidity.

In the production of india-rubber articles 6 per cent. of sulphur is a fair average amount of this vulcaniser to employ. Technically pure Parà rubber with this percentage of sulphur was rolled into sheets of about one-eighth of an inch in thickness. To fully vulcanise these sheets two hours' treatment at 130° C. was required. Another experiment was then made, mixing the india-rubber with 30 per cent. of sulphur mono-iodide which is the equivalent of the 6 per cent. of sulphur used in the first experiment. Already the mixing of this quantity of sulphur iodide with the india-rubber between the only gently-heated rollers proved a most unpleasant operation, clouds of iodine being given off. This mixture was also rolled into thin sheets and then placed in a vulcanising press at 130° C. During the first few minutes much iodine was given off, then after nine minutes' treatment a very violent reaction ensued, dense vapours of iodine bursting from between the press plates. On opening the press at this stage the sheet was found to be converted into a black treacly mass, which, on cooling did not set hard. This experiment was repeated but only 20 per cent. of sulphur iodide, equal to about 4 per cent. of sulphur, were mixed with the rubber. Also in this case large volumes of iodine vapour were given off between the mixing rollers. The sheet into which this mixture was finally rolled was cut into strips with which the following experiments were carried out.

One of the strips was placed in a stove at 90° C. Iodine was slowly given off and the mixing assumed a brownish-black coloration. After 30 minutes' heating the evolution of iodine ceased, but the india-rubber had not become vulcanised, indeed it had rather lost its elasticity. Prolonging the heating for two hours no further change was observable, but the rubber now possessed very little elasticity, its tackiness had entirely disappeared. It could easily be ground into a flaky mass, in which form it was analysed:—

| | | |
|---|---|---|
| Sulphur | Free | Trace. |
| | Combined : | 3·32 per Cent. |
| Iodine | Free | : None. |
| | Combined : | 10·94. |

A second strip of the above mixing was similarly treated at 115° C. After 30 minutes' heating all of a sudden a very violent reaction occurred, dense fumes of iodine, sulphur and an oily organic matter escaping. No hydroiodic acid was formed, but the very sticky black mass which remained behind, and which, after cooling, formed a brittle black resin, exhibited a distinct smell of sulphuretted hydrogen. It contained not a trace of iodine and very little sulphur only.

This shows that the vulcanising action of pure sulphur iodide at low temperatures leads to a polyprene iodosulphide containing a large percentage of iodine, which as I showed before, exerts a very detrimental influence upon vulcanised india-rubber, the elasticity of which it greatly diminishes. On the other hand, the second experiment seems to suggest that at temperatures slightly below those ordinarily employed in dry heat vulcanisation, no addition of iodine to the india-rubber takes place, no doubt owing to the instability of such an addition product at those temperatures. It appears therefore feasible that if a mixture of a small percentage of iodine with a comparatively large percentage of sulphur was employed, this small quantity of sulphur iodide might initiate the vulcanisation, the iodide being set free, which then in its turn would again combine with the free sulphur present and so on until the vulcanisation of the india-rubber is completed.

To test this idea 5 grms. of sulphur iodide were intimately mixed with 45 grms. of ordinary flowers of sulphur, and 8 grms. of this mixture were between mixing rollers incorporated into 92 grms. of pure Parà rubber. This mixture was again rolled into a sheet and vulcanised at 120° C. side by side with a mixture of 8 grms. of sulphur and 92 grms. of india-rubber. These two samples were then placed in a vulcanising press at 115° C. At this temperature the sample containing the sulphur iodide required two hours for complete vulcanisation, the sample containing sulphur only required nearly three hours. Even then there was a very noticeable difference between the two samples, the one vulcanised with sulphur iodide being rather better in point of elasticity and firmness. The analysis of these samples gave the following values :—

| | | I. | II. | III. |
|---|---|---|---|---|
| — | | Cured with Mixture of S and $S_2I_2$ (Two Hours). | Cured with free S, after Two Hours. | Cured with free S, after Three Hours. |
| | | Per Cent. | Per Cent. | Per Cent. |
| Sulphur | Free ............ | 5·13 | 6·11 | 5·64 |
| | Combined ...... | 2·72 | 1·79 | 2·17 |
| Iodine | Free ............ | 0·33* | .. | .. |
| | Combined ...... | 1·13 | .. | .. |

* Estimated by titration of the alcoholic extract of the ground ("crumbed") sample, with standard $Na_2S_2O_3$.

Comment on these figures is superfluous and there can be no doubt about the beneficial action of the small quantity of sulphur iodide, and which may be stated to consist both in a saving of time, as well as in a better vulcanised article.

From a general point of view it is interesting to note that simply in following up the observations made in the investigation of the action of the halogen derivatives of sulphur upon india-rubber, which constitutes what is usually called the "cold cure" process of vulcanising, the above experiments led quite unintentionally into the midst of what is described as the "dry heat cure" process of vulcanising. This is interesting as it seems to show that the generally supposed fundamental difference between these two processes does in fact not exist. In the one process as much as in the other the vulcanising action is a specific function of the sulphur, but while in the "cold cure" process the reactive energy of the sulphur is induced by chemical means, we produce it in the "dry heat cure" process by the disaggregating action of heat upon the complex molecules of sulphur. Sulphur iodide stands on the border line between the compounds vulcanising by chemical and those vulcanising by physical inducement. But this border line is not a separating line. The two vulcanising processes are firmly linked together by the above described behaviour of sulphur iodide against india-rubber. In the next paper, which is to conclude this series, I shall be able to show how the removal of this assumed difference between the two classes of vulcanising processes enables us to arrive at an explanation of the still rather mysterious "dry heat" vulcanising processes in which besides free sulphur a number of compounds of various description is used, the practical value of which is a matter of common knowledge, but the chemical action of which was never yet understood.

The above discussed action of sulphur iodide suggests some relation between it and another vulcanising compound patented some years ago by Mr. Fawsitt. This new vulcaniser has sometimes been stated to be antimony iodide, but this substance has no vulcanising action whatever without sulphur, and this fact renders the existence of a relation as suggested even more likely. Fawsitt's vulcaniser is a mixture of about 20 per cent. of crude antimony iodide with about 80 per cent. of sulphur, the latter containing a few per cent. of aniline. The purpose of the last named substance in this mixture I am not able to explain yet, but Mr. Fawsitt asserts its usefulness. But the action of the antimony iodide is a very simple one, and in conclusion I will shortly explain it.

Schneider† observed that antimony trisulphide reacts with molten antimony iodide to form a sulphiodide, SbSI. In treating this compound with excess of sulphur at 115° C. antimony trisulphide and sulphur iodide form, and this latter then acts, of course, exactly as we have seen before. This is the very simple explanation of the action of this vulcaniser. It is again a striking illustration of the artificiality of the chemical distinction drawn between the cold and hot vulcanising processes.

### Discussion.

Mr. Terry said that the paper, though very interesting as a contribution to the chemistry of india-rubber, could not be said to appeal so strongly to their Society as Dr. Weber's former paper, which dealt with chloride of sulphur. The latter was an article in regular use, while the advantages of bromine and iodine, or their compounds, had not yet, he thought, been sufficiently demonstrated to the manufacturer. He was not aware that Mr. Fawsitt had ever explained the *rationale* of the process associated with his name, but from what they had heard that night, it would appear that, even if the iodine had no great intrinsic value, yet its presence permitted the vulcanising action in the dry-heat cure to go on at a lower temperature than in the case of sulphur alone, and, of course, the lower the temperature at which this process went on, the better, both for the rubber and the cloth. He could not agree with Dr. Weber's preference for carbon bisulphide over hydrocarbons in the cold-cure process. He thought he had said before (but he would repeat), that the latter could be safely used for this purpose both with great advantage to the health of the workpeople and with freedom from fires. If, however, Dr. Weber only intended his remarks to apply to benzoline, a liquid he specially mentioned, in that case he would agree with him. He did not quite follow Dr. Weber's remarks as to physical *versus* chemical vulcanising processes, as he thought the gist of his paper was to overthrow the old physical theory, and to show that all vulcanising processes were strictly on chemical lines.

Dr. Weber, in reply, said he had had some doubt in his own mind as to whether a paper like the one read was a suitable paper to be brought before a society like this, and whether a purely scientific journal was not a better medium for its publication. But he asked them to take into account the very great difficulties which, at the outset, every investigator met in inquiring into the *rationale* of the chemical processes employed in the manufacture of india-rubber articles, difficulties which were essentially added to by the fact that the chemistry of india-rubber, as a whole, was, up to this day, almost entirely *terra incognita*, as reference to the latest editions of Watts' and Thorpe's dictionaries would readily show. For this reason points of no immediate practical bearing had often to be gone into before questions of direct practical interest could be satisfactorily investigated. But it would be found in the long run that the progress of india-rubber manufacture was no less served by the scientific elucidation of the properties of india-rubber from the purely chemical point of view, than by actual working formulæ. Mr. Terry seemed to have misunderstood the meaning in which he (Dr. Weber) used the terms "chemical" and "physical" in regard to vulcanisation. He (Dr. Weber) did not speak of chemical and physical vulcanisation, but of chemical and physical inducement towards vulcanisation. If we tried to vulcanise with sulphur, we had evidently to overcome some resistance or inertiæ before the sulphur would unite with the rubber. That resistance he considered to be the resistance of the very complex sulphur molecules to a disintegration into smaller molecules. But until a certain degree of disaggregation had been attained, the reaction or vulcanising energy of sulphur was evidently very low, or even nil. This disaggregation was produced by heat in the dry-vulcanising process, so that in this process vulcanisation could be said to be induced by physical means, although by itself it was a chemical reaction. On the other hand, in vulcanising with chloride of sulphur, that disaggregation of the complex sulphur molecule, which was at least $S_8$, into $S_2$, was obtained by chemical means, by combining sulphur with chlorine, to form $S_2Cl_2$. Therefore, in the cold-vulcanising process he spoke of vulcanisation being induced by chemical means. He had no doubt in his mind that the use of Fawsitt's vulcaniser, or of iodide of sulphur, offered considerable practical advantages, as vulcanisation was thereby effected at lower temperatures and in less time. The high temperatures which had to be employed for a prolonged time in vulcanising with sulphur by the old processes, were far from beneficial to the india-rubber. One other point he wished to refer to regarding the use of light benzoline as a solvent for chloride of sulphur in the cold-vulcanising process. His objection to that solvent was that it was a mixture of hydrocarbons boiling from about 22° C. to about 50° or 60° C. In using such a mixture they would find that as they went on working the light parts would fly off first, and then would follow the heavy-parts. This would lead to a constantly decreasing rate with which the solvent volatilises from the cured surfaces, and it also would mean that the heavier the residual solvent became, the more of the vulcanising solution would be distributed over a unit area of the fabric. All this meant that by using light benzolene, uniformity of vulcanisation was a practical impossibility. Moreover, the substitution of benzolene for carbon bisulphide offered scarcely an advantage from the sanitary point of view, as the inhalation of light benzoline had a most intoxicating effect upon the workmen; indeed, much more so than carbon bisulphide, although the symptoms accompanying it were of a rather milder tye.

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† Pogg. Ann. 110, 1 and 7.

Dr. Weber said he did not refer to benzoline boiling upwards of 50°C. If ordinary benzoline was distilled up to 50° or 60° C., it would be found that about 30 per cent. of the distillate boiled at from 18° to 30° C.

Mr. Terry: Then do you consider carbon bisulphide preferable to benzoline.

Dr. Weber: As a matter of boiling-points, I certainly do, but from the hygienic point of view, I hold the one to be as bad as the other.

At the close of the meeting, Dr. Weber exhibited the spectra of argon and nitrogen.

## Newcastle Section.

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*Hon. Local Secretary and Treasurer:*
Saville Shaw, Durham College of Science, Newcastle-on-Tyne.

The name in italics is that of a Member of Committee that retires at the end of the current session.

The following has been elected to fill the vacancy, and will take office in July next:—N. H. Martin.

*Meeting held at the Crown Hotel, Newcastle-on-Tyne, Thursday, April 25th, 1895.*

MR. GEO. T. FRANCE IN THE CHAIR.

## NOTE ON THE ESTIMATION OF PHOSPHORUS IN IRON AND IRON ORES CONTAINING TITANIUM.

BY J. PATTINSON, F.I.C., AND H. S. PATTINSON, PH.D., F.I.C.

Blair has pointed out that when an iron ore or iron containing phosphorus and titanium is digested with hydrochloric acid, a phospho-titanate of iron is formed which is insoluble in the acid, and consequently remains with the silica after evaporating the solution to dryness and redissolving in hydrochloric acid. In estimating the phosphorus in such kinds of iron or ore, it is therefore necessary to extract the phosphorus from the insoluble siliceous residue. This may be done by first expelling the silica by digestion with hydrofluoric acid, and then fusing the residue with sodium carbonate, and extracting the fused mass with water. The titanium remains insoluble in water as acid sodium titanate, and the phosphorus goes into solution as sodium phosphate.

The whole of the phosphorus and titanium, however, do not remain with the siliceous matter insoluble in hydrochloric acid, but only a portion of the total amounts present, the remainder passing into solution together with the other soluble constituents of the iron or ore; but we are not aware that it has as yet been noted that titanic acid, in solution with phosphoric acid, very materially interferes with the precipitation of phosphoric acid as ammonium phosphomolydate. Such, however, is the case, and to such an extent that, in highly titaniferous ores, only a mere trace of ammonium phosphomolybdate precipitate may be formed even when a considerable amount of phosphorous is actually present in the ore.

The following experiments which we have made with known quantities of titanic acid and phosphoric acid show very clearly the effect of titanic acid in solution in preventing the precipitation of ammonium phosphomolybdate. A solution of titanic acid of known strength was made by fusing a definite amount of titanic acid with sodium carbonate, dissolving the sodium titanate formed in hot dilute hydrochloric acid, and making up to a definite volume with distilled water. Measured quantities of this solution were then mixed with measured quantities of a solution of di-sodium phosphate of known strength, and after adding ferric chloride in excess of the amount required to combine with the phosphoric acid as ferric phosphate, we threw down the mixed precipitate of ferric hydrate, ferric phosphate, and titanic acid with calcium carbonate or with ammonia. The precipitate, after slight washing, was dissolved on the filter in hot dilute nitric acid, and the phosphoric acid precipitated by ammonium molybdate. The volume and the temperature of the liquid at which the precipitation was made was varied. In one series of experiments the volume of liquid was about 70 c.c., and in another series from 40 to 50 c.c. In some cases the temperature was 85° C., and in others the liquid was brought to the boiling point before the ammonium molybdate solution was added. In the following table we have stated the quantities of phosphoric acid taken in terms of the corresponding weights of ammonium-phosphomolybdate, and we have given the weights of ammonium phosphomolybdate precipitates found after drying at 100° C.:—

| Volume of Liquid. | Temperature of Liquid. | Weight of am-phos-molybdate equivalent to Phosphoric Acid taken. | Weight of Titanic Acid in Solution. | Weight of Molybdate precipitate formed. |
|---|---|---|---|---|
| | | Grm. | Grm. | |
| About 70 c.c. | 85° C. | 0·122 | 0·114 | No precipitate. |
| ” | ” | ” | 0·016 | Trace. |
| ” | ” | ” | 0·008 | 0·071 grm. |
| About 40 c.c. | ” | 0·140 | 0·016 | 0·103 ” |
| ” | ” | ” | 0·008 | 0·118 ” |
| About 70 c.c. | Boiling point about 107°.) | 0·122 | 0·016 | 0·088 ” |
| ” | ” | ” | 0·008 | 0·110 ” |
| About 40 c.c. | ” | 0·140 | 0·016 | 0·118 ” |
| ” | ” | ” | 0·008 | 0·122 ” |

It will be seen that in every case there was a very appreciable deficiency in the weight of precipitate found even when only 0·008 grm. of titanic acid was present in the solution, and that from a volume of about 70 c.c. of solution, at a temperature of 85° C. only a trace of molybdate precipitate was formed when 0·016 grm. of titanic acid was present. It will be also seen that rather more precipitate forms when the liquid is more concentrated and the precipitation made at the boiling point. Under these last conditions it is however often very difficult to obtain the precipitate free from intermixture with molybdic acid, especially if the quantity of iron in the solution is small. The presence of about 1 grm. of iron as ferric nitrate will, in most cases, prevent the separation of molybdic acid, but it is nevertheless much safer to precipitate ammonium phospho-molybdate at a temperature not exceeding 85° C.

It is evident, from these results, that in estimating the phosphorus in iron and iron ores containing titanium it is not only necessary to eliminate the titanium from the portion insoluble in hydrochloric acid, but also from the portion soluble in this acid. This may be done by a method which is often employed when titanium is also to be determined, viz., by reducing the solution of iron to the ferrous state and then separating the phosphorus from the bulk of the iron by precipitation as ferric phosphate, with which all the titanium in solution also comes down, and then fusing this precipitate with sodium carbonate. In order to completely decompose the ferric phosphate, the residue, after extracting the first fusion with water, has to be again fused, and sometimes even a third fusion is necessary. Mr. J. E. Stead of Middlesbro', to whom we had pointed out the effect of titanic acid in solution, and who has confirmed the results we have arrived at has told us of a very useful modification of this tedious process which he has devised, and which he gives us permission to communicate in this note. After reducing the iron in the solution of the ore or metal to the ferrous state, he adds enough alum to combine with all the phosphoric acid, and then he precipitates aluminium phosphate instead of ferric phosphate. The advantage of this is that aluminium phosphate readily dissolves in fused sodium carbonate and the fused mass is completely soluble in water. If titanic acid be present, all the alumina and phosphoric acid pass into solution in water, whilst insoluble acid sodium titanate remains. As a rule one fusion suffices to separate all the phosphoric acid from the titanic acid.

# DETERMINATION OF ARSENIC IN IRON ORES AND IN STEEL AND PIG-IRON.

BY J. E. STEAD.

Of all the methods for separating arsenic from iron solutions, the process of distilling with hydrochloric acid and ferrous chloride takes the first position.

It has been the general practice I believe to precipitate the arsenic as sulphide with hydric sulphide from the distillate and either weigh the pure sulphide after drying at 212° F., or to oxidise it with bromine and hydrochloric acid and then precipitate the arsenic acid with ammonia and magnesia solution and weigh the precipitate produced. This process, although accurate if carefully done, is rather tedious, and takes at least 24 hours to complete.

After many trials and experiments I have found that if the distillation is conducted in a special manner the whole of the arsenic may be obtained in the distillate unaccompanied with any trace of chloride of iron, and that if the hydrochloric acid is nearly neutralised with ammonia, and finally completely neutralised with acid carbonate of soda, the arsenic can be determined volumetrically with a standard solution of iodine, using starch solution as an indicator.

The process of distillation with ferrous chloride and titration of the distillate with iodine solution was, I believe, first proposed by Emil Fischer, but as the description of the method given in Crookes' Select Methods of Chemical Analysis contained only the general principles on which it was worked, I found it necessary to work out the details in my own laboratory, and I think when the elaborated method has been thoroughly explained, it will be admitted that a more simple and accurate device for the determination of small quantities of arsenic it will be impossible to conceive.

## Standard Solutions.

### *Arsenious Oxide.*

To prepare this solution, weigh off 0·66 grm. (0·5 grm. metallic arsenic) of pure arsenious acid in fine powder, and place it in a flask and add 1 grm. of acid carbonate of soda and 200 c.c. boiling distilled water, and boil the liquid till all the arsenious oxide has dissolved. Cool and add 2 grms. more of the carbonate, and dilute to 1 litre.

1,000 c.c. = 0·5 grm. arsenic.
1 c.c. = 0·0005 ”

### *Iodine Solution.*

Dissolve 1·693 grm. pure iodine in 5 grms. of potassium iodide and dilute the solution to 1 litre and standardise it by titrating 20 c.c. of the arsenious solution. If the iodine has been pure 20 c.c. of the solution should be required to just produce a permanent blue coloration of iodide of starch.

1,000 c.c. of this solution = 0·5 grm. arsenic.
1 c.c. ” = 0·0005 ”

These solutions keep fairly well without alteration for several months. It is advisable, however, to periodically ascertain the value of the iodine by titrating 20 or 30 c.c. of the arsenic solution.

### *Starch Solution.*

This is prepared by thoroughly well boiling 1 grm. of potato starch with half a litre of water, and after cooling the solution, the clear liquid is decanted off and the sediment rejected.

### *In Steel.*

From 1 to 50 grms. of the steel in drillings are introduced into a 32-oz. flask, and a sufficient quantity of equal parts of strong hydrochloric acid and water is added to dissolve it. Into the mouth of the flask an india-rubber cork carrying a safety-tube and a tube to convey the gas evolved into a Winkler's gas absorption tube containing a strong saturated solution of bromine in water, or a solution of sulphate of silver as recommended by Dr. Clark of Glasgow.

This tube is filled to one-third of its length with the solution, and about $\frac{1}{2}$ c.c. of free bromine (which I prefer instead of silver sulphate) is run in to replace the bromine which is consumed or carried out with the passing gas.

The contents of the flask are now gently heated to such a degree that a steady but not rapid current of gas passes through the bromine solution.

In about one hour the whole of the steel will be dissolved, and when no more evolution of hydrogen can be observed the liquid in the flask is well boiled so as to completely drive all the gas into and through the bromine solution. It is advisable to connect the outlet of the Winkler tube, a smaller tube, containing potash selution, to absorb the bromine which otherwise would pass into the laboratory.

The absorption tube is now disconnected, and the bromine solution containing that part of the arsenic which has passed off as $AsH_3$ is rinsed out together with the contents of the potash tube into a 100 c.c. beaker, acidulated with hydrochloric acid, and the excess of bromine is gently boiled off, and the clear colourless solution is poured into the flask containing the steel solution.

If silver sulphate is used instead of bromine the solution is treated with hydrochloric acid to separate the silver, and the liquid is filtered directly into the flask containing the iron solution.

If there are not many samples to test, it is advisable to place the whole of this solution into a retort and to distill nearly to dryness, then to add 20 c.c. hydrochloric acid, and proceed exactly as described below. If there are many samples it is more rapid to separate as sulphide, and for this purpose about half a grm. of zinc sulphide is now dropped into the iron solution, and the contents are violently shaken for about three minutes, by which time the whole of the arsenic will be in the insoluble state, partly as sulphide and partly as a black precipitate consisting of free arsenic and arsenide of iron.

It has been found that violent agitation for a few minutes is quite as efficaceous in effecting the complete separation of arsenic sulphide as by the older methods of passing a current of carbonic acid through the solution to remove the excess of hydric sulphide, or by allowing it to stand 10 or 20 hours to settle out.

The insoluble precipitate is now rapidly filtered through a smooth filter paper and the flask is rinsed with cold distilled water.

The precipitate does not usually adhere to the filter, and in such cases the paper is spread out flat upon a porcelain slab and the arsenic compounds are rinsed off with a fine jet of hot water into a small beaker. The precipitate is now dissolved in bromine water and a drop or two of hydrochloric acid. If the precipitate should happen to stick pernaceously to the filter it is dissolved off with bromine water to remove all traces of arsenic.

If the filter is smooth and the precipitate coagulated into small masses as it almost invariably is, it never adheres to the paper, and is readily washed off.

The bromine solution now containing all the arsenic is gently boiled to expel the bromine, and it is then poured into a 20 ounce retort, and is distilled with ferrous chloride and hydrochloric acid.

The apparatus I use consists of an ordinary Liebig's condenser, but the retort has its tubulure bent to an angle of about 150°, and this is attached to the condenser by an india-rubber connection.

The object of bending the tube of the retort is to enable it to be placed at such an angle so that the greater part of the tubulure when in position may incline in the direction of the bulb of the retort leaving in this way an extended space where any chloride of iron which is always mechanically carried off with the acid vapours, may condense and run back. By gently distilling by this device the distillate will never contain more than the very slightest trace of iron.

The solution containing the arsenic having been run into, the retort, the beaker is washed out, and the washings are also poured in. If the solution is much above 30 c.c. in bulk it is advisable to add a strong solution of ferrous chloride containing about half a grm. of iron in the ferrous state, and for this purpose nothing answers so well as a portion of the steel solution remaining after separating the arsenic, which is first well boiled to free it from hydric sulphide, and should contain about 10 per cent. of soluble iron as ferrous chloride. 5 c.c. of this solution will contain the necessary amount of iron to add to the retort. After adding the chloride it is best to boil down the solution to about 20 c.c. before adding any hydrochloric acid, taking care, of course, to collect what liquid distils over. When the necessary concentration has been effected, 20 c.c. strong hydrochloric acid is run in, and the distillation is continued till all excepting about 10 c.c. has passed over. A further quantity of 20 c.c. mixed with 5 c.c. of water is run in, and this is all distilled over. At this point, as a rule, all the arsenic will have passed into the distillate, but it is advisable to make quite certain, and to add a third portion of hydrochloric acid and water and to distil it over.

If the distillation has not been forced, the distillate will be quite colourless.

The arsenic in the distillate will exist as arsenious chloride accompanied with a large excess of hydrochloric acid.

A drop of litmus is put into this solution, and strong ammonia liquor is run in till an alkaline reaction is indicated. It is now made slightly acid with a few drops of hydrochloric acid, and a slight excess of solid acid carbonate of soda is dropped in. The contents of the flask are now cooled by a stream of water from the tap, and, after adding a perfectly clear solution of soluble starch, the standard iodine is run in from a burette till a deep permanent blue coloration is produced.

If the steel or iron contains much arsenic, a smaller quantity, say 1 or 2 grms. may be dissolved in nitric acid of 1·20 sp. gr., and the solution be evaporated to dryness, the residue being dissolved in hydrochloric acid and the solution be transferred to the retort and be distilled directly with ferrous chloride and hydrochloric acid, care being taken that the distillation is not forced or some of the iron solution will pass over into the distillate.

### *Pig-Iron.*

In testing pig-irons they may be dissolved in nitric-acid and evaporated to dryness, or be treated in a flask with hydrochloric acid, exactly in the manner described above, but it is advisable to distill the whole of the ferrous solution and not separate the arsenic as sulphide.

### *Iron Ores.*

In testing ores it is only necessary to place the ore directly into the retort and distil at once with hydrochloric acid and ferrous chloride, taking care to place a few pieces of fire-brick also in the vessel to avoid the "jumping" of the liquid.

If the ore contains much peroxide of manganese it is advisable to dissolve it in a separate vessel to liberate and expel the chlorine, and then to transfer it into the retort.

The time taken to test iron or steel need not exceed 2 hrs. and for iron or other ores not much more than half an hour.

It is quite possible to accurately determine as small a quantity as 0·002 per cent. arsenic by this method.

When dissolving steels in dilute hydrochloric acid, if there is no rust on the sample or ferric chloride present in the hydroclorie acid, and the presence of air is carefully avoided, as a rule only about one-tenth of the total arsenic present passes off with the gas.

When solution is effected entirely in the cold, a very much less quantity is evolved, and a very slight amount passes into the solution. As an example an alloy containing 4·125 per cent. arsenic dissolved in dilute hydrochloric acid in the cold gave the following results :—

| | Per Cent. |
|---|---|
| Evolved as gas | 0·035 |
| Found in the solution | 0·125 |
| Remaining insoluble as a dense black residue | 3·965 |
| | 4·125 |

The volumetric method described by Mr. E. Platten at a meeting of the London Section of the Society, April 16, 1894, gives equally accurate results with the above.

This method depends on the fact that sulphide of arsenic on being boiled for a sufficient length of time with pure water, decomposes into sulphuretted hydrogen, which passes off, and arsenious oxide, and the solution after complete decomposition has been effected is then titrated with the iodine solution.

A large number of samples of steel tested independently by two different manipulators, myself in Middlesbrough and Mr. Harbord in London, one using the Emil Fischer, and the other Platten's method, gave results confirming each other most exactly.

The only objection to the Platten method is that the time required to completely decompose the sulphide of arsenic sometimes amounts to 6 or 8 hours.

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## Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

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*Vice-Chairman : C. Spackman.*
*Committee :*

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J. F. Kempson.
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J. O'Sullivan.
*S. J. Pentecost.*
C. Taylor.
G. J. Ward.

*Treasurer : J. T. Wood.*
*Hon. Local Secretary :*
*R. L. Whiteley,* University College, Nottingham.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next :—*Chairman :*—F. J. R. Carulla. *Vice-Chairman :*—J. M. C. Paton. *Treasurer :*—S. J. Pentecost. *Secretary :*—J. T. Wood. *Committee :*—W. G. Johnston, and R. Lloyd Whiteley.

*Meeting held at University College, Nottingham,*
*on Wednesday, April 24th, 1895.*

MR. J. M. C. PATON IN THE CHAIR.

## NOTE ON VARIATIONS IN DETERMINATIONS OF OIL IN LINSEED CAKE.

BY JOHN M. C. PATON, MEMB. INST. MECH. ENG.

In the ordinary course of his business it occasionally becomes necessary for the mechanical engineer to refer to the analytical chemist for information as to the exact constituents of some of the materials employed in the manufacture of ordinary machinery, and also of some of the products of that machinery. It may sometimes be of importance to know the full analysis of a sample, while for other purposes it is sufficient to ascertain the percentage of some one element or component only. A full analysis may give the proportions of some eight or ten ingredients in figures running into three or four places of decimals, the whole adding up to exactly 100, and not the one thousandth of 1 per cent. more or less. Whether the amount of only one compound is asked for or a full analysis is given, the figures are usually accepted as beyond question, a result no doubt flattering to the chemist. Occasionally, however, one's confidence in the absolute accuracy of such analyses receives a somewhat rude shock, and the present note is intended to show what very serious discrepancies may sometimes arise between the returns of different observers.

Some months ago the writer's firm were called upon to design and construct a set of seed crushing and oil extracting apparatus on a scale much smaller than usual. The plant was destined for a place where the oil was valuable, but the cake, or residue, was practically a waste product. Very small sets of this class of machinery usually extract less oil than is the case when large plants are employed, and the main object in the present case was to so proportion the crushing and expressing power as to put the same pressure per square inch on the crushed meal as is put on in large mills, and so ensure the same degree of extraction of oil and dryness of cake.

The general appearance of a small plant of this character is indicated in these photographs, which were taken in the workshop. It will be seen the whole set of machinery is mounted on one foundation plate, and a belt on the main pulley supplies the driving power for the whole. The seed is placed in a feed hopper and gradually fed into the crushing rolls. These rolls are placed one directly over the other and the seed is guided so as to pass alternately between them. As the upper rolls rest on the lower ones the crushing is heavier at each succeeding nip or passage. The seed falls from the rolls in the form of meal, with the husk broken up and the oil cells bruised and broken open. This meal is placed in the steam-heated kettle which is fitted with a mechanical stirrer, and also with a valve to admit steam among the meal. This heating and steaming renders the oil in the cells more fluid than it is when cold. The hot meal is measured out from a slide in the kettle bottom, each measurefull being placed under the hand-press where the pile is reduced in thickness sufficiently to let it pass in between the horizontal plates of the hydraulic press. So soon as the press is full, the pump is set to work, and the oil pressed out. The press is then opened, the cake removed, and fresh meal takes its place. The round operation is performed in 20 minutes, or three times per hour.

This plant was set to work and fully tested in the workshops. The hydraulic pressure was about 3,500 lbs. per square inch, putting a total of 135,000 lbs. on the ram, or approximately 2,000 lbs. per square inch on the cake.

Although the plant was not ordered for crushing linseed yet that material was considered most satisfactory for test purposes, and was of course easy to obtain.

A sufficient quantity of linseed was sent in from the warehouse of a firm af seed crushers. It was not specially selected, but simply taken from the bulk at that time passing through in the ordinary way of business. The plant was set to work and kept going for several days, with results which were to all appearance satisfactory. It was expected the cake would contain substantially less than 10 per cent. of oil. To ascertain the exact percentage, samples were sent out for examination, and it is to the results of these analyses I wish to draw attention. The only question asked of the analysts was the percentage of oil in each sample.

In the table there are 10 columns, numbered 1 to 10, and over each column will be found a letter indicating which analyst supplied the figures.

The first column gives figures which resulted from an ordinary observation. The same analyst afterwards made another investigation with the result given in column 2. After a suggestion that these results were open to question, fresh determinations gave column 3. To check these figures, duplicate samples were sent to a well-known firm in another town, who reported as shown in column 4.

The remark that mechanical pressure had extracted more oil than the report showed the seed to contain, elicited the fact, that owing to pressure of work caused by illness of members of their own staff, the samples had been sent on to another laboratory for examination, with the result as given. The firm who signed and sent in the report were of course, much annoyed, and, to put the result beyond question, they made two separate and independent examinations in the most careful manner, see columns 5 and 6.

With a view to the writing of this note, after an interval of more than two months, another piece was cut off the same two cakes; each of these pieces was cut in half, and one pair of samples sent on to Messrs. C., without special remark or reference to what had previously been done. The other halves of the specimens were sent also without remark to Messrs. D., a firm of repute in a town over 150 miles from Messrs. C. Messrs. C.'s report is given in column 7, and Messrs. D.'s in column 8.

| —— | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |
|---|---|---|---|---|---|---|---|---|---|---|
| | $A_1$. | $A_2$. | $A_3$. | B. | $C_1$. | $C_2$. | $C_3$. | $D_1$. | $D_2$. | $D_3$. |
| Linseed cake. Meal from 4 rolls | 5·90 | .. | 10·1 | 11·98 | 12·06 | 12·21 | 12·00 | 10·36 | 12·36 | 12·08 |
| | | | | | 12·13 mean. | | | | 12·22 mean. | |
| „ „ „ 3 „ | 7·06 | .. | 10·8 | 11·56 | 11·82 | 11·93 | 11·46 | 10·52 | 11·29 | 11·63 |
| | | | | | 11·87 mean. | | | | 11·46 mean. | |
| Linseed meal .................... | .. | 30·2 | .. | .. | .. | .. | .. | .. | .. | .. |
| „ Uncrushed ............. | 18·5 | 28·48 | .. | 17·92 | 34·60 | 34·78 | .. | .. | .. | .. |
| | | | | | 34·69 | | | | | |
| Cottonseed. Uncrushed........ | .. | 24·64 | .. | 22·94 | 22·52 | 22·48 | .. | .. | .. | .. |
| | | | | | 22·5 | | | | | |
| „ cake .............. | 6·4 | .. | .. | 6·28 | .. | .. | .. | .. | .. | .. |

Now, taking the whole seed, it is somewhat surprising to find two different observers, unknown to each other, reporting the oil at 17 per cent. and 18 per cent. respectively. Had there been nothing further done, it would have been fair to assume one observation had approximately checked the other, the figures would have been accepted as correct; and it would have been thought the sample of seed was abnormally poor in oil, and of exceedingly low value. Fortunately, the "mechanical analysis" by pressure, had proved the seed to contain more oil than was reported, and further investigation was made, with the results shown in the table.

The meal, being simply the crushed seed, without any extraction of oil, ought to show the same oil as the seed, yet a careful observer reports diffierent figures. See column 2 and line 3.

The mill was worked for a time with the seed passing three rolls only, instead of the full set of four, all other conditions remaining the same. The natural result from a less perfect bruising of the seed is a lower extraction of oil, and a higher percentage of oil left in the cake. Line 1 is cake made with four rolls, and line 2 gives figures from cake made of meal from three rolls only. The figures in columns 1, 3, and 8, show more oil in the three roll cake which was just what was expected. In the other columns, the figures show an exactly opposite result, and one which is somewhat difficult to account for. The final analyses in columns 7 and 8, show in one case more oil in the cake from the three roll meal, and in the other case just the opposite. It is curious to note the unexpected result of less oil in the three roll cake, consistently appears in each analysis from Messrs. C., and also in the B column, the latter passing through Messrs. C.'s office, although the work of other observers. Both A and D in colunms 1 and 8, show the 4 roll meal to contian less oil.

(Before reading the above note, Messrs. D. had been asked to make a more careful determination, but the result was not received in time for the meeting. The figures are now given in columns 9 and 10. They agree with column 7.)

In addition to the linseed, a quantity of cotton-seed was also crushed. The general treatment and pressures were exactly as for the linseed. The results of analyses are given in lines 5 and 6, and do not vary to anything like the same extent as the linseed figures.

Assuming the general correctness of the results given, it is not easy to see why similar treatment and pressure should give so much better an extraction in the case of the cotton-seed. It is also not clear why the reports of oil in the cotton-seed and cake should show so little difference, when the same observers, presumably using the same methods, give such different results when working on linseed.

I can say very little about the methods used in the different laboratories, but Mr. A. has kindly given me a note of his work, and this reads as follows:—

"Two samples of oil-cake (linseed) were submitted for the total determination of oil: below is the method used in both cases:—

"The cake was powdered in an iron mortar, 10 grms. were accurately weighed out and packed in a percolator, which had a small piece of asbestos fibre for a bottom, previously washed with ether. Dry ether was then passed through the percolator into a tared flask, until a drop evaporated on a watch-glass gave no indication of the presence of oil; it was thus concluded that all oil had been dissolved out by the ether, and that the exhaustion of the cake was complete.

"The flask containing the ether and oil dissolved in it was connected up in the ordinary way with a Liebig's condenser and the ether recovered by distillation. The tared flask with the oil was placed in a water-oven heated to about 95° to 98° C. for one hour and a half, it was then cooled and weighed. Upon further treating for half an hour, and again cooling and weighing, there was no appreciable difference.

"Linseed cake marked △
Flask and oil = 39·284
Flask = 38·578
0·706 × 10 = 7·06 per cent.

"Linseed cake marked ☐
Flask and oil = 49·128
Flask = 48·538
0·590 × 10 = 5·90 per cent.

"These results were forwarded, but after some little time had elapsed it was suggested that some mistake might have been made, as different analyses had been obtained. The samples of cake, which had fortunately been left in the percolators, were then treated with more ether, this cake on examination as before, by evaporation on the watch-glass, was found to leave a residue of oil, proving that the first quantity of ether had failed to extract the whole of the oil.

"Further experiments were then conducted upon the two samples, but instead of attempting to powder the cake it was this time ground in a coffee mill, and high results were obtained as below—

"Cake marked △ = 10·8
" " □ = 10·1

"I put these latter results down to the fact that all the seeds were in a more perfect state of division, and consequently the ether was brought into contact with all the oil which was present."

Apparently a correct determination of oil in linseed can only be made by taking the greatest possible care that every particle is well broken up, and the oil cells bruised and crushed so as to ensure the full and complete action of the solvent. General methods appear to vary very little, but great differences exist in the degree of care given to the preliminary operation, with consequent differences in the reports.

It would perhaps have been better if complete analyses had been made of both seed and cake, but as the percentage of oil remaining in the cake was the principal point on which information was required, nothing further was asked for.

The cakes would at first contain some moisture, and, as they were kept on an ordinary office shelf, no doubt the later examinations might be expected to show a slightly higher percentage of oil in consequence. Columns 7 and 8 were determined two months after the others, yet they both show less oil. Column 7, being by Messrs. C., is probably the outcome of careful work, owing possibly to their recollection of the annoyance caused by the inaccuracy of column 4. Column 8 is apparently as correct as one may expect to get such figures in the ordinary course of business.

Apparently the oil has to be well exposed to the solvent, and it must not be expected the ether will go in and seek for oil to any great extent.

If the greatest care is not taken to thoroughly grind up the sample for analysis, there may possibly be, in that particular sample, several whole seeds which have escaped crushing by the machine rolls, and as such seeds would scarcely be acted on in the least degree by the solvent, it is evident the resulting figures may be very seriously affected.

As perfect bruising of the seed seems necessary for the full extraction of the oil by solvents, it may also fairly be presumed (it is indeed quite well known) that the more perfectly the seed is crushed, the more perfectly will the oil be expressed by hydraulic pressure; yet several careful analyses show opposite results, although these results are not confirmed by others, who give just a contrary report.

Possibly some of you may consider it unnecessary to bring forward with so much prominence such an elementary and well understood matter as the need for using great care when preparing linseed for the action of the solvent, but the various figures given above appear to be a sufficient reason for believing a word of caution is not wholly unnecessary.

The differences in the figures are more than sufficient to raise serious questions between the maker and the purchaser of machinery to express oil from seeds, and from a business point of view the varying reports have been a source of trouble and perplexity to the writer. If his experience is a fair sample of what usually happens, he thinks the subject is of sufficient importance to merit further investigation at the hands of the members of this Society, and this is his reason for bringing it forward to-night.

## Discussion.

Mr. Golding, speaking as an agricultural analyst, said that some of the figures appeared to be very inaccurate, which he accounted for by supposing that the analysts were not used to the work. Any firm or any analyst who accepted a cubic inch of cake for analysis would not be worthy of the name of an agricultural analyst, and it would not be safe to depend upon his results. It was essential in commercial analyses of oil cake of any kind that the cake should be thoroughly well ground, and there were proper mills for the purpose, which ought to be in every laboratory where this work was done. Some of the figures mentioned by Mr. Paton were not so bad. In commercial analyses of this kind where they were concerned with cake, some parts of which necessarily contained more oil than other parts, the sampling must be done very thoroughly indeed, and even then they would not get absolute results. They might get first place decimals pretty accurately, but no agricultural analyst would attempt to get second and third and fourth decimals in an ordinary analysis of cake. A coffee mill was not a bad substitute for a cake mill, but an analysis of this kind should certainly be sent to a laboratory properly equipped.

Mr. Meggitt, referring to the difference in the results obtained by crushing between three rolls and four rolls, said it was found that in crushing between three rolls less oil was obtained than in crushing with four rolls, so if the samples were not reground less oil would be extracted by ether from the three-roller meal, than from the four-roller meal, by reason of the three-roller meal being coarser.

Mr. Coleman said many analysts used different methods for extracting oil, but though in such cases they must expect a discrepancy there ought not to be so great a difference in the amount obtained. The different results obtained showed how essential it was to have a standard method, officially recognised, as is done in the Agricultural Department, U.S.A.

Mr. Whiteley said that an analyst would easily obtain an incorrect result where petroleum ether was used to extract oil unless he was particular to get an ether that readily vaporised below 100°. Many samples did not do this, and without such care he could not expect to obtain correct results.

Prof. Clowes called attention to the fact that there was an interval of many weeks between some of the analyses, and that meanwhile the cake had been kept on the shelf. The effect of that would be to dry the cake, and therefore to increase the percentage weight of the oil in the portions weighed of for analysis. Therefore the actual percentage obtained from the cake which had been stored on the shelf ought to have been greater than that found in the fresh samples. This was true in some cases mentioned by the chairman, but the difference ought certainly not to be so great as it was—almost double.

The Chairman said he would not reply at all from a chemists point of view, but would leave the chemist to take care of himself. The firms referred to as C. and D. were of the highest standing. It has been suggested the chemist ought to be told beforehand what the analysis was wanted for, but this was surely not necessary in cases like the present where the engineer merely wants to know what oil is in the cake, so that if there is too much he could make a stronger machine to press more out. The analyses appeared to show less oil left in the worst meal which was quite contrary to expectation. Some doubt had been thrown on the sampling, but this was not a question of getting a correct average over a large quantity, but merely an analysis of a particular piece of cake. The samples in columns seven and eight were adjacent pieces of the same cake, being in fact a sample piece cut in halves. One half was sent to C. and the other half to D. by the same post, and both reports came back by the same post. The sampling could scarcely be at fault in this case, yet the reports were quite different. Columns five and six would no doubt be taken with considerable care, and might probably be accepted as correct, but the unexpected difference between the three-roll and four-roll cake caused a suspicion at first. In conclusion he said that as an engineer making no claim to a knowledge of analytical chemistry he had to trust to returns sent in by competent firms, and when they varied as much as the figures he had quoted he thought there was obvious need for improvement somewhere.

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*Meeting held at the Midland Hotel, Derby, on Wednesday, May 22nd, 1895.*

MR. J. M. C. PATON IN THE CHAIR.

Mr. J. T. Wood said :—

The following paper appeared in the "Centralblatt für Bakteriologie" for January 30th and February 6th, 1895.

My object in translating it and bringing it before this Society, with the permission of Dr. Herfeldt, is to afford some aid to those who are investigating the action of dung as used in the manufacture of leather, and who may not have access to the original.

It is certain that before anything can be done to introduce an efficient substitute for such an unpleasant material, without trusting to mere chance, a proper understanding is necessary both of the constituents of the dung and of the fermentations and decompositions taking place in it, and of the products of these fermentations.

Although the paper is written as a contribution to agricultural chemistry, it will also be useful from the point of view I have mentioned. Not the least valuable part of the paper is the list of references with which it concludes.

## THE BACTERIA OF STABLE MANURE, AND THEIR ACTION.

COMPREHENSIVE SUMMARY BY DR. E. HERFELDT, BONN.

STABLE manure consists, as is well known, of a mixture of the excrements of animals employed in agriculture, with straw and other materials.

The excrements consist of the intestinal secretions (fæces), and the secretions of the kidneys, the urine. The intestinal secretions contain the undigested and indigestible remainder of the fodder, and a part of the digestive fluids, such as bile, pancreatic juice, &c., mixed with worn-out portions of the mucous membrane of the intestines.

Through the urine the final products of the decomposition of nitrogenous substances, a portion of the absorbed salts, and the surplus water, are removed from the body. The other materials consist of portions of plants, as straw, turf, reeds, leaves, twigs, &c.

The decompositions which the dung undergoes, partly in the stable, but chiefly on the manure heap, and finally on the land, are not only simple putrefactive processes, but include also fermentations of a very various nature, caused almost exclusively by the vital activity of an enormous number of different species of bacteria.

In the alteration which the dung undergoes we find—

1. The decomposition of albumins and albuminoids ;
2. The fermentation of urea, the decomposition of tyrosin, leucin, and other similar nitrogenous bodies ; and
3. The fermentation of carbohydrates, organic acids, and their salts.

These decompositions and fermentations may be considered in the following order :—

*a.* The fermentation of the fatty acids ;

*b.* The fermentations of the amido compounds ;

*c.* Putrefactive fermentation ;

*d.* Ammoniacal or urea fermentation ;

*e.* Sulphuretted hydrogen fermentation ;

*f.* Cellulose or methane fermentation ; and

*g.* The fermentation of carbohydrates.

### (*a.*) *The Fermentation of the Fatty Acids.*

The most important facts as yet known may be grouped together as follows :—

The fermentability of the acids is, as a rule, best in the form of the calcium salts (see table).

| No. | Fermenting Substance. | Cause of Fermentation. | Fermentation Products. | Authors. |
|---|---|---|---|---|
| 1 | Calcium formate .... | Bacteria from sewer slime. | *Calcium carbonate, $CO_2$ and H* ........................ | Hoppe-Seyler, Archiv. f. d. g. Physiol. XII. |
| 2 | Calcium acetate...... | " " | *Calcium carbonate, $CO_2$ and $CH_4$* ........................ | .. .. |
| 3 | Calcium lactate ...... Undergoes four different fermentations. | Thin bacillus ........<br>Other species of bacteria: short aerobic, butyric bacteria (Fitz). | 1. *Propionic acid*, and, as by-products, *acetic acid, succinic acid*, and *alcohol*.<br>2. *Propionic acid* and *valerianic acid*.<br>3. *Butyric acid* and *propionic acid*.<br>4. *Butyric acid*, according to Pasteur, Comptes rend. 1861. | Fitz, nine papers in the "Berichte der Deutsch. Chem. Gesellschaft," 1876—1884. |
| 4 | Calcium malate ...... | Bacteria (not described), Thin bacilli.<br>Bacteria ............ | 1. Chief product, *propionic acid* ; and as by-product, *acetic acid*.<br>2. Chief product, *succinic acid* ; and as by-product, some *acetic acid*.<br>3. *Butyric acid and H.*<br>4. *Lactic acid and $CO_2$.* | Schützenberger, "Fermentation," 1876. |
| 5 | Calcium tartrate ..... | Different species of bacteria. | 1. Chief product, *propionic acid* ; by-product, *acetic acid*.<br>2. *Butyric acid*.<br>3. Chief product, *calcium acetate* ; by-products, *ethyl alcohol, butyric* and *succinic acids*. | .. .. |
| 6 | Calcium citrate...... | Small, thin bacilli.... | *Acetic acid* in large quantities, along with small quantities of *ethyl alcohol* and *succinic acid*. | Fitz. |
| 7 | Calcium glycerate.... | Micrococci ..........<br>Medium sized bacilli . | 1. *Calcium acetate*, along with small quantities of *succinic acid* and *ethyl alcohol*.<br>2. *Formic acid*, with some *methyl alcohol* and *acetic acid* | .. .. |

### (*b.*) *The Fermentation of the Amido-Compounds.*

Amido-acids and other amido-compounds are formed in the dung from the plant stuffs and animal waste products, and also from the splitting up of the albumins by putrefactive fermentation. To these belong tyrosin, leucin, glutaminic acid, glutamine, asparagine, glycocol, &c. At present research has been confined chiefly to leucin and tyrosin.

The fermentation products of leucin are valerianic acid, ammonia, carbonic anhydride, and hydrogen.

Tyrosin is formed in considerable quantities at the beginning of putrefactive fermentation, but is soon further decomposed, and, according to Nencki (1), when air is excluded, indol, carbonic anhydride, and hydrogen are formed.

In the presence of air, occur, according to Baumann (2), successively, hydro-para-cumaric acid, paraoxyphenylacetic acid, paracresol, phenol, and by the splitting off of carbonic anhydride, water and ammonia.

According to others, hydrophenylacrylic acid is also formed, and, according to Fitz (3), by the action of *Bacillus putrificus coli*, paraoxybenzoic acid, and from this phenol.

### (c.) *Putrefactive Fermentation.*

Putrefactive fermentation is the rapid and intense decomposition of albuminous bodies, through the vital activity of certain definite species of bacteria, with the formation of evil-smelling gaseous products. A whole series of bacteria take part in the decomposition of such materials as albumin, peptone, and albuminoids, and therefore the kind of decomposition is varied, undergoing variations dependent on the species of bacteria, the kind of fermentive material, and external conditions.

In general this fermentation takes place in the following manner: first of all the action of the bacteria changes the albumins into peptones, *i.e.* into a soluble form. The peptones are then split up, amido-derivatives of the fatty acid series (chiefly amido-acids such as leucin, tyrosin, &c.) being formed from the albumin molecule, as well as nitrogenous bodies of the aromatic series, and perhaps a peptone-like residue.

The amido-acids quickly split up into fatty acids and ammonia. The fatty acids are then decomposed (see *a*). The course of the putrefactive fermentation and the fermentation products are considerably different according to the external conditions, the chief of which are presence or absence of air.

In the first case energetic oxidations take place, whereby the simplest compounds are formed, such as water, carbonic anhydride, and ammonia, whilst the characteristic putrefaction products are not observed. This kind of fermentation is called mouldering (Verwesung).

When the fermentation, however, takes place in absence of air, extensive reduction processes set in. Oxy-acids become changed into fatty acids, and methane, hydrogen, sulphide, and hydrogen are formed. This fermentation process is considered as true putrefaction (Fäulniss).

A number of species of bacteria is now known, which unusually take part in putrefactive fermentation, and to a certain extent also the products of pure cultures of these from the albumin molecule, viz.:—*Bacillus saprogenes I., II., and III. Bacillus coprogenus fœtidus, Bacillus pyogenes fœtidus.* The composition of the evil-smelling gases given off by these is not known.

*Bacillus ureæ, Bacillus prodigiosus*, and *Bacillus fluorescens putridus* evolve trimethylamine during putrefaction.

*Bacillus pyocyaneus* and *Bacillus janthinus* form peptone and ammonia, while the ordinary putrefactive bacteria, as *Proteus vulgaris, Proteus mirabilis*, and *Proteus zenkeri* produce peptones and stinking gases.

The products of the decomposition of the albumin molecule, by *Bacillus putrificus coli, Bacillus fluorescens liquefaciens*, and *Bacillus butyricus* (Hueppe) are more exactly known.

In the putrefactive fermentation caused by Bacillus putrificus coli, according to the researches of Bienstock (4), occur as products of the decomposition of albumin, peptone, ammonia, amine bases, amido fatty acids, fatty acids, tyrosin, phenol, paraoxyphenylpropionic acid, paraoxybenzoic acid, indol, and skatol.

*Bacillus fluorescens liquefaciens* produces chiefly peptone, volatile fatty acids, and a grey colouring matter; on the other hand, *Bacillus butyricus* (Hueppe) gives peptone, leucin, tyrosin, ammonia, and bitter-tasting stuffs. Nencki (5) found in the decomposition of serum albumin through the anaerobic species *Bacillus magnus, Bacillus spinosus, Bacillus liquefaciens*, and the Clostridium of symptomatic anthrax, the gases hydrogen and methylmercaptan, the whole series of volatile fatty acids up to and including caproic acid, then leucin, and phenylpropionic acid, skatol-acetic acid, and oxyphenylpropionic acid. According to the same investigator gelatine yields by decomposition, neither tyrosin nor indol and skatol, but benzoic acid.

The faculty of bacteria to induce superficial or profounder decompositions of albumin, appears from our present knowledge to vary greatly. Any general equation expressing putrefactive decompositions is out of the question.

Very extensive decomposition of the albumin molecule by one and the same species of bacteria (*e.g.*, through *Bacillus coli* after Bienstock) is best explained in this way, viz.:—that the albumin molecule is merely peptonised by the respective bacteria with subsequent splitting off of amido compounds and formation of ammonia by splitting off of hydrogen, and that all further decompositions are to be considered as due to reductions and oxidations brought about by the nascent hydrogen.

We must also take into consideration the fact that putrefaction in absence of oxygen (Fäulniss) proceeds in quite a different way, as when oxygen has free access. (Verwesung) see above.

In stable manure, dung drainings, middens, &c., both these processes go on at once.

The aerobic bacteria first use up all the oxygen in the interior of the fermenting material, and hydrogen, carbonic anhydride and methane take its place; at this point the anaerobic bacteria take up the work, and evil-smelling gases are given off in considerable quantity.

The anaerobic bacteria are principally concerned in the proper decomposition of dung, as the aerobic bacteria cause too great a decomposition, and the valuable constituents of the dung escape in a gaseous form.

Th. Schlösing (6) endeavoured to ascertain in the methane fermentation of stable manure, by which in absence of air, carbonic anhydride and free hydrogen are formed along with the methane, whether free nitrogen is given off, and he came to the conclusion that it was not.

Organic nitrogenous bodies are not formed from the ammonia existing in the fresh material; on the contrary, the nitrogen in the complicated organic compounds is changed into ammonia. The organic substance loses more carbon than oxygen, and the amount of hydrogen remains almost unaltered. The water present takes part in the decomposition and yields up its elements, oxygen and hydrogen, to the carbon of the organic substances.

Th. Schlösing, father and son (7), have published further studies of the fermentation of stable manure. They were able to prove energetic combustion in presence of air, combined with great activity of aerobic bacteria, vigorous evolution of $CO_2$, and considerable rise of temperature.

When access of air was prevented, the anaerobic bacteria caused evolution of methane, hydrogen, and carbonic anhydride, with a far smaller rise of temperature. With free access of air the temperature may rise so high that microbic activity ceases, and pure chemical combustion takes its place. This change is not, however, a sudden one, but both phenomena run their course simultaneously. Schlösing son, endeavoured to establish by experiment what share these two factors had in the decomposition of the dung at different temperatures, *i.e.*, on the one hand, the activity of the microbes, on the other, chemical combustion. He found that at 66° in presence of air, aerobic bacteria produced 17 times more $CO_2$ than was produced by a sterile dung under exactly similar conditions. At 73° fermentation was still clearly shown, but at 79°·5 the microbes were killed. In a similar manner this investigator established that methane fermentation in absence of air ceased at 66°; and further, that at 52° the evolution of gases containing carbon, and in this connection the decomposition of organic substances, is far greater when microbes are present than in sterilised dung; and further, that the pure chemical action is greater at 66° than at 52°. In no case did the quantity of $CO_2$ given off, reach to anything like the height as in aerobic fermentation.

### (*d.*) *The Ammoniacal or Urea Fermentation.*

The ammoniacal fermentation is also known as urea fermentation, since the greater part of the ammonia is produced from the urea contained in the urine. The urea is split up by the direct vital action of bacteria into ammonium carbonate and ammonium carbamate.

Pasteur (8) and Van Tieghem (9) were the first who succeeded in isolating cocci (probably identical species) which possessed the property of setting up urea fermentation in fresh sterilised urine. They named these cocci *Micrococcus ureæ.* They are 0·8 to 1·0 μ in diameter, often in the form of diplococci or tetrads, sometimes in chains.

Later (1879), Miquel (10) showed that certain rod-shaped bacteria, and even moulds, were able to cause energetic ammoniacal fermentations. Miquel gave a description of his *Bacillus duclauxii* or *Bac. ureæ β.* Six years later Leube (11) named a similar bacillus *Bacterium ureæ*, and described as well a coccus which caused an energetic decomposition of urea, and two other baccilli with weaker hydrating power. *Bacterium ureæ* develops plump rods with rounded ends, at most 2 μ long and 1 μ wide. One of the two last-mentioned bacilli forms thick oval rods 1·2—1·5 μ long and 0·7—0·8 μ wide; the other, thick rods with square ends 1·2—1·4 μ long, 0·6 μ wide.

Flügge (12) finally succeeded in isolating from decomposed urine a coccus which caused energetic urea fermentation, and which is distinguished from *Micrococcus ureæ* by its property of liquefying nutrient gelatine, which the latter does not possess. Flügge calls the new coccus *Micrococcus ureæ liquefaciens.*

### (*e.*) *Sulphuretted Hydrogen Fermentation.*

In putrefactive fermentation, sulphuretted hydrogen production is frequently set up by bacteria. Miller (13) isolated from the intestines a bacillus which caused evolution of sulphuretted hydrogen and ammonia in the decomposition of albumins. Holschevnikoff (14) described two sulphuretted-hydrogen-forming bacteria, one cultivated from water, which he called *Proteus sulphureus;* the other, which he isolated from the slime of the Wiesbaden sewage beds, he named *Bacterium sulphureum.*

Balistreri (15) found amongst 35 bacteria which he examined, 18 which produced sulphuretted hydrogen. The evolution of sulphuretted hydrogen by the bacteria, according to the author, is not due to the presence of oxygen, but to certain additional circumstances not yet investigated.

### (*f.*) *The Cellulose Fermentation.*

Déhérain and Gayon first showed that the solution and fermentation of cellulose in the form of dead vegetable matter, which had previously been observed, also took place in dung. It also occurs in the ground, the conditions being a certain degree of heat, moisture, and a sufficient quantity of the cellulose material. After Mitscherlich (16) established, in 1850, that cellulose can be dissolved by fermentation, and expressed the opinion that this was due to vibrios, Van Tieghem (17) arrived at the result that the solution of cellulose is caused by micro-organisms, whose properties correspond with the bacteria described by him as *Amylobacter.*

Tappeiner (18) found later that cellulose fermentation can also be caused by the bacteria of the first and second stomachs and of the large intestines of ruminants. Tappeiner considers that there are two kinds of this fermentation. In the first, which was set up in pure cellulose (in the form of pure cotton-wool or paper-pulp suspended in neutral 1 per cent. meat-extract solution), by bacteria from the intestines of oxen, carbonic anhydride and methane were formed, and $H_2S$, aldehyde, butyric acid, and acetic acid were recognisable in small quantities. In the second kind of fem600entation, set up by the same bacteria in alkaline meat-extract solution, the principal products were carbonic anhydride and hydrogen, along with the same by-products as the first.

These researches, although not conducted with pure cultures, are valuable as showing that the intestinal bacteria of oxen can excite cellulose fermentation, and that these bacteria, escaping with the dung, are able to carry on the fermentation in it.

According to Hoppe-Seyler (19), who was able in some degree to characterise the bacteria causing evolution of $CO_2$ and $CH_4$ from cellulose, there is no difference between these and the bacteria Van Tieghem calls amylobacter. Hoppe-Seyler found only traces of soluble matter along with the known fermentation products, so that the action can only be explained by considering that first a sugar-like carbohydrate is formed by addition of water, and that this is then split up into equal volumes of $CO_2$ and $CH_4$. Hoppe-Seyler was able to set up cellulose fermentation with mud and soil from fields, meadows, and woods.

Schlösing (20) was able to produce a rapid cellulose fermentation in stable manure at a temperature of 42° to 52° C., as soon as all air was pumped out of the fermentation flasks and dung.

Van Senus (21), in his researches on cellulose fermentation, arrived at partly new results; he describes a pure cultivation of the *Bacillus amylobacter;* it has a length of 2—10 μ, mostly 5—7 μ and 0·8—1 μ wide; forms measuring as much as 13 μ occur in strongly fermenting liquids.

Spore formation only occurs in presence of air; under other conditions it is hindered, and the mobility of the organism also ceases.

*Bacillus amylobacter* grows in gelatine 1½—3 cm. below the surface; in an atmosphere of hydrogen in grows also on the surface.

Van Senus considers, on the ground of his researches, that the common assertion that *B. amylobacter* is the cellulose ferment is considerably weakened, as the organism under no circumstances attacks cellulose suspended in meat extract solution; it attacks it, however, under symbiotic conditions with another verysmall bacterium isolated from the intestines of rabbits; at the same time each organism by itself is without action on cellulose.

The author considers the cellulose fermentation to be anaerobic; hydrogen, carbonic anhydride, acetic acid, and perhaps butyric acid being first produced. The acetic acid is then reduced by the hydrogen successively to aldehyde, alcohol, ether, and methane, so that in media poor in other bodies, acetic acid and hydrogen are entirely consumed—an explanation of how Hoppe-Seyler found cellulose fermented to equal parts of carbonic anhydride and methane.

Van Senus has also isolated a ferment which dissolves cellulose, and finally he describes a number of bacteria, some of them new ones, which he isolated from mud, stomach contents, and putrefying leaves; these are *Clostridium, butyricum, Bacillus tenuis, fibrosus, actinobolus, liquefaciens magnus, perforator, multiformis, ruminicola, flavus, augescens, erraticus, iriodes, fluo bacillus* (*Bacillus fluorescens*) and *albus.*

As a rule he always found *Clostridium butyricum* associated with the cellulose fermentation, along with anaerobic, and a few aerobic bacteria.

### (*g.*) *The Fermentation of other Carbohydrates.*

Besides cellulose, other carbohydrates occur in dung, principally starch, different sugars, and gums, which are fermented by bacteria. From the starch, sugars are formed, the final products of the fermentation being carbon dioxide and water. The middle fermentation is occupied by lactic or butyric fermentation, the former being set up by the *Bacillus acidi paralactici* or by other lactic cocci or bacilli of which a large number exist. In this fermentation the sugar is changed into lactic acid, while $CO_2$ is given off. Butyric ferementation is also induced by a large number of bacteria, partly aerobic and partly anaerobic. Among the most widely distributed of these may be mentioned *Clostridium butyricum, Bacillus butyricus* of Prazmowski and Hueppe, and butyric-acid-producing bacteria of Liborius and Fitz. In butyric fermentation, the most favourable temperature for which is 40°, carbon dioxide and hydrogen are formed in large quantities, besides the butyric acid.

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The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* N. Farrant, A. Hess, and Geo. Ward.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

*Meeting held Monday, May 6th, 1895.*

MR. C. F. TETLEY IN THE CHAIR.

## ON THE MORDANTING OF WOOL WITH CHROMIUM.—PART V.

BY J. J. HUMMEL AND WALTER M. GARDNER.

In the earlier papers dealing with this subject* the results have been given of experiments in which wool was mordanted by boiling the fibre with a solution of bichromate of potash either alone or with the addition of certain assistants, *e.g.*, sulphuric, oxalic, or tartaric acid, cream of tartar, &c. Incidentally reference was made (see this Journal 1893, 246) to some experiments in which it was attempted to reduce, already in the mordanting bath, the bichromate of potash to a chromic oxide salt by making additions of glucose or alcohol, with the object of obtaining a green mordanted wool suitable for dyeing with colours which are sensitive to oxidation.

Although negative results have always been obtained in this manner, we have allowed each year one student to carry out two or three experiments dealing with the point in order to demonstrate the fact. In accordance with this custom, in the autumn of 1892, Dr. W. H. Cavallo made the experiment of mordanting wool with bichromate of potash and alcohol, with sufficient acid to liberate chromic acid. The acid previously used in this experiment had invariably been $H_2SO_4$, but on this occasion HCl was employed. As usual, no reducing action was effected, owing no doubt to the dilution of the bath, but this time it was seen that the wool had acquired a brownish-yellow tint somewhat deeper than is usually obtained when mordanting with chromic acid alone. This observation being corroborated, we were thus prompted to institute a systematic series of experiments to determine the cause of the unexpected result.

Parallel experiments were first made in which patterns were mordanted with 3 per cent. bichromate of potash with addition of increasing amounts of hydrochloric acid, with and without alcohol; and from the appearance of the two series of mordanted patterns, as well as that of the waste mordant liquors, it was evident that the presence of alcohol, as already observed, did aid reduction of the chromium chromate on the fibre, but only to a slight extent. A similar experiment in which glucose was employed showed the same result, neither addition causing a greater fixation of mordant.

The effect originally noticed was therefore really due to the hydrochloric acid employed.

### *Comparison of the Action of Sulphuric, Hydro-chloric, and other Acids, when used with Bichromate of Potash Mordant.*

It thus appeared that there must be some difference between the effect of hydrochloric and sulphuric acids when employed as assistants with bichromate of potash; and this point was first investigated.

It is well to note that some of the experiments in which sulphuric acid is the assistant employed, are similar to those already described in Part I. (this Journal, 1893, 244, 245), but it was absolutely necessary to repeat them, so that the parallel experiments with hydrochloric and sulphuric acids might be carried out under exactly similar conditions. Any differences in the results obtained with sulphuric acid, previously and now, are entirely due to the different conditions observed, *e.g.*, duration of the boiling, quality of the wool, &c.

*Experiment* 1.—A series of six wool patterns was mordanted with 3 per cent. $K_2Cr_2O_7$ (1 mol.), with the addition of 0, 0·5, 1, 1·5, 2, 3 mols. of $H_2SO_4$. The mordanted patterns varied in colour from a drab-white in No. 1 to a pale olive-yellow in No. 4, after which from No. 4 to No. 6 the colour became distinctly greener. The waste mordant liquor of No. 1 had a pale greenish-yellow which gradually became slightly paler towards No. 6. The addition of sulphuric acid up to 1·5 mols. results therefore in an increased fixation of mordant, from which point, with larger proportions of acid the amount of reduction increases.

*Experiment No.* 2 was of a similar character to No. 1, but larger variations in the amount or sulphuric acid were employed, 3 per cent. $K_2Cr_2O_7$ being used with 1·5, 3, 4·5, 6, 7·5, 9 mols. $H_2SO_4$. No further information was here obtained, the addition of 1·5 mols. $H_2SO_4$ again giving the maximum fixation, while with 3 mols. partial reduction of the chromic acid occurred and with increased amounts of acid the amount of reduction was somewhat greater.

*Experiment* 3.—In this trial, amounts of hydrochloric acid equivalent to the sulphuric acid in Experiment 1 were employed. The appearance of patterns Nos. 1, 2, and 3 was similar to that of the corresponding Nos. of Experiment 1. A very remarkable difference, however, was shown in patterns Nos. 4, 5, and 6, which here had a pronounced olive-yellow colour. In accordance with this gradual increase in colour of the mordanted patterns, there was a corresponding decrease in the colour of the waste mordant liquors, in which, from No. 4 to 6, the colour was much paler than in the corresponding waste liquors of the previous experiment; indeed, Nos. 5 and 6 mordant baths with 4·5 and 6 mols. HCl were almost entirely exhausted. A continuation of this experiment, using larger amounts of hydrochloric acid (6–16 mols.), showed that 6 mols. sufficed for the fixation of the chromium chromate, and that larger amounts merely caused a further slight reduction; but even with 16 mols. the reduction was far from complete when 3 per cent. bichromate was employed.

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* Liechti and Hummel. This Journal, vol. 12, March and April 1893; vol. 13, March and April 1894.

*Experiments* 4 *and* 5.—The corresponding experiments with nitric acid indicated that the use of this acid gives a result very similar to that obtained with hydrochloric acid; the mordanted patterns showed the same deep olive-yellow colour and the waste liquors were equally well exhausted. The amount of $HNO_3$ necessary to give the maximum amount of fixation of mordant was indeed somewhat less than in the case of HCl, 4 to 5 mols. only being required. Excess of $HNO_3$ appeared also to induce a somewhat greater degree of reduction of the chromium chromate than excess of HCl.

In *Experiments* 6 *and* 7 the effect of using acetic acid as assistant was determined; the trials being exactly comparable with those already described. The examination of the waste mordant liquors showed that although the bath was more exhausted than with the use of bichromate alone, much less mordant was fixed than in the case of the addition of any of the mineral acids; the greenish-drab colour of the mordanted patterns indicated that partial reduction of the chromic acid to chromium chromate had taken place.

A comparison of the foregoing results shows that there is a very distinct difference in the behaviour of the various mineral acids when used as assistants along with bichromate of potash in the mordanting of wool. The employment of hydrochloric or nitric acid in suitable proportion causes a remarkable increase in the amount of chromium taken up by the fibre, so that it is even possible, when using small amounts of bichromate, to completely exhaust the mordanting bath. When using either of these acids as assistant, much more mordant is fixed than with sulphuric acid, excess of any of them, especially of $H_2SO_4$, tending slightly to aid reduction. The chromium under normal conditions appears to be fixed as a chromium-chromate, judging from the olive colour of the mordanted wool, and from the fact that by boiling with sodium carbonate, green mordanted wool remains.

*Experiment* 8.—Four sets of experiments were now made in which various amounts of bichromate of potash were used, each with varying proportions of hydrochloric acid, thus:—

(*a.*) 1 per cent. $K_2Cr_2O_7$ + 0, 3, 6, 9, 12, 18 mols. HCl.
(*b.*) 2 „ „ + 0, 3, 6, 9, 12, 18 „
(*c.*) 4 „ „ + 0, 2, 3, 4, 5, 6 „
(*d.*) 4 „ „ + 6, 8, 10, 12, 14, 16 „

In series (*a*) the colour of the mordanted patterns varied from very pale buff or cream in No. 1, through pale drab, to pale green in Nos. 5 and 6. The waste mordant liquors were pale greenish-yellow in No. 1, becoming paler towards No. 3, and absolutely colourless in Nos. 4, 5, and 6. From this it would appear that with 1 per cent. $K_2Cr_2O_7$ the addition of 9 mols. HCl (3·48 per cent. HCl, 32° Tw.) completely exhausts the mordant bath, and that larger amounts of HCl effect reduction, which, with the small amount of $K_2Cr_2O_7$ here used, is practically complete with 18 mols. HCl. Later experiments have shown that the amount of acid necessary for exhaustion of the mordant bath is considerably influenced by secondary influences subsequently referred to.

In series (*b*), No. 3 pattern exhibited after mordanting, a full olive-yellow colour, which became somewhat greener from Nos. 4 to 6. The baths Nos. 4—6 were exhausted.

In series (*c* and *d*), which belong together, 4 mols. HCl produced a deep olive-yellow-coloured pattern, the shade being again rendered greener by excess of HCl. In this series the mordant bath was in no case exhausted, but the colour of the solution became much paler, being reduced from a deep yellow in (1*c*) to a pale greenish yellow in (6*d*). When mordanting with 4 per cent. $K_2Cr_2O_7$, therefore, the bath is not entirely exhausted.

*Experiments* 3 *and* 8 show that the proportion of HCl which is necessary for the maximum fixation of mordant, varies somewhat with the amount of $K_2Cr_2O_7$ employed; and the results may be tabulated as follows:—

| Amount of $K_2Cr_2O_7$ employed. | Proportion of HCl 32° Tw. giving Maximum Fixation. | Appearance of Bath. |
|---|---|---|
| 1 per cent. (1 mol.) | 3·48 per cent. (9 mols.). | Quite exhausted. |
| 2 „ „ | 4·64—6·96 per cent. (6—9 mols.) | „ „ |
| 3 „ „ | 6·96 per cent. (6 mols.). | Almost exhausted. |
| 4 „ „ | 6·15—9·28 per cent. (4—6 mols.) | Bath cannot be exhausted even by 16 mols. HCl. |

It is therefore possible, when using not more than 2·5 to 3 per cent. bichromate of potash, to quite exhaust the mordant bath by adding HCl in proper proportion, a result which has not hitherto been attained so completely by other means. It will probably never be necessary to mordant with more than 3 per cent. bichromate of potash if hydrochloric acid is added to exhaust the bath, as a rule only 1 per cent. will be needed; but experiment shows that even when using 4 per cent. bichromate with hydrochloric acid, a comparatively small amount of chromium remains in the waste liquors; a rough estimation indicated that the residual chromium did not exceed one-eighth, and was probably nearer one-tenth, of the amount originally employed.

Although the point did not arise until a later stage of the work, it is convenient here to note that subsequent experiments showed that the proportion of hydrochloric acid necessary to effect complete fixation of the mordant varied somewhat with different qualities of wool, the effect being quite independent of any adventitious impurities, such as alkali, remaining from the scouring, &c. Thus, as seen in the above table, 1 per cent. bichromate of potash (1 mol.) required 3·48 per cent. HCl, 32° Tw. (9 mols.), in order to completely exhaust the bath when using the woollen cloth with which most of the experiments were made, but with another (finer) quality of wool, 6 mols. only were necessary, as stated below. The extent of the reduction of the bichromate which occurs, is also largely influenced by the character of the wool, as well as by the length of time during which the boiling is continued.

Since it is possible to conduct the mordanting process in such a manner that the whole of the chromium employed is fixed upon the wool, it became important to ascertain the effect of the various acids when a small amount of bichromate was used. With this object a series of experiments were made in which 1 per cent. $K_2Cr_2O_7$ instead of 3 per cent. was used in conjunction with various amounts respectively of HCl, $HNO_3$, $H_2SO_4$, and acetic acid. In all cases the mordant baths were raised to the boiling point in the course of 30 minutes and boiled for one hour, the time in which the baths were exhausted being noted in each case. With hydrochloric acid, 6 mols. were found, under the conditions of the experiment, to be the minimum amount which produced absolute exhaustion of the bath, although with 5 and even 4 mols. the very pale colour of the liquor indicated that a mere trace of mordant remained unfixed. Even with 6 mols. HCl very considerable reduction of the chromium chromate occurred, which larger amounts rendered more complete.

In the course of this experiment it was noticed that the solutions containing the larger amounts of acid became more quickly decolourised. With 9 mols. HCl, for instance, fixation of the mordant was absolutely complete after only

10 minutes' boiling; with 8 mols. after 15 minutes', with 7 mols. after 20 minutes', and even with 6 mols. at the end of only 30 minutes' boiling. The mordanting process, with full fixation of the chromium upon the fibre, may therefore be completed in 1 hour or less, instead of the 1½ or 2 hours usually employed, and in which complete fixation is far from being attained.

The corresponding trial with nitric acid gave the result that with 6 mols. the bath was absolutely colourless after 30 minutes' boiling, but even after boiling for 60 minutes with 4 mols. this amount did not suffice to remove the last traces of chromic acid from the bath, although reduction of the chromium chromate upon the fibre appeared to be practically complete at the end of 30 minutes' boiling.

With sulphuric acid, again, the bath appeared to be quite exhausted by boiling for 50 minutes with 4 mols.; larger proportions of this acid (5, 6, and 7 mols.) also exhaust the mordant bath more quickly, viz., in 45, 40, and 35 minutes respectively.

At first sight it would thus appear that equally good results are obtained with all three mineral acids when small amounts of bichromate are employed; but a careful examination of the respective waste mordant liquors showed that, although when using 4 mols. $H_2SO_4$ the exhaustion of the bath appeared complete, it really contained a notable amount of chromium in the reduced condition. On subsequently dyeing the patterns mordanted with bichromate of potash, with addition of hydrochloric, nitric, and sulphuric acids respectively, the superior result in the case of the two former was very marked, the $K_2Cr_2O_7$ and $H_2SO_4$ mordant giving much paler shades.

In practice a considerable economy is effected by using the same mordant baths, suitably replenished, for several operations; and since, when mordanting with suitable amounts of bichromate and hydrochloric acid, the whole of the chromium was extracted from the bath, it seemed important to determine how much hydrochloric acid remained. With this view an experiment was made in which patterns were mordanted with amounts of bichromate of potash varying from 1 to 4 per cent., using in each case the best proportion of hydrochloric acid as determined in previous experiments.

An estimation of the acidity of the waste mordant liquors indicated that in all cases the amount of free acid left in the bath was practically *nil*, amounting to less than 1 per cent. of the acid originally used; this was so, even when 4 per cent. $K_2Cr_2O_7$ (1 mol.) + 9·12 per cent. HCl, 32° (6 mols.), was used as mordant. A considerable amount of ammonium chloride was, however, always found in the waste liquors. (Compare Part III.; this Journal, March 1894, 225.)

A further experiment was then made, in which four pieces of wool (each 10 grms.) were mordanted one after the other in the same liquor; adding at first, and before each subsequent operation, 2 per cent. $K_2Cr_2O_7$ (1 mol.) and 6·86 per cent. HCl, 32° Tw. (9 mols.). After the last mordanting operation, the waste liquors were found to contain no chromium, and only a mere trace of free acid; but, as observed before, a noticeable amount of ammonium chloride was present. In practice, therefore, the same mordant bath may be used several times, with the certainty of obtaining at each operation an identical result.

*Experiment* 9.—A series of patterns was mordanted with various amounts of bichromate of potash and sulphuric acid, and dyed with 15 per cent. logwood.

$K_2Cr_2O_7$....... 1·0, 1·5, 2, 2·5, 3, 4 per cent. (1 mols.)
$H_2SO_4$, 168° Tw., 0·5, 0·75, 1, 1·25, 1·5, 2 per cent. (1½ mol.)

The appearance of the mordanted patterns varied from pale buff (No. 1), to full olive-yellow (No. 6), the waste liquors varying from pale greenish-yellow to deep yellow. In the dyed patterns, the intensity of the dark blue colour obtained increased from No. 1 to No. 3, and then gradually decreased, No. 6 being a pale greyish-blue. The appearance of the corresponding waste dye-liquors was as follows: No. 1 a deep crimson-red, showing, therefore, the presence of free colouring matter; from No. 1 to No. 4 the colour gradually changed to a brownish-olive, while Nos. 5 and 6 were greenish-olive and greyish-blue.

These appearances indicate that with 15 per cent. logwood the maximum amount of colouring matter is fixed by the use of 2 to 2·5 per cent. $K_2Cr_2O_7$ + 1 to 1·5 per cent. $H_2SO_4$. With larger amounts of mordant the dyed colour is paler, "over-chroming" being very apparent with 4 per cent. $K_2Cr_2O_7$ + 2 per cent. $H_2SO_4$.

*Experiment* 10.—A similar series of patterns was mordanted with the use of equivalent amounts of hydrochloric acid replacing the sulphuric acid in Experiment 4, and afterwards dyed with logwood. In this case the maximum depth of colour was obtained with the use of a smaller amount of bichromate of potash (1·5 per cent.), the condition of over-chroming being already evident with 3 per cent., and highly developed with 4 per cent.

*Experiment* 11.—An experiment was now made using pure chromium trioxide as mordant, in amounts equivalent to the bichromate employed in the two previous trials, viz.: 0·68, 1·02, 1·36, 1·70, 2·04, 2·72 per cent., and the patterns were subsequently dyed with 15 per cent. logwood. An examination of the waste mordant-liquors showed that even with the smallest amount of chromic acid employed, the bath was not nearly exhausted, and that with the larger amounts the depth of colour increased in proportion. All the liquors were more highly coloured than those of the previous corresponding experiments in which bichromate of potash was employed along with sulphuric or hydrochloric acid. With respect to the dyed patterns the maximum depth of colour was obtained with 1·02 per cent. chromium trioxide, and over-chroming was very evident with 1·7—2 per cent., and highly developed with 2·72 per cent.

It is an extremely interesting fact that one cannot obtain by the use of sulphuric acid and sodium chloride in any proportions, a result similar to that produced by hydrochloric acid. It appears from our experiments, indeed, that the addition of NaCl along with $H_2SO_4$ has absolutely no effect, sulphuric acid alone, giving precisely the same result.

With regard to the amount of bichromate of potash which should be employed when used in conjunction with hydrochloric acid, it has frequently been stated that when mordanting with 3 per cent. $K_2Cr_2O_7$ alone, about one-third of the amount or 1 per cent. is actually fixed upon the wool.* If sulphuric acid is added in amount sufficient to liberate chromic acid a somewhat larger amount of mordant, 1·5 per cent. to 1·75 per cent., is fixed. The exhaustion of the mordant bath is no doubt, in all cases, influenced by the character of the wool, duration of process, &c.; but experiments made annually by our students show the above to be a fair approximation.

In Experiments Nos. 32*a*, 32*b*, 32*c*, patterns were mordanted respectively with—

(*a*.) 3 per cent. $K_2Cr_2O_7$.
(*b*.) 2 per cent. ,, + 0·66 per cent. $H_2SO_4$ (1 mol.).
(*c*.) 1 per cent. ,, + 3·48 per cent. HCl., 32° Tw. (9 mols.).

and dyed with madder, fustic, logwood, alizarin, alizarin cyanin, and anthracene brown. Comparison of the mordanted patterns showed that greater reduction had taken place in (*c*) than in (*a* and *b*), and the dyed patterns of (*c*) were also fuller as well as brighter than those of either (*a*) or (*b*), with the single exception of those dyed with anthracene brown, which gave a slightly fuller shade with $K_2Cr_2O_7$ and $H_2SO_4$ mordant.

### *Experiments to Determine the Cause of the Peculiar Action of Hydrochloric Acid.*

It seemed evident from the result of the foregoing experiments that the action of hydrochloric acid as an assistant in conjunction with bichromate of potash must be due to some special reaction occurring between the hydrochloric acid and the liberated chromic acid.

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* Knecht and Ward, Jour. Soc. Dyers and Colourists, 5., p. 184 (1889). Lodge, same Journal 8, p. 60 (1882).

It is well known that when chromium trioxide is heated with hydrochloric acid, chlorine is liberated. We are also acquainted with such compounds as chromium oxychloride (chromyl chloride), $CrO_2.Cl_2$, and chloro-chromic acid $HCrO_3.Cl$.

The first of these compounds is obtained by distilling a fused mixture of NaCl, $K_2Cr_2O_7$, and $H_2SO_4$, and is a liquid which, in contact with water, decomposes with considerable energy into chromic and hydrochloric acids. The properties of this compound preclude the possibility of its formation under the ordinary conditions of mordanting wool.

As to the second compound, it is only known in the form of its salts. Potassium chloro-chromate is formed, for example, by heating bichromate of potash with hydrochloric acid and a little water. It crystallises in flat rectangular prisms. The salt is partially decomposed by water, but may be recrystallised from water containing hydrochloric acid. It decomposes at 100° C with evolution of chlorine.

It was interesting therefore to ascertain the behaviour of chloro-chromic acid when used as a mordant, and for this purpose a quantity of the potassium salt was prepared. Several experiments were then made, using equivalent amounts of: bichromate of potash with and without hydrochloric acid, chromic acid, and potassium chloro-chromate, with and without sufficient sulphuric acid to liberate the free acid.

It was found that by using potassium chloro-chromate, considerably more mordant was fixed than when an equivalent amount of bichromate of potash was employed; and that with free chloro-chromic acid very considerable exhaustion of the mordant bath occurred. Indeed this substance exhibited, throughout both the mordanting and dyeing operations a very similar action to that observed with bichromate of potash and hydrochloric acid. Since, however, 9 mols. HCl were used along with the $K_2Cr_2O_7$, a simple calculation shows that the amount of chlorine present in the two cases ($K_2Cr_2O_7$ + 9HCl, and $HCrO_3.Cl$) was in the proportion of 4·5 : 1. Absolute identity of result could not therefore be expected.

Having thus learned that chloro-chromic acid, and bichromate of potash with hydrochloric acid, behave similarly, and knowing that chlorine is given off when the former substance is decomposed, as it necessarily must be during the mordanting process, it appears very probable that the special action of hydrochloric acid in conjunction with bichromate of potash is also due to an evolution of chlorine which acts upon the wool substance.

It has long been known that wool treated with chlorine has an increased affinity for colouring matters. The fact was first pointed out by John Mercer in 1839, and was soon practically applied in the printing of muslin-de-laines, by Fort Bros. and Co., Oakenshaw, and by James Thompson, at the Primrose Works, Clitheroe. At a later date (1865) it was utilised by John Lightfoot for aniline black prints on wool. Further, it is applied in skin-mat dyeing, where, owing to the necessity of dyeing at a low temperature, the skins are submitted to a preliminary treatment with cold bleaching powder-solution, chlorine, or hypochlorous acid. In 1882, G. Witz[*] published a valuable paper on the action of hypochlorous acid, chlorine, and other reagents, upon textile fibres. His experiments had principal reference to cotton, but he also corroborated the fact that "chlorinated" wool has a greatly increased affinity for colouring matters. At the same time Persoz[†] published some additional notes upon the subject.

In recent years the "chlorination" of wool has been found advantageous by O. Witt and by Messrs. Cassella and Co. in the application of induline, naphthol black, and other similar colours; also by Kallé in connection with the production of steam aniline black on wool by the ferricyanide process.

Wool treated with chlorine having therefore a greatly increased affinity for many colouring matters, it appeared possible that mordants also would be more strongly attracted; indeed, this has already been shown by E. Lodge to be the case, and reference to the fact was made in Part I. (this Journal, 1893, 245). Lodge[*] treated woollen patterns with dilute acidified solutions of bleaching powder, and subsequently dyed with a variety of colouring matters. His main object was, to determine the conditions necessary to overcome the defects of discolouration and the harsh feel of the wool which occur when the somewhat large amount of bleaching powder proposed by Lightfoot is employed; viz., 12 per cent. of the weight of wool.

Incidentally, in the application of certain colouring matters for which bichromate of potash mordant was used, Lodge observed that the "chlorinated" wool acquired a much deeper colour already in the mordant bath than did untreated wool. An estimation of the amount of chromium in the waste mordant liquors showed that with the use of 10 per cent. bleaching powder and mordanting with 3 per cent. bichromate of potash, the equivalent of 2·29 per cent. $K_2Cr_2O_7$ was fixed on the wool; whereas on the untreated wool only 1·16 per cent. was fixed. He further noticed that the amount of chromium fixed on the fibre increased with the greater concentration of the bleaching powder solution previously employed.

With the intention of combining the chlorinating and mordanting operations, Lodge endeavoured to apply hypochlorites of aluminium and tin, but the experiments being incomplete, no results were given in the paper.

More recently, Knecht and Milnes have studied the action of chlorine and hypochlorous acid on wool. Their object was to explain, if possible, the nature of the reaction which occurs; and although they do not consider their experiments conclusive, their view is that the treatment results in an oxidation rather than a true chlorination of the fibre (Jour. Soc. Dyers and Col. **8**, p. 41, 1894).

A Balard (Mon. Sci., 1894) has also published some experiments dealing with this point.

If the opinion of the above authors is correct, wool which has been oxidised by other agents should also have an increased affinity for chrome mordant; and this point we have incidentally endeavoured to investigate by treating the fibre under a variety of conditions with solutions of hydrogen peroxide.

It would be tedious, and is indeed unnecessary, to describe the experiments *seriatim*; a capitulation of the results arrived at will suffice, these being as follows:—

1. Wool which has been previously oxidised by preparing with an acid or alkaline solution of hydrogen peroxide, either cold or boiling, does not attract an increased amount of chromium during an ordinary mordanting with bichromate of potash or chromic acid. In fact, excessive oxidation of the fibre in this manner appears to decrease its power of fixing chromium from a boiling solution of bichromate.
2. The addition of hydrogen peroxide to the bichromate mordant bath does not aid the *fixation* of the mordant, but an increasing amount of *reduction* results.
3. When chromic acid ($K_2Cr_2O_7 + H_2SO_4$) is the mordant employed, the addition of hydrogen peroxide to the bath causes a greater fixation of mordant and also aids reduction.
4. With chloro-chromic acid as mordant the addition of hydrogen peroxide retards fixation.
5. Wool oxidised by means of hydrogen peroxide always produces darker shades than unprepared wool when mordanted with bichromate of potash and dyed with logwood; but this effect is not due to the fixation of a larger amount of mordant, but rather to oxidation of the colouring matter and fixation of the brown oxidation products of hæmatein. The cause of this oxidation of colouring matter is, moreover, not to be found in the condition in which the mordant is fixed, since reduction of the latter is induced by the preliminary preparing process. It seems evident, therefore, either that a portion of the hydrogen peroxide has passed through the mordanting process and been carried over into the dye-bath, or more probably that some oxidation product of the fibre is reduced by the colouring matter.

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[*] Bull. de Soc. Ind. de Rouen, **10**, 461, 1882.

[†] Bull. de Soc. Ind. de Rouen, **10**, 467, 1882.

[*] Jour. Soc. Dyers and Colourists, **8**, p. 60 (1892).

The above experiments show that treatment of the wool with hydrogen peroxide, either previously to, or at the same time as, mordanting with bichromate or chromic acid, does not produce the same effect as mordanting with potassium bichromate and hydrochloric acid.

It was not, however, our intention at the present time to thoroughly investigate the action exerted by hydrogen peroxide on the wool fibre, or to discuss the question of whether the action of chlorine, hypochlorous acid, &c. is an *oxidation* or a *chlorination* of the fibre; and in subsequent experiments, when speaking of "chlorinated" wool, it must be understood that we merely refer to wool treated with one or other of these reagents.

*Action of Hypochlorous Acid.*—Hypochlorous acid was prepared in the usual manner by precipitating a clear solution of bleaching powder with carbonate of soda, and adding to the filtered solution of sodium hypochlorite an equivalent amount of acetic acid.

A series of wool patterns were steeped for one hour in various strengths of this hypochlorous acid solution, and after washing successively with water, dilute ammonia, dilute acetic acid, and finally with water, they were mordanted with bichromate of potash; an unprepared pattern was simultaneously mordanted with bichromate and hydrochloric acid. An examination of the waste mordant liquors and of the mordanted patterns showed that with the increased strength of the hypochlorous acid prepare, the mordant baths were more and more exhausted, and the patterns acquired a fuller brownish-yellow colour, approximating to that produced with bichromate and hydrochloric acid, but greyer. It should be noted, however, that the HClO prepared patterns, even before mordanting, exhibited a distinct brownish-yellow colour, and also that very little effect was produced as regards the amount of mordant fixed, unless such a strength of HClO was used that the fibre was partially disorganised.

From this experiment it would appear that wool prepared with hypochlorous acid behaves, when mordanted with bichromate of potash, in a somewhat similar manner to that of unprepared wool towards bichromate and hydrochloric acid mordant, but the results, as above noted, are by no means identical in the two cases.

*Action of Chlorine.*—An experiment was made in which wool patterns were steeped in a series of baths containing various strengths of freshly-prepared chlorine water, so constituted that, in respect of the available amount of chlorine they contained, the solutions exactly corresponded to those of the previous experiment with hypochlorous acid. It was noticed that the fibre became much less discoloured by this treatment than when hypochlorous acid was employed, a fact already observed by Knecht and Milnes. On subsequently mordanting with bichromate of potash the patterns thus prepared, and comparing them with unprepared patterns mordanted with bichromate and hydrochloric acid, it was seen that there was here a greater similarity in appearance and behaviour on dyeing, than was the case with the hypochlorous acid prepared patterns. Here there was indeed a very great resemblance in the effect of the two methods, though the "chlorinated" wool did not exhaust the mordant bath quite so completely, and the fibre was rendered somewhat harsher to the feel than was the case with the bichromate of potash and hydrochloric acid mordant.

It may be noted in passing, that the wool prepared with chlorine materially differs in its behaviour from wool oxidised with hydrogen peroxide, when mordanted with bichromate of potash and dyed with logwood.

Another method of preparing the fibre was now tried, in which the wool (10 grms.) was boiled for 1 hour in solutions containing 0·2, 0·5, 1, and 5 grms. sodium chlorate with sufficient sulphuric acid to liberate chloric acid. The prepared patterns were all quite colourless and unaffected in feel, not discoloured and rendered harsh, as with chlorine or hypochlorous acid. The patterns were afterwards mordanted with chromic acid and dyed with logwood, and it was observed that in all stages of the process, as well as in the final result, the chloric acid prepared wool behaved in the same manner as wool mordanted with bichromate and hydrochloric acid.

Having regard to the results of the foregoing experiments, we come to the conclusion that the peculiar action which occurs during the mordanting of wool with bichromate of potash and hydrochloric acid is probably to be explained as follows:—A portion of the hydrochloric acid decomposes the bichromate and liberates chromic acid; then, in consequence of the well-known attraction of wool for acids generally, the chromic and hydrochloric acids are separately attracted by the fibre, and indeed in such amount that in their comparatively concentrated state within the fibre, they react upon each other with evolution of chlorine. This may occur either directly or by the decomposition of chloro-chromic ($HCrO_3Cl$) acid or some similar compound formed as an intermediate product. In this manner the wool substance becomes chlorinated or oxidised, or at least modified in such a manner that it has acquired a greatly increased attraction for the chromic acid; and, providing that the amount of the latter is not excessive, the mordant bath is entirely exhausted. The partial reduction of the absorbed chromic acid to the form of chromium chromate or even to chromic hydrate is effected by the wool itself, as already explained in Part I. of the papers on this subject.

Remembering the fact that if wool containing chromium chromate is boiled sufficiently long with water, chromic acid is removed and green chromic hydrate is left behind on the fibre (see Part I., this Journal, 1893, 245), it is not surprising to find a similar further reduction of the chromium chromate to occur under certain circumstances in the method here described. Once the bath is exhausted, continued boiling can only have the effect of decomposing the chromium chromate already upon the fibre, for it is equivalent to boiling with water. No liberated chromic acid is found in the bath in this case however, because in the moment of liberation it is attracted by the "chlorinated" wool; and thus gradual and complete fixation and reduction may ensue.

When *nitric acid* is employed as an assistant it is probable that here, too, concentration of nitric and chromic acids upon the wool takes place, with formation of nitro-chromic acid ($HCr_3O_9.NO_2$), which by its decomposition also acts upon the fibre in such a manner as to cause it to attract an increased amount of chromic acid from the bath. Whether in the case of hydrochloric acid real chlorination of the wool occurs and with nitric acid an oxidation, or whether the fibre is oxidised in both cases, we leave for the moment undecided, with the hope that we may devote further attention to the question.

The similarity in the action of hydrochloric and nitric acids when employed as assistants with bichromate of potash, and the fact that, even with comparatively small amounts, they are capable of exhausting the mordant bath, is moreover interesting in the light of the fact that it is just these two acids which are known to form compounds with chromic acid; whereas sulphuric and acetic acids, which do not form similar compounds, are only capable of causing exhaustion of the mordant bath when comparatively large additions of acid are employed, the latter fact being already known and referred to in Part I. of these papers.

It appears probable that in the case of hydrochloric and nitric acids we have a precisely similar state of matters to that referred to when discussing the action of tartaric acid and cream of tartar as assistants with bichromate of potash mordant. (See Part II. This Journal, Vol. XII., pp. 333 and 334, 1893.) There it was noted that *apart* from the wool, *i.e.* in the bath, reduction of the chromic acid took place with difficulty, whereas on the fibre itself reduction occurred much more rapidly and completely, especially in the case of tartaric acid. Evidently the chromic and tartaric acids concentrated upon the fibre, by reason of the attraction of the latter for acids, to such an extent that they reacted upon each other, and complete reduction of the chromic acid was effected *within the fibre*. In the solution itself, on the other hand, the reaction did not occur to the same extent, because the two acids were there in too dilute a condition.

Probably any two acids soluble in water and capable of reacting upon each other when in a concentrated condition, would inevitably do so within the wool fibre if it were steeped or boiled in a dilute solution containing them.

At the beginning of this paper it has already been stated that we first noticed the peculiar action of hydrochloric acid as an assistant with bichromate of potash in the autumn of 1892. Although many of the experiments now recorded were then made, and we fully recognised the practical importance of the discovery, the observation was not published; nevertheless no steps were taken to prevent publicity; the process was communicated to several persons, and it would appear that certain dyers have already found an advantage in adopting the process.

In June 1893 an English patent (No. 11,634) appeared under the name of O. P. Amend, for an improved method of dyeing aniline black on wool, in which, before the application of the aniline salt, the fibre is steeped in a somewhat concentrated solution of chromic and hydrochloric or acetic acids.

At a later date (September 1893) another English patent (No. 18,232) was taken out under the same name for "improvements in the process of dyeing," in which the fibre is treated with a cold solution of chromic acid together with some other acid which must be of what is termed a "non-oxidising" character; hydrochloric and acetic acids being specified. The patentee considers sulphuric and nitric acids to have an "oxidising and destructive action on animal fibres," and therefore unsuitable. After steeping as above, the fibre is subjected to the action of a reducing agent in solution, *e.g.*, ferrous sulphate, sodium bisulphite, &c. The product on the fibre is described as an insoluble chromate of the fibre. (See this Journal, Vol. XIII., p. 150, Feb. 1894.)

At first sight it might be supposed that the patentee had observed the peculiar action of hydrochloric acid to which we have referred, but after a careful perusal of the abstracts of the patents as they appear in the Journal of the Society of Dyers and Colourists, and after repeating the experiments according to the directions given, we come to the conclusion that this is not the case.

We notice, for example, that the steeping of the wool in strong tepid or cold solutions of bichromate of potash, with addition of equivalent amounts of sulphuric, hydrochloric, nitric, and acetic acids, leads to very similar results; in each case the wool acquires a full, bright yellow colour, probably through the absorption of chromic acid as such, the waste liquors being all of a pale yellow colour. Of course wool mordanted in this manner is absolutely useless for ordinary dyeing processes; hence the necessity, when required for this purpose, of submitting it to the action of reducing agents, but even then the amount of chromic oxide fixed on the fibre would be very excessive and far beyond anything required in practice, for which indeed the whole process, as described, seems altogether unsuitable.

It will be noted also that the inventor regards acetic acid as equally useful with hydrochloric acid, while nitric acid is not considered useful; whereas we find the reverse to be the case in respect of these two acids.

Incidentally, in June 1894, we showed the results of our 1892 experiments to Mr. J. Smith, Director of the Dyeing Department of the Massachusetts Institute of Technology, Boston, U.S.A., and were interested to learn from him that he had already noticed the difference of behaviour between sulphuric and hydrochloric acids when employed as assistants in mordanting wool with bichromate of potash. He stated that both acids are annually employed in this way by his students in the usual systematic series of experiments which they carry out. The observation, however, had evidently not sufficiently attracted his attention to cause him to investigate the matter.

Bichromate of potash is by far the most important and most largely used mordant of the wool-dyer, and yet the method of its application up to the present must be regarded as having left much to be desired, chiefly because of the non-exhaustion of the bath. Not only has this defect given rise to irregularities of one kind and another, through the difficulty of regulating the amount of chromium fixed on the fibre; but also such serious defects as over-chroming, tendering of the fibre, accelerating the fading of the dyed colour, &c., are by no means of infrequent occurrence, arising as they do in consequence of excessive accumulation of bichromate in the mordanting bath through the general adoption of the system of retaining the spent chrome liquors and freshening up for successive lots of material.

By adopting the method of mordanting described in this paper these defects may be entirely avoided without the necessity of determining the amount of chromic acid in the spent liquors. The mordant baths may be exhausted to such perfection that neither chromic acid nor free hydrochloric acid are left in the bath, and successive lots of material may be mordanted with an equality, as regards percentage of chromium fixed on the fibre, hitherto unattainable. Those dyers who have not used a "standing bath" of bichromate, but have had to make up a fresh mordant bath for each dye, *e.g.* loose-wool dyers, will effect a considerable economy in bichromate, and need only use one-half to one-third of the amounts hitherto employed.

Add to this the fact that the waste liquors discharged into the neighbouring stream are absolutely colourless and devoid of any injurious ingredients whatever, and we cannot but think that the method above described will be largely adopted in practice. From a practical point of view, indeed, we regard the improvement brought before your notice this evening as one of the most important results of our studies on the mordanting of wool with chromium, to which we have now devoted attention for some years.

## DISCUSSION.

Mr. C. RAWSON asked whether the combined action of chromic and hydrochloric acids rendered the wool harsh, and whether the materials were evenly mordanted. In practice, he said, it was found more difficult to obtain even mordanting with an acid bath than with potassium bichromate alone. If the process were free from these drawbacks it would be of great use.

Mr. THORP WHITAKER said that he felt doubtful as to whether an acid bath would give even results, though should that be the case the possibility of exhausting the bath would be of value.

Mr. G. W. SLATTER said that he had found that small samples could be mordanted quite evenly, so far as he could see, using solutions of bichromate alone or together with hydrochloric or sulphuric acids. On the other hand, a piece of cloth 60 yards long mordanted in a bath containing sulphuric acid gave very uneven results when dyed, while a neutral $K_2Cr_2O_7$ bath gave even results.

Mr. FAIRLEY suggested that uneven results might be accounted for by the strong affinity of the wool for the materials present in the dye-bath. Those parts of the cloth which first enter the bath may take up a large part of the chromium and hydrochloric acid, and so leave it much weaker for the cloth coming afterwards.

Prof. SMITHELLS asked whether in those experiments in which the authors had found that a mixture of NaCl and $H_2SO_4$ gave results differing from those obtained with hydrochloric acid, equivalent quantities merely of NaCl and $H_2SO_4$ had been used.

Prof. HUMMEL replied that such amounts of sodium chloride and sulphuric acid had been employed as would be necessary to liberate, not only an amount of hydrochloric acid equal to that used in the experiments, but also a large excess, but this did not make any difference in the result; the mixture of common salt and sulphuric acid in no way behaved like hydrochloric acid.

Mr. F. W. RICHARDSON asked whether any ammonium chloride was found in the baths in which wool had been treated with hypochlorous acid or with chlorine.

Mr. GARDNER, in reply, said that he had no doubt that $NH_4Cl$ was formed, though no special experiments had been made on that point. He also said that the process of chroming described in the paper did not appear to roughen the wool fibre to any marked extent, though no doubt any process in which the wool was treated with acid tended to do so more or less. Irregular mordanting in practice, due to the employment of acid chrome baths, had already been specially referred to in Part I. of these papers, and it was probably due to the great affinity of wool for chromic acid; nevertheless, many dyers *did* employ acid chrome baths in practice; hence in the first instance we recommend such dyers to adopt the improvement described. Possibly the addition of sodium sulphate or some other levelling agent might be beneficial, and render the process available for piece-dying, but at any rate it should be suitable for loose-wool dyeing. He added that special experiments had shown that the mordanting in acid solutions did not tender the wool fibre more than a treatment with potassium bichromate.

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# THE TINCTORIAL PROPERTIES OF SOME INDIAN DYESTUFFS.—PART II.

BY J. J. HUMMEL AND A. G. PERKIN.

In continuation of our work on this subject, we have, during the past year, submitted to examination a number of yellow dyestuffs from India, samples of which have been received from the Imperial Institute of London.

One or two of the dyestuffs to be referred to have already been examined chemically by Dr. Schunck, but the rest are either at present undergoing chemical investigation, or are about to be examined in this way, in the Clothworkers' Research Laboratory of the Dyeing Department of the Yorkshire College.

Yellow dyestuffs seem to be somewhat widely diffused in the vegetable kingdom, and in recent years those which, like fustic, quercitron bark, &c., are only applied with the aid of mordants, have attracted increased attention, because certain relationships have been discovered to exist between the colouring matters contained in some of them. Moreover, certain coal-tar yellow colouring matters are now known which possess similar dyeing properties to those derived from natural sources; one at least of the natural yellow mordant dyes (gentisin) has been prepared artificially; and altogether the chemist seems to have gained such an insight into their constitution as to enable him with tolerable certainty to classify them as xanthones.

The interest attached to an examination of Indian yellow dyestuffs is to see if the principles they contain are identical with, or distinct from, those already known; and if the latter, whether, by reason of some peculiarity, their constitution may not be more readily determined than that of similar colouring principles already known.

We propose to refer first to those yellow dyestuffs, which are applied by means of mordants, and then to two or three which are applied direct. The dyeing properties of some have already been referred to by early writers on dyeing, and also in recent years by Mr. T. Wardle in his "Report on the Dyes and Tans of India," 1878–1886, presented to the Government of India, but since in this document no reference whatever is made to the methods employed, it seems desirable that some record should be made as to the necessity or otherwise of employing mordants with them, with a view to their better classification.

### *Artocarpus integrifolia.*

This is the well known Jack-fruit tree of India, belonging to the *Urticaceæ*, a large tree cultivated throughout India and Burma, except in the north. The rasped wood is used by the natives of India and Java as a yellow dye in conjunction with alum, for colouring the robes of the Burmese priests, and also for general purposes. It is often used in dyeing silk. In different parts of India, the fruit, bark, and roots, as well as the wood, are employed in dyeing.

The chemical examination of this dyestuff has already been completed by Mr. A. G. Perkin, and its colouring matter has been isolated. Further reference here is unnecessary, since the results will shortly be communicated to the Chemical Society of London.

With respect to its dyeing properties it gives on mordanted wool, shades which are similiar to those obtained from old fustic, viz., olive-yellow with chromium, dull yellow with aluminium, and a brighter yellow with tin mordant. In all cases, employing equal weights, the Artocarpus colours are much paler than those of old fustic. The most notable difference in this respect is shown on iron mordant, with which Artocarpus gives only a pale brownish-buff colour, whereas fustic gives a very dark brownish-olive. A comparative dyeing experiment made on chromium-mordanted wool showed Artocarpus to have about one-third the colouring power of old fustic. Mr. Wardle found this wood to contain a moderate amount of yellow colouring matter; he produced from it brownish-yellow colour on silk, but did not consider it well adapted for wool.

### *Datisca cannabina.*

This is a tall, erect herb, resembling hemp, belonging to the *Datisceæ*, and met with in the temperate and sub-tropical Western Himalaya from Kashmir to Nepal; it is, however, not plentiful.

The root, known as *Akalbir*, is extensively used in Kashmir and throughout the Himalaya as a yellow dyestuff, chiefly on alum-mordanted silk. In Basahr, on the Sutlej, about 200—300 maunds are obtained annually, its selling price being about 14 rupees per maund of 80 lbs.

The chemistry of this dyestuff has been studied by Braconnot, Stenhouse, and, quite recently, by Schunck and Marchlewski. The root contains a colourless crystalline glucoside, *datisein*, which when boiled with dilute mineral acid decomposes into the true colouring matter *datiscetin* and rhamnose.

The experiments here recorded we made with a small sample of root kindly supplied to us by Dr. Schunck.

We find the dyeing properties of datisca-root on wool, to be very similar to those of old fustic. It is, however, slightly inferior in dyeing-power, for on tin mordant 4 grms. datisca-root are equal to 3·5 grms. old fustic.

On cotton it dyes more like quercitron bark, in so far that the olives obtained on iron mordant are much darker and bluer in shade, as though some tannin matter were present. It appears to have about the same colouring power as quercitron bark, but gives brighter yellows with aluminium mordant. Applied to wool it differs from quercitron bark by giving with chromium mordant an olive-yellow which is not of such a reddish tone, and with tin mordant a bright yellow instead of an orange.

Although, by reason of its scarcity, this dyestuff is not likely to be introduced into Europe, we certainly consider it an excellent colouring matter, and worthy to rank with the natural yellow mordant-dyestuffs at present in use.

### *Sophora japonica.*

This is a large and beautiful tree, not unlike an acacia, belonging to the *Leguminosæ*, which grows abundantly throughout China, whence it has been introduced into Japan.

The undeveloped flower-buds constitute an important yellow dyestuff employed by the Chinese for colouring the silken vestments of the mandarins. For this purpose the buds are collected and dried rapidly, either in the sun or by artificial means, usually with the addition of a little chalk. The method of dyeing employed consists in simply boiling for 1—1½ hours, in a decoction of the flower-buds, silk which has previously been mordanted by steeping over-night in a cold solution of alum. Less frequently it is employed in the dyeing of cotton and wool. Its price is about 30*s.* per cwt.

The chemistry of this dyestuff has been studied by many chemists, but most recently by Dr. Schunck, who finds that the glucoside which it contains, formerly called *sophorin*, is really identical with *rutin*. When decomposed by boiling with dilute mineral acids it yields 1 mol. quercetin and 2 mols. rhamnose, and differs therefore but slightly from quercitrin, which under similar influences yields equal molecules of these two substances.

Sophora buds have long ago been experimented with in dyeing, both in France and England, partly with the object of determining whether it was capable of furnishing a green as well as a yellow dye, as had been stated by travellers in China.

Messrs Michel and Guinon, in a report which appears in the Annales de la Société d'Agriculture de Lyon, 1847, Vol. X., pp. 534—536, state that for silk-dyeing the properties of Sophora buds are similar to those of weld, but that it is three times stronger in colouring power. Mercer and Crum, who examined the dyestuff in 1853 for the Board of Trade, state that it dyes a pure yellow very like that given by Persian berries.

This last statement agrees entirely with our own experiments with it in cotton-dyeing.

When applied to wool, however, it gives colours more like those obtained with quercitron bark, viz., a dull orange with chromium, a yellow of moderate brilliancy with aluminium, a bright yellow with tin, and a dark olive with iron; in no case, however, are the colours identical. In dyeing power it seems to be equal, if not slightly superior, to quercitron bark.

These experiments have been made with Sophora buds received from Mr. James Buchanan, of Shanghai.

We regard this as an excellent dyestuff, quite equal to those of a similar character in general use.

### *Delphinium zalil.*

This is a perennial herbaceous plant belonging to the *Ranunculaceæ*, which bears a spike of yellow flowers two feet in height. It is abundant in certain parts of Afghanistan, *e.g.*, on the downs of the Badghis, and in the vicinity of Gulran, and in Khorasan.

The dyestuff, known as *Asbarg*, consists of the dried flowers and flowering stems, which are largely exported from Kabul and Khorasan, *viâ* the Punjab, into all parts of India. It is used in the native calico-printing, but chiefly in silk-dyeing, along with datisca cannabina roots, and with alum mordant, for the production of a bright sulphur-yellow colour known as *gandhaki*. Its price is 27½ rupees per cwt.

The chemistry of this dyestuff has still to be studied, and this we hope to do as soon as further supplies, already asked for through the Imperial Institute, come to hand.

The dyeing properties of Delphinium, both on wool and cotton, are very similar indeed to those of Sophora, from which it differs only by having less dyeing power. Compared with the ordinary dyewood it is therefore most similar to quercitron bark, and compared with this dyestuff on wool with tin mordant, it appears that 1·75 grms. quercitron bark are equal in dyeing power to 5 grms. delphinium, but the latter gives a much purer yellow, *i.e.* less orange. It would therefore seem to have about half the colouring power of Sophora-buds.

Although quite a good dyestuff for native use, the comparatively low colouring power of Delphinium zalil flowers will prevent it from finding any employment in Europe.

### *Myrica nagi.*

This is an evergreen tree, belonging to the *Myricaceæ*, met with in the sub-tropical Himalaya from the Ravi eastwards, also in the Khasia Mountains, the Malay Islands, China and Japan. It is the box-myrtle or *yangmæ* of China, and is synonymous with M. sapida, M. rubra, and M. integrifolia.

The bark is occasionally used as a tanning agent, and for medicinal purposes, and is said to have been exported from the North-West Provinces to other parts of India in recent years to the extent of about 50 tons per annum. In Bombay it is met with under the name of *kaiphal*, and is worth 1—2 rupees per maund of 41 lbs.

It does not appear to be used as a dyestuff except in Sirmour, in the Simla district, but since it is said to be employed for dyeing pink (?) there must be some error in the statement.

For the small sample of bark used in the present experiments we have to thank the authorities of the Imperial Institute, London, who have promised a larger supply to enable us to make the chemical examination which we have in view.

The dyeing properties of Myrica bark, although generally similar to those of other yellow mordant dyestuffs, differ in some respects from any one of them. On wool, with chromium mordant, it gives a deep olive-yellow, and with aluminium a dull yellow, similar to the corresponding colours obtained from quercitron bark, but much fuller; with tin mordant, however, it gives a bright red-orange, redder in hue than that given by quercitron bark, and fuller even than that given by an equal percentage of Persian berries, to which otherwise it is very similar; with iron mordant it gives a dark greenish-olive like that obtained from quercitron bark, but again fuller; it seems indeed to have a greater colouring power than all other natural yellow mordant-dyestuffs.

On cotton, with aluminium and iron mordants it dyes colours which are more similar to those obtained from old fustic than from quercitron bark, the colours with iron mordant, for example, not exhibiting the dark and bluish hue given by the latter, as though tannin matter were absent.

Compared with old fustic, on wool mordanted with aluminium, 3·7 grms. Myrica bark equal in dyeing power 5 grms. old fustic, but it gives a much duller olive-yellow colour. Compared on wool with chromium mordant, 2 grms. Myrica bark are equal to 5 grms. old fustic, but here, too, the colour is much redder or browner.

The comparative richness in colouring power of Myrica bark, and the full, brilliant red-orange given with tin mordants on wool, are sufficiently interesting to warrant us in examining this bark thoroughly, more particularly since it is evident that its utility as a dyestuff is unknown to the Hindoos.

### *Butea frondosa.*

This is a moderate-sized, deciduous, distorted tree, belonging to the *Leguminosæ*, and bearing numerous large, bright orange flowers having a dark, olive-green velvety calyx. It is common throughout India and Burma, extending in the North-West Himalaya as far as the Jhelum river. It is said to be one of the most beautiful trees of the plains and lower hills of India.

It is this tree which yields the so-called "Butea Gum" or "Bengal Kino," and upon which also the lac insect is reared in many parts of India.

The dried flowers called *tésú*, *késú*, *kesnda*, or *palás-ké-phúl*, yield by the native methods a brilliant but fleeting yellow dye, much used, especially during the *Hóli* festival. The dye is extracted either by expressing the coloured sap of the fresh flowers, or by making an aqueous decoction or infusion from the dried flowers. These are obtainable in unlimited quantity, and are usually collected in March and April, and dried in the sun.

The native methods of dyeing with tésú are of the simplest kind, and consist in steeping the textile materials in a hot or cold decoction. As a rule no assistant or mordant is employed, so that virtually the process is one of staining rather than of dyeing, and the colour can be readily washed out; this is regarded indeed as an advantage, and is usually effected after the festival is over. Sometimes the cloth is previously prepared with alum or wood-ash, and then boiled with the decoction of the flowers, or these substances are added to the dye-bath previous to the introduction of the cloth. Sometimes other dyestuffs are employed along with tésú, *e.g.* annatto, turmeric, myrabolams, &c., either with the object of modifying the colour obtained, or to render it less fleeting.

With respect to the chemical examination of this dyestuff, now being made for the first time, it promises to give interesting results. The flowers contain a glucoside, readily decomposed by boiling with dilute mineral acid, and thus yielding the true colouring matter, which crystallises from water or alcohol in the form of colourless needles. It seems to differ in its reactions from other yellow mordant-dyestuffs, though in some respects it is not unlike the fisetin obtained from young fustic. (See Proc. Chem. Soc. 1894, 11.)

As might be expected from the foregoing statement, the dyeing properties of Butea flowers differ from those of other natural yellow dyestuffs. The glucoside does not decompose readily during the dyeing process, hence the flowers do not dye mordanted cotton; and even in wool-dyeing, where acid baths are employed only comparatively weak colours are obtained. When, however, the glucoside has been decomposed by boiling the flowers with dilute mineral acid, the full and normal dyeing power is obtained. The flowers may be boiled with dilute hydrochloric acid, and the whole evaporated to dryness on the water-bath to remove excess of acid, or one may use dilute sulphuric acid, and eventually neutralise the acid liquid with sodium carbonate. After treatment in this manner the Butea flowers give, with the different mordants on wool, colours which somewhat resemble those obtained from young fustic, namely, a terra-cotta shade with chromium, a bright orange with aluminium, bright yellow with tin, and a brownish-olive with iron. The chromium colour is remarkable by being much redder in hue than the corresponding colour obtained from all other yellow mordant-dyestuffs. All the colours obtained on wool, with the different mordants, are very fugitive to light, so that in this respect, too, this dyestuff is similar to young fustic. We cannot therefore endorse Mr. T. Wardle's opinion, that if Butea flowers could be obtained in quantity and sufficiently cheap, they would be a useful addition to the yellow dyes we already possess.

For the supply of Butea flowers with which these experiments have been made, and for the purpose of the chemical investigation now in progress, we are indebted to Mr. W. Reid, of Bombay, to whom we express our thanks.

### *Mallotus philippinensis.*

This is a small evergreen tree belonging to the *Euphorbiaceæ*, met with throughout tropical India, Burma, and Ceylon, also in China, the Malay Islands, and Australia.

The so-called *kamala* dye, obtained from this plant, is the red glandular powder found on the exterior of the fruit. The ripe capsules are gathered in March, and shaken in bags till the powder separates. Most of that sold in the bazaars is largely adulterated with red mineral matter, hence the price varies considerably from 7 to 40 rupees per maund, an average price being about 1*s.* 6*d.* per lb.

Kamala is extensively employed by the Hindoos, both as an anthelmintic drug, and for dyeing silk and wool a bright orange colour. The fabric is dyed in a boiling bath containing 4 parts kamala, 1 part alum, 2 parts sodium carbonate (native barilla), previously well rubbed together in the powdered state with a very small quantity of sesamum oil. The alum is sometimes omitted, but the addition of the alkali is absolutely necessary in order to dissolve the colouring matter, which is of a resinous character and quite insoluble in water.

The chemistry of kamala has been studied by Anderson and others, and quite recently by A. G. Perkin (Chem. Soc. Trans. 1893, **63**, p. 975; 1895, **67**, p. 230), who has isolated the following crystalline substances: *rottlerin*, $C_{33}H_{30}O_9$; *homo-rottlerin*, $C_{33}H_{36}O_7$; *iso-rottlerin*, $C_{12}H_{12}O_5$; also two resins, $C_{12}H_{12}O_3$ and $C_{13}H_{12}O_4$, of low and high melting point respectively, and a colourless wax $C_{25}H_{54}O_2$. The essential dyeing-agent is the rottlerin, and in lesser degree the homo-rottlerin, the latter being present in only very small amount.

About the beginning of this century the dyeing properties of kamala were examined by Bancroft, apparently in a cursory manner. In his "Philosophy of Permanent Colours," II., p. 315, he writes:—"The colour of this powder seems to be intermixed with a portion of resinous matter, which renders it but little soluble in water only, but being made soluble by an admixture of soda, I found it afterwards capable of dyeing a very high and bright orange, with alum and with solutions of tin, which orange colour was sufficiently durable on silk, but less so on cotton."

In 1830 Gonfreville sent about 1 cwt. of it to France for distribution to chemists and manufacturers. He states that the Moutchys Indians dye with it in alkaline solution, but points out that to fix it on textile material it requires in addition, the aid of a mordant, *e.g.* alum, or a tin salt.

He found the colouring matter to be insoluble in water, but soluble in alcohol and in ether, by means of which he prepared the pure substance, to which he gave the name *rottlerin* Alkaline salts he found to dissolve the colour with a deep blood-red colour. On shaking up the alkaline solution in a flask, an orange-coloured scum was produced, apparently by the action of the air; this scum contained an altered substance insoluble in alkali carbonate, alcohol, and ether, but only in boiling caustic alkali.

He states that alum added to an alkaline decoction of kamela, renders the colour more brilliant and more permanent. For silk he finds an alum and tartar mordant better than alum alone, and with an alkaline solution of tin very rich and fast oranges can be produced.

Preliminary experiments in dyeing silk with kamala, with and without additions of sodium carbonate to the dye-bath, showed that, without the addition of alkali, only a dull yellow of comparatively little depth is obtained. With the addition, a full, bright orange is readily obtained, provided the dyeing operation, which takes place at the boil, is not prolonged, since long boiling decomposes the rottlerin and destroys the colour, and makes the shade paler.

The best results were obtained by adding to boiling water 1 part kamala, 0·5—1 part sodium carbonate, then introducing the silk, and dyeing at the boil for 2—5 minutes only. Of course the bath is not exhausted with such a rapid dyeing process. Other experiments indicated that the amount of sodium carbonate to employ should be regulated according to the quantity of water employed, rather than to that of the kamala, namely, at the rate of 13—14 grms. sodium carbonate ($Na_2CO_3$ 10 aq.) per litre. After dyeing for a short time with the addition of alkali only, to the extent of one-fifth of the weight of kamala used, the addition of alum or stannous chloride to the dyebath makes the colour fuller and more orange. A similar, but by no means identical effect is obtained by making a slight addition of sulphuric acid. It does not appear, however, that the beneficial effect of alum is due to its acidity, but rather to its action as a mordant, for other experiments showed that although rottlerin itself is not attracted by mordants, its alkali compound will dye mordanted calico to a slight extent.

In none of our experiments were we able to obtain the red-orange shades of native kamala-dyed silk, and since the latter gives a different test when spotted with concentrated sulphuric acid, we are inclined to think that the distinctly redder shades of the native dye are due to the use of other dyestuffs, *e.g.*, annatto, along with the kamala.

Although highly spoken of by some writers as a fast dye, we find kamala yellow on silk to be really very fugitive to light, and since there are now many coal-tar yellow and orange colouring matters applicable with equal simplicity, and giving much faster colours, it is quite out of the question that kamala can ever become a dyestuff of any value in European commerce.

### *Toddalia aculeata.*

This Indian plant, belonging to the *Rutaceæ*, is a rambling shrub, met with in the sub-tropical Himalaya, in the Khasia mountains, and throughout the Western Peninsula and Ceylon.

According to Dr. Bidie the root-bark is used in Madras as a yellow dyestuff, but nothing is known as to how the colour may be fixed.

The plant early attracted European attention in India as a very valuable medicinal product; the leaves, fruit, bark, and root are all spoken of by various writers as possessing tonic, stimulant, and antipyretic properties.

It was first made known in 1671 from specimens obtained by Pigneiro at the mouth of the Zambesi, and was introduced into European medicine by Gaubius in 1771. According to Flückiger and Hanbury it had at one time some celebrity under the name of "Lopez Root" or "Root of Juan Lopez Pigneiro," but it has long since fallen into disuse.

The small sample of root examined by us was obtained from Dr. G. Watt during his official connection with the Colonial and Indian Exhibition held in London in 1886. The root, about ¾ inch in diameter, possesses a marked aromatic odour, and has a pale yellowish, almost white, woody centre, and a brown bark covered with a bright yellow powdery pith-like substance. The central woody portion contains no colouring matter, this being concentrated in the external yellow powder.

The chemical examination, now made accurately for the first time, proves the active principle to be *berberine*.

The dyeing properties are the same as those of Evodia meliæfolia referred to below.

### *Evodia meliæfolia.*

This is a large tree, belonging to the *Rutaceæ*, and met with in China and Japan, where its bark is largely employed in dyeing as well as in medicine. It was formerly described by Loureiro and others as *Pterocarpus flavus*, but this error was eventually corrected by P. W. Squire (Pharm. Journ. [3], 1888, 18, 785), who proved it to be really *Evodia glauca*, which is synonymous with *E. meliæfolia* (Flora, British India, 1, 490).

For the sample examined by us we are indebted to Mr. James Buchanan, of Shanghai. It is a comparatively thin bark, of a close laminar texture, and possessing internally a bright yellow colour.

The chemical examination of the bark showed that it contained about 3 per cent. *berberine*.

When employed in dyeing silk, the Chinese macerate the bark in water for 2—3 days, and dye the material in the cold, without using any mordant.

Our own experiments show that it behaves as a basic colour in the normal manner, exactly like berberine hydrochloride. Wool and silk are dyed direct, without the necessity of any mordant, by boiling for half an hour in an aqueous decoction of the bark. The addition of 1 per cent. sodium carbonate intensifies the bright yellow colour obtained; excess of alkali and prolonged boiling dull the colour.

Evodia bark is best adapted for dyeing silk, on which a full, bright yellow is obtained with 20 per cent. dyestuff.

Cotton has no attraction for the colouring matter, and can only be dyed after it has been mordanted with tannic acid fixed in the usual manner with antimony or tin; it then acquires in a neutral bath a dull yellow colour of little or no practical value.

The yellow colours derived from Toddalia and Evodia are fugitive to light, and possess at the present time no importance, at least in European dyeing.

* * *

## NOTES ON THE PURIFICATION OF SOME CONGO AND ACID RED COLOURS.

BY A. G. PERKIN, F.R.S.E.

For the purpose of some experiments with these colours, it was desirable to have them in a chemically pure condition, or in a state of 100 per cent. strength. As it was found impossible to procure pure specimens, the present investigation was instituted with the object of purifying commercial samples of all the known colours of the Congo and diazo classes. The difficulty of the work was found, however, to be greater than was at first expected, so that after experiments with the colours described below, the work was abandoned, the time and labour involved being too great to warrant its continuation.

A point of some interest involved was whether all these substances when pure were of crystalline nature, as is known to be the case with Congo red and Benzo purpurine 4 B.

The principal impurity contaminating the Congo colours is inorganic, and consists chiefly of common salt. Organic impurities, which are much smaller in quantity, will consist chiefly of traces of the intermediate substance formed first in the Congo reactions, phenolic substances, and small quantities of one or other of the products used in the production of the dyestuff.

The amount of mineral impurity present in any of these colours can be roughly gauged by ignition and conversion of the residue into sodium sulphate by means of sulphuric acid or ammonium nitrate. As the dyestuffs themselves, however, are sodium salts of sulphonic acids, it is necessary to deduct from the percentage of sodium found above, as nearly as possible, that known to be combined in this way. The residue, if calculated as sodium chloride, will give approximately the amount existing as such in the sample. Sometimes traces of other mineral constituents, iron, &c., can be detected in the colour, but usually the quantity present is too minute to materially affect the estimation.

It is well known that the sodium chloride has originated during the operation of precipitation or "salting out" of the dyestuff from its solution in water, in which condition it is first obtained. The precipitate cannot be entirely freed from the salt liquid, for by washing with water, loss of the dye would obviously occur. The more soluble the dyestuff, the more mineral matter it will probably contain.

The Congo colours possess a characteristic reaction which at first suggested itself as a ready means for their purification. When a solution of these dyes is treated with a mineral acid, a coloured precipitate of the free sulphonic acid is thrown down, almost insoluble in water.

By washing with water this could be freed from mineral matter, and then reconverted into the sodium salt by neutralisation. It was found, however, that the free sulphonic acids thrown down in this way from either hot or cold solutions could be filtered off only with difficulty, and complete washing on this account was rendered extremely tedious.

It was therefore necessary to have recourse to some method of crystallisation or deposition of the dyestuff itself from solutions, and the only liquids that could be found applicable for this purpose were water and dilute alcohol.

Alcohol alone is useless for this purpose, since it has little or no solvent action upon these colours.

Those dyes which are the most difficultly soluble in water, can be the most readily purified, for in their case very dilute alcohol can be used as a crystallising agent, the mineral matter remaining in solution in the supernatant liquid.

With those, however, which are readily soluble in water, and for whose crystallisation, therefore, a stronger alcohol must be used, purification by this means alone is far more difficult, and in many cases impossible, since the mineral and colouring matters, both soluble in the hot liquid, separate out together on cooling. It was therefore necessary to devise some means by which the more soluble dyestuffs could be crystallised from a more dilute alcohol. It seemed possible that if one could obtain some substance readily soluble both in water and alcohol, that this could be effected, for this substance could obviously be used to "salt" out the colour from its solution in dilute alcohol, and be then removed itself from the precipitate by extraction or washing with alcohol. A substance answering these requirements was found in potassium acetate, and, as was expected, this proved of considerable service for the purification of the more soluble colouring matters. Not only could it be used as an agent for "salting out," as referred to above, but a preliminary purification was often effected by washing the crude dye with aqueous potassium acetate solution of such a strength that a large quantity of the mineral, and but little of the colouring matter itself, was so dissolved. In almost every case it was found possible to obtain the Congo reds in a crystalline condition, and though in the case of a few this was accomplished in a comparatively easy manner, with the majority it was more difficult, and depended, not only upon the purity of the substance, but upon the strength of the alcohol and the quantity of potassium acetate added. As is to be expected from the high molecular weight of the Congo red colours, they are never obtained as large crystals, but rather of a microscopic size. In many cases they possess a bronzy-green lustre.

In the purification of some samples of crude dyestuffs, greater difficulty was experienced owing to the presence of mineral matter other than sodium salts, chiefly of a ferruginous nature. This was best removed by fractional crystallisation of the sample, or by its fractional precipitation from solution with potassium acetate. In these cases the objectionable impurity was chiefly found in the first deposit or precipitate, which was filtered off and neglected.

The purity of the crystallised dye was determined in each case by the amount of sodium it contained, by a similar method to that previously described, and in a few instances also nitrogen estimations were carried out. Special attention was also paid to the microscopic appearance of the sample, and in no case was the substance considered pure, unless it was found to be homogeneously crystalline.

A full description of the process of purification used with each dyestuff would be tedious and involve considerable repetition. To obviate this difficulty the methods employed in a few typical cases are given below, but with the bulk of the colours the main points are only described.

*Benzopurpurine I B.*—Twenty grms. of the crude product were digested with 180 c.c. of 55 per cent. alcohol, filtered, the filtrate treated while hot with 50 c.c. of boiling alcohol, and allowed to cool. Minute red needles separated out, which were recrystallised in a similar manner until pure.

If the hot alcoholic solution is quickly cooled this dyestuff is deposited in a gelatinous condition.

On analysis 0·3897 grm. gave 0·0642 $Na_2SO_4$.
Found Na = 6·12 per cent. Requires Na = 6·35 per cent.

0·143 grm. gave 15 c.c. N, $t$ = 15. Bar. 760 mm.
Found N = 12·27. Theory requires N = 12·07 per cent.

*Benzopurpurine 4 B.*—The impure colour was stirred up with boiling water, and the mixture evaporated over the steam-bath until a thick, pasty mass was obtained. This was strained, pressed, and the product again treated in a similar manner. For further purification it was crystallised from 50 per cent. alcohol, the crystals which separated out collected while the mixture was still warm, washed with dilute alcohol, and recrystallised in a similar manner. It appeared under the microscope as a tangled mass of pale red needles, having when dry a brick-red colour.

On analysis 0·2845 grm. gave 0·0555 $Na_2SO_4$.
Found Na = 6·03 per cent. Requires Na = 6·35 per cent.

*Roseazurine G.*—This sample of colour, though readily obtained in a crystalline condition, contained a small quantity of iron and was on this account only purified with considerable difficulty. 10 grms. of the crude substance were agitated with a boiling aqueous solution of potassium acetate, filtered, the residue washed, first several times with the acetate solution, and finally with boiling alcohol. The mass was now dissolved in 50 c.c. of boiling water, filtered, and the filtrate treated with so much hot alcohol that a small quantity of crystals separated out on cooling. After standing 12 hours these were collected, and being found to contain much iron were therefore neglected. To the boiling filtrate potassium acetate was added, and the crystals which separated on cooling, collected washed with alcohol and dried. They were found to be free from iron, and on analysis gave the following result :—

0·1525 grm. gave 0·0305 $Na_2SO_4$.
Na found = 6·47 per cent. Requires Na = 6·23 per cent.
It formed minute prismatic needles.

*Terra Cotta R.*—Crystallised several times from water. On slow cooling it is deposited as thin leaflets, but when rapidly cooled, in the form of fine needles.

0·2185 grm. gave 0·0480 $Na_2SO_4$. Found Na = 6·86.
Constitution not published.

*Rouge St. Denis.*—The crude product was extracted several times with boiling potassium acetate solution, this being of such a strength that only a small quantity of the colour was thereby dissolved. A subsequent extraction with boiling alcohol removed some quantity of a dark brown impurity. The residue was finally crystallised from 80 per cent. alcohol. It formed a bright red powder consisting of small needles.

0·3855 grm. gave 0·0750 $Na_2SO_4$. Na = 6·28 per cent.
Requires Na = 5·97 per cent.

*Congo Red.*—Crystallised from 60 per cent. alcohol. Garnet-coloured needles, possessing a beetle-green lustre.

0·5900 substance gave 0·1240 $Na_2SO_4$.
Found Na = 6·79 per cent. $C_{33}H_{22}N_6O_6S_2Na_2$ requires
Na = 6·6 per cent.

*Benzopurpurine 6 B.*—Crystallised from 80 per cent. alcohol. Minute needles having an intense beetle-green lustre.

0·3922 substance gave 0·0777 $Na_2SO_4$.
Found Na = 6·41 per cent. $C_{31}H_{26}H_6O_6S_2Na_2$.
requires Na = 6·35 per cent.

*Brilliant Purpurine R.*—Crystallised from 65 per cent. alcohol. Scarlet needles having a slight greenish lustre.

0·4158 substance gave 0·1080 $Na_2SO_4$.
Found Na = 8·42 per cent. $C_{31}H_{25}N_6O_9S_3Na_3$
requires Na = 8·35 per cent.

*Roseazurine B.*—Extracted twice with a little boiling water and crystallised 65 per cent. alcohol.

Minute tangled needles having a beetle-green lustre.

0·7058 substance gave 0·1243 $Na_2SO_4$.
Found Na = 5·71 per cent.
$C_{36}H_{30}N_6O_6S_2Na_2$ requires Na = 6·12 per cent.

*Hessian Purple D.*—Crystallised 70 per cent. alcohol, potassium acetate being used in the purification.

Thick, irregular needles, having a green lustre.

0·3450 substance gave 0·1015 $Na_2SO_4$.
Found Na = 9·53 per cent.
$C_{33}H_{22}N_6O_{12}S_4Na_2$ requires Na = 9·93 per cent.

*Napthylene Red.*—Crystallised 75 per cent. alcohol.

Forms a beautiful glistening mass of red flat needles devoid of green lustre.

0·3482 substance gave 0·0712 $Na_2SO_4$.
Found Na = 6·64 per cent.
$C_{30}H_{20}N_6S_2O_6Na_2$ requires Na = 6·85 per cent.

*Deltapurpurine 5 B.*—Crystallised dilute alcohol.

Very minute needles of a maroon colour.

0·2505 substance gave 0·0482 $Na_2SO_4$.
Found Na = 6·25 per cent.
$C_{34}H_{26}N_6O_6S_2Na_2$ requires Na = 6·35 per cent.

*Diamine Fast Red F.*—Crystallised 50 per cent. alcohol.

Stellate groups of red needles.

0·3495 substance gave 0·0780 $Na_2SO_4$.
Found Na = 7·23 per cent.
$C_{29}H_{19}N_5O_7Na_2S$ requires Na = 7·33 per cent.

*Diamine Red 3 B.*—Crystallised dilute alcohol with the aid of potassium acetate.

Fine violet-coloured needles having a green lustre.

0·2265 substance gave 0·0450 $Na_2SO_4$.
Found Na = 6·43 per cent.
$C_{34}H_{26}N_6O_6S_2Na_2$ requires Na = 6·35 per cent.

*Direct Red.*—Crystallised 65 per cent. alcohol.

Fine hair-like needles.

0·391 substance gave 0·0740 $Na_2SO_4$.
Found Na = 6·14 per cent.
$C_{35}H_{23}N_6O_7S_2Na_2$ requires Na = 6·14 per cent.

*Diamine Scarlet B special.*—65 per cent. alcohol.

Stellate groups of bright scarlet needles.

0·4315 substance gave 0·0790 $Na_2SO_4$.
Found Na = 5·93 per cent.

*Erika B.*—Crystallised twice from water, and then from 75 per cent. alcohol.

Minute needles.

0·4350 substance gave 0·0955 $Na_2SO_4$.
Found Na = 7·11 per cent.
$C_{26}H_{19}N_3O_7S_3Na_2$ requires Na = 7·33 per cent.

*Hessian Brilliant Purple.*—Dilute alcohol with the aid of potassium acetate. Thick needles.

0·3260 substance gave 0·1055 $Na_2SO_4$.
Found Na = 9·99 per cent.
$C_{34}H_{22}N_6S_4O_{12}Na_4$ requires Na = 9·93 per cent.

*Brilliant Congo R.*—Crystallised from water, with the aid of potassium acetate. Bright red powder having a slight greenish lustre.

0·3465 substance gave 0·0940 $Na_2SO_4$.
Found Na = 8·78 per cent.
$C_{34}H_{25}N_6O_9S_3Na_3$ requires Na = 8·35 per cent.

*Brilliant Congo G.*—Crystallised in a similar manner. Not obtained definitely crystalline. Bright red mass.

0·3615 substance gave 0·1000 $Na_2SO_4$.
Found Na = 8·95 per cent.
$C_{32}H_{21}N_6O_9S_3Na_3$ requires Na = 8·66 per cent.

*Hessian Purple B.*—Crystallised from water twice, and from dilute alcohol with the aid of potassium acetate. Violet needles, having a green lustre.

0·3000 substance gave 0·0900 $Na_2SO_4$.
Found Na = 9·70 per cent.
$C_{34}H_{22}N_6O_{12}S_4Na_4$ requires Na = 9·93 per cent.

*Hessian Purple N.*—Crystallised from dilute alcohol with the aid of potassium acetate. Needles having a green lustre. Is difficult to obtain crystalline, being more readily deposited in a gelatinous condition.

0·2885 substance gave 0·0615 $Na_2SO_4$.
Found Na = 6·8 per cent.
$C_{34}H_{21}N_6O_6S_2Na_2$ requires Na = 6·37 per cent.

*Maroon for Wool.*—Crystallised from water and dilute alcohol. Flat needles, appearing as a salmon-brown coloured glistening mass.

0·2400 substance gave 0·0400 $Na_2SO_4$.
Found Na = 5·41 per cent.

Other colours of this class which were crystallised but not examined as to their purity were—

*Benzopurpurine 10 B.*—Flat needles having a coppery lustre.

*Salmon red.*—Needles resembling Benzopurpurine 4 B.

*Hessian Purple N B.*—Resembling Hessian Purple N.

It suggested itself that these colours might contain water of crystallisation, but to examine each critically in this respect would have occupied more time than was at my disposal. The above analyses were all made with the samples all dried at 100° till constant, but it is of course possible that even at this temperature water of crystallisation might still be retained. In consequence, however, of the high molecular weight of these dyes, it will be found that one or even two molecules of water of crystallisation would not greatly interfere with the percentages recorded above; for instance, taking Benzopurpurine 4 B.

$C_{34}H_{26}N_6O_6S_2Na_2$ requires Na = 6·35 per cent.
$C_{34}H_{26}N_6O_6S_2Na_2H_2O$ requires Na = 6·20 per cent.
$C_{34}H_{26}N_6O_6S_2Na_22H_2O$ ,, Na = 6·05 ,,

Before leaving this portion of the subject it will be well to mention a method which, though not fully examined, suggested itself lately as a somewhat ready means for the purification of these dyes. It is based upon the fact that the ammonium salts of some sulphonic acid crystallise more readily, and are soluble in stronger alcohol than the corresponding sodium salts. A solution of the dyestuff is treated with sufficient acid for its precipitation, and the free sulphonic acid thus produced, collected, drained, and washed once with water. It is then suspended in water, neutralised with ammonia, the solution of the ammonia salt evaporated to dryness, and the residue crystallised from alcohol or this solvent in a slightly diluted condition. To convert this into the sodium salt, it is suspended in alcohol, a few drops of alcoholic soda added, and the mixture gently warmed. The insoluble sodium salt is collected, washed with alcohol, and dried. A preliminary examination of this method has promised satisfactory results.

### *The Acid Reds.*

The purification of these colours was effected by crystallisation from water and dilute alcohol. Many are known to be crystalline, and all those experimented with were obtained in this condition with comparative readiness. It is not necessary to record the details of purification here.

*Crystal Ponceau 6 R.*—Thin leaflets having a bronze lustre.

Na found. = 9·3 per cent.
Theory $C_{20}H_{12}N_2O_7S_2Na_2$ = 9·16 per cent.

*Buffalo Rubine.*—Glistening needles having a green-bronze lustre.

Found Na = 8·95 per cent.
$C_{20}H_{12}N_2O_7S_2Na_2$ requires Na = 9·16 per cent.

*Crocein B.*—Groups of minute needles.

Found Na = 8 per cent.
$C_{22}H_{14}N_4O_7.S_2Na_2$ requires Na = 8·27 per cent.

*Brilliant Crocein M O O.*—Scarlet needles.

Found Na = 8·28 per cent.
$C_{22}H_{14}N_4O_7S_2Na_2$ requires Na = 8·27 per cent.

*Ponceau 5 R.*—Long, flat needles.

Found Na = 10·15 per cent.
$C_{22}H_{13}N_4O_{10}S_3Na_3$ requires Na = 10·6 per cent.

*Crocein Scarlet O X F.*—Flat needles.

Found Na = 8·6 per cent.
$C_{20}H_{12}N_2O_7S_2Na_2$ requires Na = 9·16 per cent.

*Bordeaux B X.*—Fine needles.

Found Na = 4·76 per cent.
$C_{26}H_{23}N_4O_4SNa$ = 4·51 per cent.

*Cloth Red 3 B extra.*—Stellate groups of minute needles. Is somewhat difficult to obtain in this condition.

Found Na = 4·56 per cent.
$C_{26}H_{24}N_5O_3SNa$ = 4·51 per cent.

*Fast Bordeaux.*—Minute needles.

Found Na = 7·48 per cent.
$C_{24}H_{18}N_4O_7S_2Na_2$ = 7·87 per cent.

*Cloth Red 3 G extra.*—Stellate groups of minute needles.

Found Na = 4·82 per cent.
Theory Na = 4·78 ,,

*Ponceau Sextra.*—Groups of flat needles.

Found Na = 12·38 per cent.
Theory Na = 12·1 ,,

*Croceine Scarlet 7 B.*—Leaflets.

Found Na = 7·86 per cent.
Theory Na = 7·87 ,,

Others were obtained in a crystalline condition, but were not examined as to their purity.

Anisol Red. Fine red needles.
Coccinine B. ,, ,,
Kresol red. ,, ,,
Napthorubine. Very fine needles.
Fast Red B. ,, ,,
Cotton Scarlet. Thin leaflets.
Ponceau 2 S extra. Hair-like needles.
Bordeaux G. Fine brown needles.
Brilliant Scarlet G. Long thin, plates.
,, Crocein 9 B. Very minute needles.
,, Scarlet G G. ,, ,,
Crocein Scarlet O F. Fine needles.
Coccinnin. Brown prismatic needles.
Cochineal Scarlet 4 R. Prismatic needles.

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## CYANIDES OF IRON AS MORDANTS FOR BASIC ANILINE DYES.

BY G. DONALD.

In the Journal of this Society for Dec. 1894, 1193, there appears the abstract of a communication by W. E. Kay to the Bulletin de la Société Industrielle de Mulhouse, respecting the statement of M. Camille Schoen in the Bulletin of May 7, 1894, that he had succeeded in fixing basic coal-tar colours as reserves under aniline black by means of ferrocyanides, without the aid of tannin. Within recent months several processes of this nature have been published, viz., by W. E. Kay, patented in England, 12th Jan. 1893; Camille Schoen, as above stated, and Ferd. Oswald (Bull. Soc. Ind. Mulhouse, June 1894). Regarding this interesting property claimed for the ferrocyanides, Dr. Chas. Dreyfus, speaking of Mr. Kay's process, said (this Journal, 1894, 485). "The remarkable part in this invention is the observation made by the inventors, that certain aniline dyes (we presume the basic dyes) are sufficiently fixed without the aid of *any mordant* when printed on the cloth prepared with an undeveloped aniline black mixture, one of the ingredients of which is a *ferrocyanide;* this observation should be followed out to its logical conclusion, and experiments should be made to know if ferrocyanides do actually act as mordants for basic aniline dyes, and fix them as effectually as tannic acid and emetic mordants."

While Mr. Kay appears to have been first to make use of this property in connection with resist colours under aniline black, still it was known, I find, to at least one investigator who published the results of his experiments over ten years ago. M. Chas. Reber, jun. (Bull. de Rouen, 1884, 768), padded cotton cloth in a solution of potassium ferro- or ferricyanide, dried, printed with the basic aniline colours steamed, and lightly soaped. He also printed or padded potassium ferro- or ferri-cyanide on cotton cloth, passed through a bath of zinc sulphate, and dyed with aniline colours. Another method he used was to precipitate the ferro-cyanides and basic aniline colours as lakes, thicken with albumin, print, and fix by steaming. (*See also* Dingl. Polyt. J. 256, 42; Textile Recorder, Manchester, May 1885, 7; and this Journal, May 1885, 342.)

## ON THE DETERMINATION OF MORPHIA IN OPIUM.

BY LYMAN F. KEBLER, M.S.

In a communication presented at the last meeting of the Amer. Pharm. Association, convened at Ashville, N.C., I stated that as high as two per cent. of foreign matter had been found in the morphia obtained by the officinal process. This remark was not made in a captious spirit, but rather as a stimulus for further investigation in the direction of securing a purer final product representing fairly the morphia strength of the opium, and simultaneously rendering the method more expeditious. I am fully convinced that the present officinal process is by far the most efficient method we are in possession of to-day.

Simultaneously with the above contribution, appeared (1894, Am. J. Pharm., **66**, 433), an able article by Mr. F. X. Moerk, in which he enumerates several observations frequently noticed by myself; among which may be mentioned, especially, the large percentage of impurity contained in the morphia, established by igniting the morphia and basing calculations on the resulting residue. Mr. W. T. Hankey (1891, Am. J. Pharm., **63**, 113), certifies that this procedure is so infinitely superior to the lime-water and absolute alcohol as corrigenda that the two latter cannot be compared with the former, but does not supply data to justify this conclusion. Not only is this procedure quite impracticable in the average pharmacist's laboratory, but also exceedingly arbitrary. It is based on the assumption that the impurity consists entirely of calcium meconate which an approximate analysis of the ash does not support.

I have frequently estimated the percentage of ash in the crude morphia from the various assays and found it to vary from 0·91 per cent. to 1·41 per cent. or calculated as calcium meconate from 2·32 per cent. to 3·59 per cent. The percentage of ash varied with the time allowed for precipitation as well as the kind of opium. Any operator is perfectly safe to deduct the percentage of ash from the morphia, but more than this he is barely justified in doing so long as the contents of the ash are not even approximately known to him.

When we consider the small percentage of ash contained in crude morphia, we can readily see that it necessitates many assays to accumulate a sufficient quantity to justify even an approximate analysis of the residue. Accordingly, when enough material was collected to warrant such a course, the crude morphia obtained from about 30 assays was well powdered and intimately mixed in a mortar. For qualitative analysis five grms. were gently incinerated and brought to a bright red heat, where it was retained until the ash was white. The residue was then treated with an aqueous solution of ammonium carbonate, carefully dried and again heated to a dull redness for several minutes. This converted the caustic lime into calcium carbonate. On treating the residue with a small quantity of water and testing the reaction of the aqueous solution, I was surprised to find it alkaline. This unquestionably demonstrated the presence of a fixed alkali, for the calcium had been converted into a carbonate. A few tests proved the presence of potassium, sodium, and a carbonate. It is valueless to enumerate the remaining constituents of the ash here, since the following quantitive analysis depicts them very clearly.

For quantitative analysis 25·8 grms. of the crude morphia were carefully treated as above. 0·3329 grm. or 1·29 per cent. of ash were secured, yielding on analysis:—

| | Per Cent. |
|---|---|
| Soluble in water ($K_2CO_3$, $K_2SO_4$, NaCl) | 27·88 |
| Silica | 0·83 |
| Aluminium phosphate | 0·43 |
| Magnesium phosphate | 13·45 |
| Calcium carbonate | 56·17 |
| Loss | 1·24 |
| Total | 100·00 |

I was much surprised when it was observed that the ash, when treated as above, had an alkaline reaction; but you can imagine my astonishment when I found 27·88 per cent. of the ash soluble in water, consisting of potassium carbonate, potassium sulphate and sodium chloride. On the above analysis of the ash can be based a calculation of the per cent. of pure morphia contained in the crude morphia. 56·17 of 0·3329 grm. equals 0·187 grm. of calcium carbonate, which multiplied by the factor 2·55 equals 0·4768 grm. or 1·85 per cent. of calcium meconate. 0·187 grm. of calcium carbonate deducted from the total ash, 0·3329 grm., equals 0·1459 grm. or 0·565 per cent. of ash not derived from calcium meconate, giving us a total impurity of 2·41 per cent. against 3·29 per cent., if the entire ash was calculated as calcium meconate, leaving 97·59 per cent. of pure morphia.

The above 30 assays represent about 100 cases of opium and it is not unfair to assume that these assays also represent the average opium in the market. The morphia was allowed to precipitate from 16 to 20 hours or over night, as we conveniently term it.

In view of these facts, the above analysis of the ash may fairly be taken as a basis of calculation, if it is convenient to employ the ash method, for establishing the percentage of impurity in the crude morphia. It must be borne in mind, however, that the same time is allowed for precipitation and the morphia must be fairly white to begin with, otherwise the colouring matter will be calculated as morphia.

That this method gives very satisfactory results is clearly demonstrated by estimating the per cent. of pure morphia in crude morphia, identical in composition to that used for obtaining the ash for the above analysis, by the several processes, including titation with volumetic acid solutions, employing the various indicators especially prepared.

| | Per Cent. |
|---|---|
| Ash method, pure morphia | 97·59 |
| Lime-water method, pure morphia | 98·22 |
| Absolute alcohol, pure morphia | 98·33 |
| Methyl orange solution, pure morphia | 100·02 |
| Cochineal solution, pure morphia | 99·53 |
| Litmus solution, pure morphia | 98·93 |
| Brazil wood solution, pure morphia | 98·47 |
| Haematoxylin solution, pure morphia | 97·59 |

The per cent. of pure morphia according to the ash method is, if anything, a trifle high. If this method could be utilized by all who assay opium, it would be the most desirable process for establishing a correction. According to the above data, excluding the ash method, there is but a slight difference; and ultimately, whether the lime-water or the absolute alcohol process be employed, it is only a question of relative expedition. The lime-water certainly possessed a marked advantage, both for rapidity and cheapness, over absolute alcohol, but titration with volumetric acid solutions has a decided advantage over both for rapidity and rivals them in accuracy. Titration with volumetric acid solutions is by far the quickest procedure; and since the U.S.P. of 1890, requires both a decinormal acid solution and a centinormal alkaline solution in the course of standardizing some of its preparations, there can no valid objection be raised against this process. Haematoxylin as indicator has given me the most satisfactory results with morphia. With both the lime-water and the absolute alcohol methods, counterpoised filters are employed. I have always, with a certain degree of reluctance, employed counterpoised filters for accurate work, feeling that a certain degree of uncertainty lurked in them. Where all facilities are at hand, I would rank the four methods as follows: 1st, the ash method, based on the above analysis of the ash; 2nd, titration with volumetric acid solutions, using haematoxylin as indicator; 3rd, the lime-water method; and last, the absolute alcohol process.

Having duly considered the methods for obtaining a correction for the crude morphia, let us now investigate how much morphia is lost and where it is lost. I stated above that the percentage of ash or purity in the crude morphia varied with the time allowed the morphia for precipitation. This has frequently been observed by making two duplicate assays of the same opium, allowing one set of duplicates to precipitate 16 hours, the other set one day longer; the latter invariably contained the greater percentage of ash. In view of this fact, a series of experiments were undertaken to establish how many hours are required for precipitating the maximum amount of morphia containing a minimum amount of impurity. Dr. Squibb (Ephemeris, **3**, 1155) executed a series of experiments with a view of shortening the process. His results indicate that it is safer to allow the morphine to precipitate over night, or about 16 hours. On the same page, Dr. Squibb conveys the idea that the precipitation is complete in 10 hours; to quote his own words, "After four or five hours, a film begins to form on the bottom of the flask, and this increases up to six or seven hours, and is not surely complete under 8 or 10 hours." My experience has been that the precipitation is not complete in even 40 hours. The following results will be the best support for this assertion.

100 grms. of powdered opium were extracted with 3,000 c.c. of water. The first 1,500 c.c. were kept distinct from the second 1,500 c.c. The analyses were made as usual, allowing the time of precipitation to vary from three hours to 36 hours. The table below contains the percentage of pure morphia by the ash method, the lime water method and titration with volumetric acid solutions for the several hours during which the morphia was allowed to precipitate.

| —— | Hours. | Hours. | Hours. | Hours. | Hours. | Hours. | Hours. | Hours. | Hours. |
|---|---|---|---|---|---|---|---|---|---|
| Time allowed for precipitation | 3 | 5 | 8 | 12 | 16 | 20 | 24 | 28 | 36 |
| Per cent. of crude morphia in the opium | 13·03 | 14·32 | 14·35 | 14·72 | 14·80 | 14·81 | 14·85 | 14·98 | 15·17 |
| „ of ash in the crude morphia | 0·91 | 1·33 | 1·41 | 1·81 | 1·90 | 2·00 | 2·10 | 2·63 | 3·00 |
| „ of pure morphia in the crude morphia by the ash method. Based on the above analysis. | 98·54 | 97·34 | 97·35 | 97·63 | 96·65 | 96·28 | 96·10 | 95·06 | 94·45 |
| Per cent. of pure morphia in the opium by the ash method. Based on the above anaylsis. | 12·84 | 13·94 | 13·97 | 14·22 | 14·28 | 14·26 | 14·27 | 14·24 | 14·32 |
| Per cent. of pure morphia in the crude morphia by the lime-water method. | 99·10 | 98·01 | 98·21 | 97·32 | 96·70 | 96·40 | 96·31 | 96·02 | 96·21 |
| Per cent. of pure morphia in the opium by the lime-water method. | 12·91 | 14·03 | 14·09 | 14·31 | 14·34 | 14·27 | 14·31 | 14·39 | 14·59 |
| Per cent. of pure morphia in the crude morphia by titration. | 98·17 | 97·26 | 97·56 | 97·03 | 96·52 | 96·31 | 96·31 | 95·81 | 95·02 |
| Per cent. of crude morphia in the opium by titration. | 12·78 | 13·92 | 13·99 | 14·28 | 14·28 | 14·26 | 14·30 | 14·35 | 14·41 |

A careful perusal of the above results will present the facts in a most lucid manner. It is quite significant to notice the general increase of both the morphia and the impurity as the time increases. This increase is, indeed, not by an increment proportional to the time allotted for precipitation, but the general increase is marked. The decided increase from 8 to 12 hours, in this case, is worth a passing notice. An examination of the crude morphia reveals the fact that more morphia was precipitated during the four hours intervening between the 8 and

12 hours of precipitation, than during any other subsequent four hours. The morphia obtained by allowing three hours for precipitation was decidedly purer than any subsequent precipitation of longer duration. In fact, the morphia gradually became darker up to 20 hours, when the external appearance remained practically uniform.

In connection with estimating the percentage of ash, I also examined the contents of the ash, and especially noticeable was the ever present alkaline reaction imparted to the water brought in contact with it. The presence of potassium calcium, and meconic acid was established in morphia of only three hours precipitation. Undoubtedly the remaining ingredients of the ash, as established above, were present. This was proven to be the case in every sample of ash where enough of the residue was obtained for examination. In that the three hour morphia contained an appreciable quantity of ash, I feel quite sure that part of the ingredients forming the ash are precipitated immediately on adding the alcohol, ether and ammonia water.

I have frequently observed in the course of the analysis that when the 10 grms. of alcohol are carefully added to the 20 grms. of aqueous extract and gently rotated the supernatent alcoholic layer becomes opalescent. The alcohol in one case was well mixed with the aqueous extract and allowed to stand one day. Apparently quite a precipitate of a dark brown colour was formed, but on decanting the greater portion of the menstrum and collecting the precitate on a counterpoised filter, it was found to be only 0·14 per cent., giving reactions for potassium and meconic acid. It was impossible to make a further study of this small quantity, but it demonstrated that the alcohol alone aids in precipitating part of the impurity contained in the morphia.

We have now demonstrated the amount of crude morphia precipitated during the different intervals of time, the percentage of pure morphia contained in the contaminated article and the quantity of inorganic matter as well as organic material associated with the impure product. The one thing paramount in our minds for the present at least, is the percentage of pure morphia. To what extent are the figures representing the pure morphia, in the above table, below the percentage actually contained in the opium?

My experience with the analysis of opium leads me to say that this question cannot be answered exactly with this opium or any other opium that may be investigated. But I feel confident that a co-operation on the part of the various workers will bring about a slight modification of the present process that will give us a final product needing no correction, or possibly demonstrate that the present method, if closely adhered to, yields a product that will not need a correction, that is, the impurity associated with the morphia does not exceed the amount of morphia lost in the assay process.

It has frequently been observed, by others as well as myself, that a deposit forms in the mother liquor mixed with the wash water, when allowed to stand even a short time. Accordingly the mother liquors and the wash waters were carefully collected from eight of the above assays; omitting the three hour assay and rejecting all ethereal and alcoholic washings in a bottle.

This mixture was agitated a number of times during two months. A considerable precipitate was formed during this time. The liquid was carefully decanted and the precipitate gathered on a counterpoise filter, well washed and dried below 60° C. This precipitate amounted to 0·6480 grms. or an increase of 0·81 per cent. of morphia for the opium. A portion of this residue when carefully incinerated yielded 12·24 per cent. of ash. The ash consisted chiefly of calcium carbonate, but a trace of potassium was present. Granting that the ash was composed entirely of calcium carbonate, then 31·23 per cent. of the above precipitate was calcium meconate. A second portion of the precipitate was carefully titrated, as above; this gave 54·43 per cent. of pure morphia, leaving 14·34 per cent. of organic matter, not morphia. The average of the eight assays, according to the three methods above, is 14·22 per cent. of pure morphia But 54·43 per cent. of the 0·81 per cent. (precipitate from mother liquors and aqueous washings) represents pure morphia or 0·44 per cent. which added to the 14·22 per cent. gives 14·66 per cent. as total morphia. Nor is this all; for after allowing the same mixture, from which the above precipitate was obtained, stand a month longer another perceptible precipitate was obtained. This was neither estimated nor examined.

After allowing the mother liquors and aqueous washings to stand for three months an aliquot part, freed from any sediment and representing one assay, was taken and treated according to Mr. Dieterich's process, viz., shaken out twice with 30 c.c. of chloroform and the chloroformic solutions evaporated to dryness. The residue was next dissolved in 2 c.c. of normal sulphuric acid, 3 c.c. of water added and neutralized with a sufficient quantity of normal ammonia water. The resulting mixture was filtered and the residue washed with a little water. To the mixed filtrate and washings 2 c.c. of ether and 0·5 c.c. of normal ammonia water were added and set aside for 24 hours, to allow the morphia to crystallise. By this process 0·15 per cent. of morphia was obtained. The quantity of morphia obtained by Dieterich's process was insufficient to make a qualitative examination, consequently we must rely on the originator of the method for its efficiency. It ought to be stated, however, that an examination of the product proved the presence of morphia. The percentage of morphia obtained by this procedure added to the already pure morphia secured, gives us a total of 14·81 per cent.

In all analytical work the two eminently essential elements are time and accuracy. A short method yielding uncertain results is valueless. A long, laborious time-consuming process has few advocates, even though the results are good. What we want is brevity of time coupled with accurate results. The two are frequently incompatible. In the analysis of opium this seems to be true. According to the outlines originally presented by Dr. Squibb, from two-and-a-half to three days are consumed for an assay. This includes the time required for making the correction with the lime water. About two days are required to secure the crude morphia, and nearly a day is required to make the correction.

By employing the ash method the correction can be made in two hours, while titration with volumetric solutions requires not more than half an hour. But is this correction necessary for the average well-executed assay? I always considered it essential. The cry against the method has been "too high results." Dr. Squibb claimed that the morphia was not completely extracted by the process. On comparing the percentage (14·81) of pure morphia obtained by this investigation with the percentage of crude morphia obtained during the several hours of precipitation (*see* table above) we find that it corresponds exactly with the 20-hour precipitate. From the observations embodied in this investigation I conclude that the amount of impurity contained in the morphia, obtained by this process, corresponds very closely to the percentage of morphia lost in the assay; that is the amount of morphia obtained by allowing from 12 to 16 hours for precipitation does not exceed the percentage of morphia actually contained in the opium. The crude morphia does not need a correction if the text is closely adhered to.

A point deserving especial consideration in this connection, before we close, is the precipitate issuing from the filter when the first aqueous washings are added to the precipitated morphia. This loss has harrassed me in no small degree, but as yet I have not found a remedy. The precipitate appears to be so fine that it defies the best filter paper to retain it. The loss is small, to be sure, and it does not occur with every sample of opium; but where it does occur it is a loss that ought to be prevented.

In conclusion, I would say, that on account of the voluminous literature existing on the analysis of opium, it becomes practically impossible to give individual credit, consequently I here, once for all, give credit to every one entitled to it. I have consulted literature freely.

## DISCUSSION.

Dr. SQUIBB said: "It seems fortunate that attention is being drawn to the correction of results in the determination of morphia by the officinal process, for the reason that that correction is, in my judgment, eminently necessary; that is to say, necessary when the desired degree of accuracy is known beforehand. The author of the paper very strongly emphasised the character which should belong to a process for the determination of the morphia in opium, namely, one that was not so short as to be inaccurate, and not so long as to be troublesome and obstruct the process by delay. Here, then, we should attempt to draw some line, but that line is a movable one, which must always depend upon the use to which the process is to be put. For an ordinary assay of opium by a pharmaceutist the officinal process seems to be sufficient, but when more accuracy than that is required it is certainly necessary to correct the crude morphia results.

Then comes the choice of a process to correct the results. If the results are required to be very accurate, that process must be carefully chosen and then be applied in proportion to the required degree of accuracy. I should be disposed to claim that the correction by the limewater process was sufficient for all ordinary purposes, but where great accuracy is required titration may be also applied. I never have put much confidence in the ash process of correction, but very easily comprehend that in expert hands it may be a very satisfactory process.

As an illustration of the necessity of choosing a process of correction in accordance with the purpose of the assay, Dr. Wainwright's practice supplies a good illustration where it is only necessary to determine that the opium contains not less than 9 per cent. of morphia. He might meet with a case where the 9 per cent. limit was so nearly reached as to require him to apply very accurate processes; but for his ordinary work it would be unnecessary to apply any correction. It would be useless for Dr. Wainwright in his hundreds of assays that are made at the Custom House of this port to obtain or to seek for very great accuracy in his results. On the other hand, if a scientific investigation is to be made of competing opiums it is very necessary to apply one or other of these corrections. I am very glad that the subject has come up so often of late, for I have always regretted that the committee of revision of the U. S. Pharmacopœia did not give the limewater process for the correction of its results whenever correction is needed as shown by a qualitative testing by lime water. But even the qualitative testing given in my process of assay is omitted by the Pharmacopœia.

In regard to the long or short time given to the precipitation of the morphia from the mother liquor. I make the same point of utility as in the other case. That is to say, if a very great degree of accuracy is required give the long time. If a moderate degree of accuracy is required, take less time. If no great accuracy is required, give still less time. My experience teaches me that the precipitate which we get by long time contains very much less morphia than it does of other matters; that the precipitate after the ten hours or twelve hours contains very little indeed, whilst the impurities insoluble in lime water increase more rapidly, so that there, again, we come to the choice of a method of procedure best adapted to the differing uses of the process of assay.

One more point, perhaps, I may make. It is rather dangerous to carry the principle of counterbalancing errors into an important process of assaying a complex organic substance which differs as much as different opiums do, the danger being in carrying this mode of estimation too far, and allowing it to cover up imperfect work.

Dr. Wainwright said: The subject of the correction of the amount of morphia yielded, as Dr. Squibb truly says, depends upon the object with which the assay is made. My experience has been in, I might say, almost 90 per cent. of the assays that I have ever had any occasion to make, that the impurities have been practically insignificant—so insignificant that they would not materially affect the result one way or the other for my special purposes. Of course, if we are going to make a chemical analysis of a substance like opium where we want the highest degree of accuracy, why, in that case, we would naturally correct all of our results. However, it seems to me that before we apply any method of correction such as this we should use some means to extract *all* the morphia that the opium contains and weigh *that* before we correct it. The lime-water test seems to fill every need, as far as a practical correction is required for assay purposes. The correction that Dr. Stillwell some time ago published is, I have found, one of the most easily applicable and practical methods for correcting the results. The results yielded by Dr. Stillwell's method of treating the crude morphia after weighing with hot alcohol and weighing the trifling amount of insoluble residue left, yields results which almost always check the lime water correction. I personally have never had any experience with the ash method of correction. However, if any process of assay will yield morphia, as I understand Dr. Kebler to say, which is 98 per cent. pure, why, it would seem to fulfil all the requirements necessary for a process of assay such as a commercial chemist would ever be apt to require.

In regard to the amount of time required to produce the precipitation of morphia, it depends very largely on the amount of soluble matter that the opium contains and the character of that soluble matter. If it is very thick and gummy, more time will be required. If the amount of insoluble matter in opium is large, and the extract is thin and watery, less time will be required. My experience, though, has been, and I think Dr. Squibb has stated it somewhere, that the separation of the morphia from the filtered and concentrated solution of the opium can be very much hastened by agitation. I have tried one or two experiments on this point, and have found that, after having added the alcohol, ether and solution of ammonia, agitating the solution for two or three hours will give a precipitate of morphia crystals which will check very closely the amount obtained after allowing it to stand over night, or even as long as 20 hours, and that the purity of the morphia obtained by agitation in that way is apt to be higher than in the case of its spontaneous precipitation. I question the utility of exacting in all cases from any process of assay, necessarily more or less crude, a correction of results which is so seldom needed in the hands of a skilled pharmaceutist or analyst. In the hands of such the necessity for correction would almost invariably suggest itself. In most cases he would find that no correction is needed. The appearance of the precipitated morphia usually indicates whether it is necessary to correct the result or no. If the very high results are yielded, for instance, say 15 per cent. of morphia or more, a correction should be made as a matter of precaution. Usually where the results are as high as that there will be considerable impurity in the morphia. If, however, low results are given with a light-coloured precipitate of crystals, it would be very seldom that the amount of impurity will cut any figure in the result at all, unless extreme accuracy is required.

Mr. Stillwell said: In regard to the amount of time for precipitating opium and the appearance of the precipitate, I have often noticed that in certain grades of opium the precipitate is much cleaner and more crystalline than in others; and one accustomed to the treatment of opium by analysis can easily tell approximately the amount of impurity. I have noticed over and over again where I have been unable to finish on opium the next day after precipitation, that is, after one night's standing, that the amount of impurity that comes down after standing over another night is very much larger than ordinary in that class of opiums, and it has been an invariable rule with me to purify in all cases. Sometimes there is very little correction needed, no more than two or three tenths of 1 per cent., sometimes less than that, but usually it is more because these low grades with 10 to 11 per cent. morphia have more impurities. The treatment with alcohol—and I think I was the first one to publish it, as far as I know—I use because by that treatment I get a solution of alcohol which is saturated with morphia, and that is used for washing. With regard to that precipitate that comes down when the wash water is added, I am quite sure there is no morphia in that; at least, I think I proved it myself. It seems to be a sort of separation of gum, a mucilaginous matter, or something of that kind, when the water strikes the alcoholic solution that is already run through, because I have let the wash water stand for a long while and got no real crystalline morphia precipitate. It is simply a sort of flocculent precipitate which contains gum. I was hoping that the paper would give some comparative results on the pharmacopœia method as compared with others; that is, where the extraction is carried to the total amount of morphia present, instead of taking it an aliquot part. I do not know, though, that that was germane to the subject of the paper. But in all cases a chemist, where he is called on to analyse a morphia for a percentage, on which the price is fixed, must make a correction if in his judgment it is necessary, an actual determination of the impurities present. The lime water and alcohol methods I think are practically one and the same, as far as the correction goes.

Dr. Endemann said: In all those cases where the absolute quantity of morphia is to be determined the method of Mr. Kebler is quite commendable though it does not increase the accuracy very much over those methods which have been known already before. It is peculiar, that up to the present time nobody seems to have taken any notice of an observation made and published by Dr. Squibb some years ago, namely, the fact that the addition of a small quantity of sulphuric acid in extracting the opium will increase the amount of morphia which is obtained from the opium. The additional quantity of morphia which is obtained in that way is far greater than any of the differences which exist in the methods of purification of the morphia obtained by the ordinary method. At one time I extracted a large quantity of opium, probably about 60 grammes, in the ordinary way by water. The residue from this was then again extracted with water and such quantity of sulphuric acid as Dr. Squibb at that time proposed to be added to the original water of extraction. In this way I obtained over one per cent. of morphia more from the opium, which according to the old method had been exhausted already. Another question has been raised with regard to the time which is necessary to precipitate the morphia. I have had an opium which was extracted, without the addition of sulphuric acid, because it was to be tested according to the ordinary method, to see whether it could be imported under the Tariff Act, and the opium assay had proceeded to the precipitation. It was shaken repeatedly during the day and afterwards allowed to rest over night. Next morning I found in both flasks but a trifling precipitation. The consequence was that I filtered only one of the tests and let the other one rest, because it appeared to be hardly of any use to complete both tests, for there seemed to be very little morphia present. This happened on a Saturday, and the other flask remained until Monday, and when Monday came this flask held a very heavy precipitate, as was in the wash waters which were obtained from the first flask. This shows that under certain circumstances the morphia may come out exceeding slowly, and I think that the time which is necessary to precipitate all the morphia is a factor which certainly should not be neglected.

Dr. Squibb: In regard to the use of alcohol as a corrective solvent, if absolute alcohol is really used, such as Dr. Stillwell and I would be likely to use, it is a very good way of correcting results; but when the pharmaceutist undertakes to use absolute alcohol he generally gets a 96 or 97 per cent. alcohol, which is called absolute, and then a good deal of other matter beside morphia is dissolved out.

Mr. Kebler: Mr. Chairman, I would like to ask the gentleman about sulphuric acid. Would not the increase possibly be due to the formation of ammonium sulphate? I know, when I have assayed some samples of opium, I always got a precipitate when I added the alcohol to the ether, and then added ammonia. I always got a little precipitate. Now was not that ammonia sulphate?

Mr. Endemann: It was not ammonium sulphate, because it was afterwards tested for morphia. It was real morphia. It was tested afterwards with the ordinary lime-water method and also with the alcohol method.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Improvements in or relating to the Filtration and Purification of Liquids, and Apparatus therefor.* A. J. Boult, Middlesex. From P. de Mol and A. Wilbaux, Laeken, Brussels. Eng. Pat. 3414, February 17, 1894.

The water to be purified is filtered through layers of (1) clean sponges, (2) wood charcoal, (3) gas carbon, supported one above another on gratings covered with hair felt. The wood charcoal is obtained from six different kinds of wood "by distillation with acids," and "the analysis of the water determines in each individual case, which species of wood charcoal is most suitable." The gas carbon is also variously prepared, and a variety of hair felts are employed.—L. A.

*An Improved Apparatus for Drying Phosphates, Marl, Clay, Sand, and other Materials.* D. W. Anderson and G. W. Parsons, Virginia, U.S.A. Eng. Pat. 4952, March 9, 1894.

The apparatus patented consists of a series of conveyors running in trough-shaped boxes constructed of fireclay, tiles, or similar refractory material, and set across the length of a number of flues fed by a furnace at the side and having their exit gases withdrawn by an appropriate shaft. The materials to be dried, such as those mentioned in the title, are fed in through a hopper into the trough of a single conveyor having its axis at right angles to the axes of the series of conveyors set over the flues. This conveyor distributes the material into the troughs of the drying conveyors, whence the dried substance ultimately is fed into the trough of another single conveyor serving to collect the substance which has passed through the drying trough.—B. B.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

*Improvements in Machines for Packing Powdered and other Substances in Bags or like Wrappers.* W. Harris and A. Smith, Aston. Eng. Pat. 9180, May 9, 1894.

The central portion of this machine consists of two revolving circular operating tables, each pierced with several openings or recesses of equal size, so placed one above the other—not concentrically, but geared together to move at equal speed—that the openings in both will coincide at a certain point. An intermittent revolving motion is imparted by a ratchet actuated by levers worked from the main driving shaft, and the object of the apparatus is to measure or weigh out a regular quantity of substance and successively compress, bag, and deliver the same completely packed.—C. S.

*Improvements relating to Vessels for Containing Gas, under Pressure.* W. W. Pope, Slough, Bucks. Eng. Pat. 9742, May 18, 1894.

To prevent a sudden rush of gas from vessels containing gas under pressure, a ball-valve is placed in the outlet pipe, with its seating vertically above it, so that when the flow of gas becomes too great, the valve is carried upwards and closes the outlet. An adjustable stop beneath the ball prevents the latter from falling entirely away, and the distance from the seating at which the valve rests is thereby capable of adjustment.—E. G. C.

*An Improved Method and Apparatus for Saturating Liquids with Gases, and for Bottling Liquids so Saturated.* J. F. Beins, Rotterdam. Eng. Pat. 10,523, May 30, 1894.

The inventor has designed an apparatus for accomplishing the object in view, without the use of any mechanism for mixing or agitating the gas with the absorbent liquid, by bringing them into contact while the latter is in a fine state of division.

The vessel in which the operation is performed is a strong cylinder divided into two portions by a partition, the upper to contain the liquid and the lower forming the mixing chamber. Communication between them is established by means of porous tubes, closed at the top but open below, fitting on to, or forming part of the partition, and projecting into the upper chamber.

When the chamber is filled with the liquid to be charged, the gas is forced into both compartments at once through a branched pipe, but the pressure at which it enters the lower chamber is reduced by a valve weighted to produce any relative difference that may be desired. The result is that the excess of pressure in the upper chamber forces the liquid through the porous tubes in a finely-divided condition, and it readily absorbs the gas while in that state.

To bottle the liquid after saturation, with a minimum of waste from "blowing off," a bottling nozzle is connected with the safety-valve of the upper chamber—which is fitted with a three-way cock for this purpose—and the valve unscrewed to resist a pressure only slightly inferior to that prevailing in the lower compartment. By this means the liquid is forced up into the nozzle and thence into the bottle, with the avoidance of all but the smallest proportion of waste.—C. S.

*An Appliance for Registering or Recording the Volume of Liquid passing through a Tank or Vessel.* W. P. Bruce, Currie, N.B. Eng. Pat. 17,253, September 11, 1894.

Within the measuring tank there is a float provided with a vertical spindle carrying a pencil, which moves over a vertical registering cylinder, so that the rise or fall of the liquid level is known; and when the capacity of the measuring tank is found, the volume passing through is therefore determined. In order to advance the registering cylinder at the end of each measurement, the spindle controlling the inlet and outlet valves is carried up and works a pawl so as to engage with a ratchet wheel upon the cylinder to effect the required movement, while a separate detent prevents the cylinder from springing back.—E. G. C.

*Improvements in Pumps for Rarefying or Compressing Gases.* T. Labinal, Paris. Eng. Pat. 3490, September 24, 1894.

In order to obtain a simpler connection between the clearances and the body of vacuum pumps than is afforded by Babinet's apparatus, the inventor bores in the wall of the cylinder, close against the head, one or more small passages opening again on to the interior at a distance from the first aperture of rather less than the thickness of the piston. A semicircular groove is then cut away from the substance of the piston, so that when the latter is just, or very nearly, at the end of its travel, the excised groove becomes coincident with the opening in the cylinder wall, and thus opens up communication between the spaces back and front of the piston. A similar arrangement is effected at the other end of the cylinder.—C. S.

*Improvements in Evaporating Apparatus.* D. P. F. Cardozo, New York, U.S.A. Eng. Pat. 1956, September 26, 1894. Under International Convention.

The invention relates principally to the evaporation and concentration of saline and saccharine solutions, and consists of a closed casing provided with a series of open flat pans, containing the liquid to be treated, exposed to the action of a current of hot air which circulates under, over, and around the pans to promote evaporation. The hot air is led in at the base by a broad, flat pipe immersed in liquid, and, after circulating through the apparatus, the hot air and vapour escape at the summit of the apparatus. There is an open projecting ferrule in each pan to prevent over-filling, and side doors in the walls of the apparatus enable the pans to be withdrawn and replaced.—E. G. C.

*A New or Improved Triturating and Emulsifying Machine.* W. B. Cowan, Guelph, Ontario, Canada. Eng. Pat. 18,928, October 5, 1894.

A revolving pan driven from a treadle by means of any suitable gearing, carries within it a pair of concavo-convex comma-shaped grinding stones, suspended from the two tangs of a fork, which is held by means of a spring link attached to a pillar outside the revolving pan, but fixed firmly in the base of the apparatus. The material to be ground and thoroughly mixed, is poured into the revolving pan, and reduced to an impalpable powder or slime by the stones, which swing outwards until they touch the sides, while their rounded inner ends swing freely on the tangs of the suspending fork which project into them. Each stone is thus independent of its fellow, and the shaft of the fork is pivoted at its upper end in the extremity of the spring link or fork-holder. The fork-holder or link is furnished with a spring which controls a hinge, for the purpose of either holding the fork down (together with the stones depending from its tangs), or raising the link up out of the way, and thus releasing it.—E. G. C.

*Improvements in Liquid Filters.* H. W. Powis, London, and J. Ellis, Massachusetts, U.S.A. Eng. Pat. 932, January 15, 1895.

The body of the filter is in the form of a ferrule with ends screwed alike, of which one is formed integrally with the body of the ferrule, and the other is detachably screwed thereon, while the internal space is filled with a filtering medium such as charcoal, quartz, or the like, kept in place by means of perforated plates bedded on leather washers. The apparatus is screwed on to the nozzle of a water tap, and the water percolates through the charcoal or other medium, leaving the apparatus in the filtered condition. The filter is made double-ended for reversing when necessary.—E. G. C.

## II.—FUEL, GAS, AND LIGHT.

*Report on Indian Coals.* Research Department of the Imperial Institute. Imperial Institute Journal, 1895, **1**, 162—163.

An inquiry is being made into the occurrence and working of iron in India, and in this connection, a complete examination of the coals available in India has been made, and the results are recorded in tabular form. The samples received from the Indian Government have been drawn from 23 mines and collieries.

In determining the volatile matter, the finely powdered coal (0·2 grm.) was heated in a covered platinum crucible over a No. 8 Fletcher burner for two minutes, and then immediately subjected to a blow-pipe flame for two minutes longer; in the case of caking coals, a very small quantity of soot sometimes remained on the under side of the lid and escaped combustion. After having been weighed, the crucible was put in a muffle, with the lid half on, and heated until nothing but ash remained; the loss was reckoned as fixed carbon.

The sulphur was determined by heating 1·5 grm. of the coal in a platinum dish with 30 grms. of a fusion mixture consisting of sodium chloride (4 parts), potassium nitrate (3 parts), and dry sodium carbonate (1 part), and precipitating the sulphate as usual. A difference of 0·3 per cent. was considered allowable in duplicate determinations.

The ultimate analyses of the coals were conducted as usual.—A. G. B.

*Some of the Properties of Calcium Carbide.* F. P. Venable and T. Clarke. J. Amer. Chem. Soc. 1895, **17**, 306—310.

The carbide, as obtained from the electric furnace, is hard and crystalline, but loses its lustre on exposure to air, especially when the latter is moist, and at last crumbles to a grey powder containing many graphite particles. It may be kept unchanged in well-closed bottles, especially in the presence of coal oil. Attempts to separate the carbide from the graphitic carbon failed. With water, 1 grm. of the carbide on the average yields about 200 c.c. of acetylene, completely soluble in ammoniacal copper solutions; but the exact volume yielded necessarily depends upon the variable proportion of graphite present. Burnt alone, the flame from this gas is smoky, but mixed with from 6 to 10 vols. of air, the gas yields an exceedingly brilliant flame; with excess of air, a violent explosion follows upon ignition. Heated in hydrogen, the carbide yields at first a little tarry matter and a slight white sublimate, but is otherwise unaltered, even after long heating. Heated in air, the same tarry substance comes over, but no other action is apparent; even with oxygen, the carbide is unaffected until a very high temperature is attained, when the material glows brightly, yielding a white powder; but unless the temperature is exceedingly high and the ignition prolonged, the decomposition is not complete. Carbon dioxide is without action, as also is boiling sulphur. Hydrochloric acid has no action in the cold, but on heating, it causes the carbide to swell up and become dirty grey; a small quantity of colourless liquid distils over, white fumes are evolved, and a part of the solid fuses, being converted into calcium chloride. Chlorine also is without action in the cold; at a moderate heat it causes the carbide to glow brightly, to swell, and to fuse together, whilst a slight yellowish-white sublimate is formed; but the fused mass is calcium carbide. Bromine mixed with air gives no result until heat is applied, when the mass glows, fuses together, emits bubbles of gas, gives some condensed matter in the tube, and, on cooling, has a smell different from that of bromine. The fused mass answers to the tests for calcium bromide. In chlorine water or bromine water, a violent disengagement of a gas similar to acetylene is observed; but, in the experiments tried, the gas did not ignite spontaneously as described by Moissan. With strong sulphuric acid, the carbide gives a few bubbles in the cold; but on heating, the action is increased, and continues after the flame has been removed. Strong nitric acid gives off red fumes, but the gases from this and from sulphuric acid burn with a luminous flame. Sulphuric acid and potassium bichromate react most violently with the carbide; but the evolved gas is non-inflammable. Glacial acetic acid decomposes the substance slowly in the cold. Either with the sodium hydroxide and peroxide, when melted in a nickel dish, the carbide produces a violent action and an inflammable gas (see this Journal, 1895, 352 and 353).—W. G. M.

*Use of Calcium Carbide.* Eng. and Min. J. **59**, 245.

In discussing the subject of calcium carbide as a gas-making material at the New England Association of Gas Engineers, the value of acetylene as a gas enricher was debated. Its heat of combustion is not very great compared with that of other illuminants, and its candle-power, when burned at the rate of 5 ft. per hour, is about 240, whilst benzene, which theoretically should be three times as powerful, has been shown by Frankland and Thorne to give only 466 candles. Other uses suggested for acetylene, besides the enrichment of coal- or water-gas, are the displacement by it of oil-gas in small gasworks, and of naphtha vapour in the gas of gas machines. There are, however, objections to it: brass fittings are attacked, with the formation of a substance that is explosive, and it is so readily absorbed by water that if only a small amount of it is added to coal-gas, the water in the mains, holders, &c. would dissolve a large proportion of it.

It was stated that two or three per cent. of acetylene increased the candle-power of coal gas from 16 to 20, with a clear white light. On the other hand, 30 per cent. failed to enrich water-gas to 20 candles, and 5 or 6 per cent. was necessary in the case of natural gas. If calcium carbide could be produced for 1*l.* to 2*l.* per ton, it might be compared to cannel coal at 2*l.* per ton, about the same quantity of gas being obtainable from each, with an advantage in favour of acetylene as regards its powers of enrichment.—A. W.

*Smoke Prevention.* H. J. Williams. Tech. Quarterly, **7**, 1894, 122.

*See under* XVIII. B., *page* 501.

### PATENTS.

*Improved Means applicable for Use in Mixing Liquids with Gases in the Manufacture of Vapour.* W. D. Priestman and S. Priestman, Kingston-upon-Hull. Eng. Pat. 20,808, November 2, 1893.

The inventors describe improvements in their spray-apparatus or atomiser, which is of the type employed in the Priestman oil-engine, "their object being to enable the apparatus to furnish an increased yield, or to be worked at a comparatively low pressure, without effecting a less minute sub-division of the liquid,"

In their patent, No. 5255 of 1887, devices are described in which the fluids to be mixed are contained, under pressure, in two concentric tubes; the extremity of the outer of these tubes being of such form that the gas (usually air) which it carries meets the liquid (usually oil) carried by the inner tube, at an angle which is either right or obtuse.

Fig. 1.

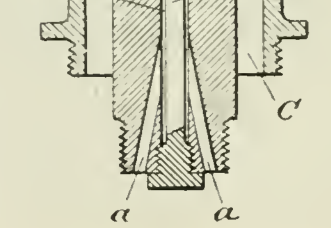


Fig. 2.

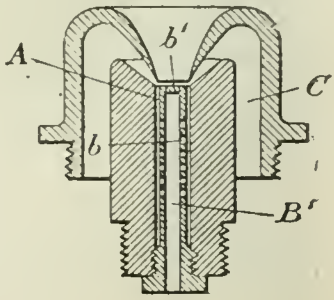
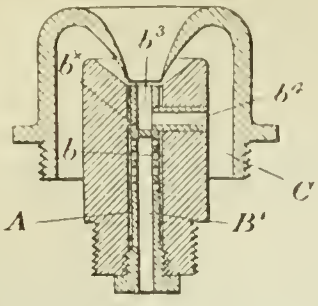


Fig. 3.



The inventors now enlarge the central oil passage A, occupying, however, most of its space by the fixed needle or plug B, the diameter of which is only slightly less than that of the passage A. The space occupied by the oil, therefore, comes to be only that minute annular space which intervenes between the surface of B and the inner wall of A. C is the space occupied by air. In the modification shown in Fig. 1 the plug B is solid, oil reaching the annular space A through ducts *a a*. In that shown in Fig. 2 the plug $B^1$ is hollow, and carries the oil, the latter reaching the annular space A by lateral apertures *b* in $B^1$. In that shown in Fig. 3 the extremity $b^3$ of $B^1$ is open, but the passage therethrough is intercepted at $b^x$, and a lateral passage $b^4$ communicates with the air- or gas-channel C, so that the air is "thus caused to overtake as well as to meet the stream of liquid as it issues from the annular passage A."

In another variation, the sides of the plug are filed to form three or more flat surfaces, the spaces intervening between these surfaces and the inner wall of the passage, forming ducts for the oil. The greater width in each of the ducts, though the total sectional area may possibly not be greater than that given by the annular passage before referred to, is a consideration of importance, unless the liquid be perfectly strained, for the interception of solid matters. Moreover, this arrangement, like the second one proposed above, allows the oil to be conducted nearly to the extremity of the annular tube under comparatively little frictional resistance.—E. R. B.

*New or Improved Apparatus for the Production of Combustible Gas.* A. Farinetti and P. Brentini, both of London. Eng. Pat. 3018, February 12, 1894.

This patent relates to the manufacture of combustible gas from "suitable spirit or essence" and air, by drawing or forcing a current of the latter through the former, employing for this purpose an "air-pump, bellows, or fan" driven by an electric or other suitable motor.

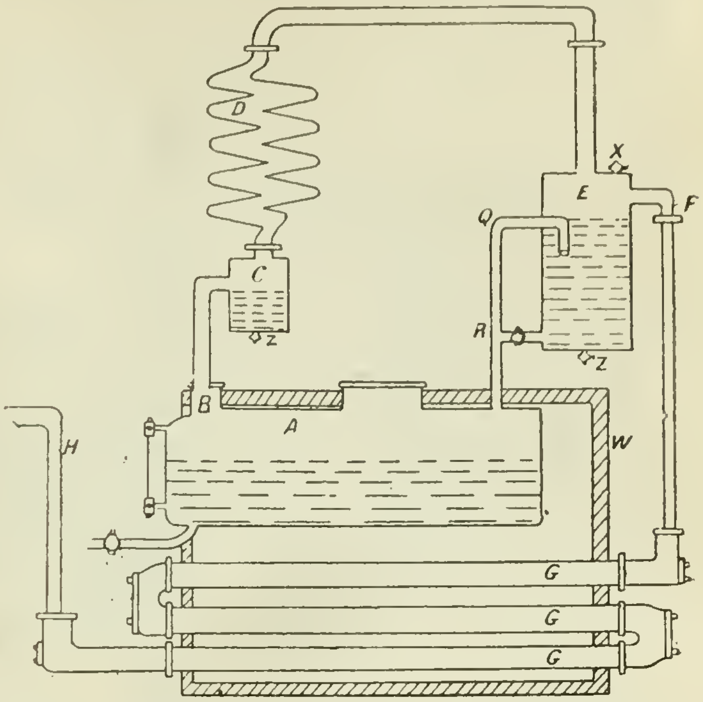
The gas or air, saturated with spirit vapour, is stored in a bell gas-holder of ordinary construction, but it is an essential part of the invention of the patentees that the bell or receiver of the gas-holder shall, as it rises or falls, according to the quantity of gas it contains, actuate a mechanism starting or stopping the motor, as the case may be; the admission of air, and therefore the manufacture of gas being thus automatically controlled. Various devices, electrical and otherwise, to effect this purpose, are described and figured.—E. R. B.

*Manufacture of Saponaceous Products from Petroleum.* C. Weygang, Child's Hill, Middlesex. Eng. Pat. 3025, February 12, 1894.

*See under* XII., *page* 493.

*Improvements in the Manufacture of Gas from Mineral and other Oils, Tars, and like Bodies, and in Apparatus therefor.* J. Laing, Edinburgh. Eng. Pat. 4053, February 26, 1894.

In the figure, the still A and the superheater G G G are contained within the furnace W, and the crude oil-gas given off passes through the condenser D. Any excess of condensible vapours, which would otherwise enter the superheater and cool it, are received by the tank E. (This Journal, 1893, 1020.) All fresh oil to be supplied to the still is fed into E by X, while the oil finds exit from E either direct by R, which is provided with a tap, or, as overflow, by Q. The feeding may be either continuous or intermittent. Z, Z afford means for drawing off any condensed water in E or C.



The oil-gas manufactured passes, either by F through the superheater G, and then through H, to coolers, where it is separated from condensed liquid, so that only permanent gas passes to the holders; or it may be caused to traverse retorts from which coal-gas is being evolved, or these two methods may be used conjointly.—E. R. B.

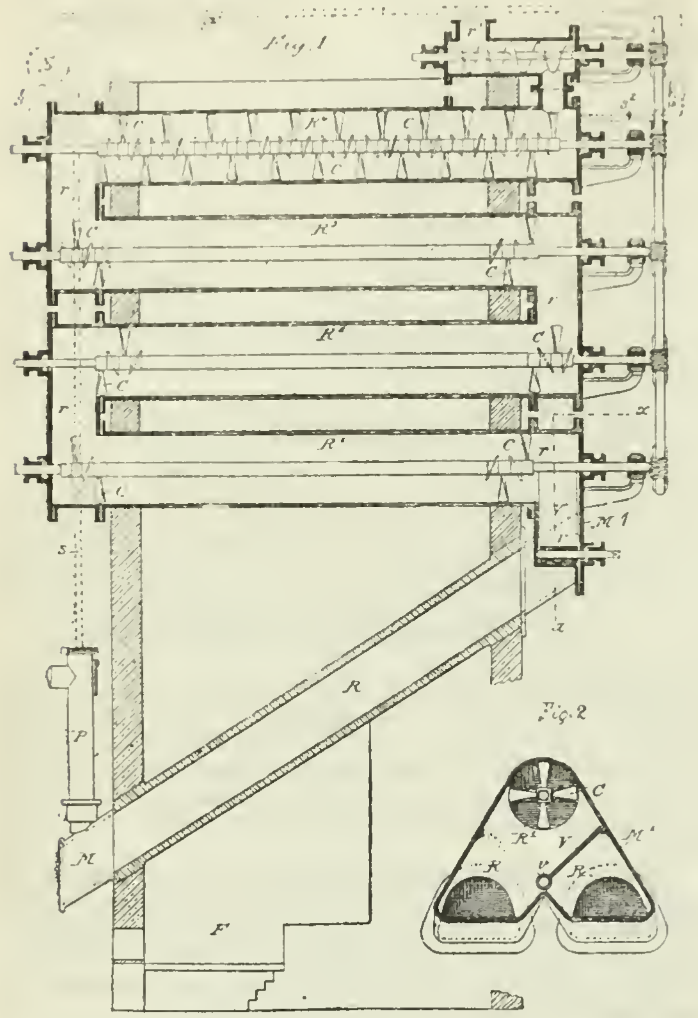
*Improvements in the Method of and Apparatus for the Carbonisation of Coal in the Manufacture of Coal-Gas.* G. Wilton, Beckton, Essex. Eng. Pat. 5540, March 16, 1894.

According to these improvements, the coal charge is caused, by means of mechanical conveyors, to travel continuously through a series of cast-iron retorts, disposed horizontally in the cooler part of the furnace, and the partly carbonised coal then drops through a somewhat steeply inclined fire-clay retort, arranged across the hotter region of the furnace. Suitable means are provided for the gas being returned to the retorts, and so passed over and amongst the coal, as many times as may be necessary.

In Fig. 1, which shows a vertical section of the apparatus, $R^4$, $R^3$, $R^2$, and $R^1$ are the iron retorts, and R is an inclined fire-clay retort. Coal fed into the double-valved hopper $r^1$, is successively worked onward by the conveyors *c c*, which are suitably geared as shown, and falls from each retort to the one below it, through the vertical connections *r r r r*. The last retort, $R^1$, of the series delivers the coal into the modified mouthpiece $M^1$, which, see Fig. 2, encloses the ends of two of the inclined fire-clay retorts R R. In $M^1$ is the 3-way valve, V, pivoted at *v*; an arrangement which permits of the discharge of partly carbonised coal and gas down one of the inclined retorts, while the other is being cleared from its lower end (M).

Gas is delivered, ordinarily, through the rising pipe P, though, if it be so desired, it may be circulated, as many times as may be required, through the whole set of retorts by means of the fan or blower S, which can extract the gas from P, through *s*, and discharge it through either $s^1$ or $s^2$ into the uppermost retort.

By these improvements, the inventor claims to effect great economy in fuel, time, and labour; and, as a result of the uniformity of temperature maintained, of the constant movement of the coal, and of the thorough carbonisation, to produce the "greatest possible volume of gas from the coal distilled," as well as to largely increase the yield of ammonia, "since none of this substance is destroyed by extreme variations of temperature."



Moreover—and this the inventor states to be his main object—there is a great reduction in maintenance costs, which in present processes are very heavy, on account of the excessive wear and tear in retorts and settings. Only the lowest two retorts of the series are in fire-clay—the material with which the greatest wear and tear occurs,—the upper part of the iron retorts being also protected by brick-work.—E. R. B.

### *Improvements in the Manufacture of Artificial Fuel.* G. S. Cory and C. Cory, Swansea. Eng. Pat. 7772, April 19, 1894.

In the manufacture of briquettes, powdered coal is intimately mixed with powdered pitch, and this mixture is subsequently treated by steam and compressed into blocks. Considerable economy in the amount of pitch necessary for the manufacture might be effected by employing the pitch in a plastic state; the practical difficulties, however, attending this procedure have hitherto prevented its use. The patentees, taking advantage of the known property possessed by naphthaline, its salts, and "other hydrocarbon substances," of softening pitch, add one of these bodies whilst the grinding of the coal and pitch is in progress (or during mixing, if the materials are ground separately), taking care that the naphthaline, &c., is added in such a manner that the intimate mixture of the coal and pitch has been effected before the naphthaline has time to soften the pitch. Suitable proportions are 92 per cent. coal, 7 per cent. of pitch, and 1 per cent. of naphthalene, &c.—E. R. B.

### *An Improved Solid Combustible, and Process of Manufacturing the same.* L. Dardel and H. Bécoulet, Paris, France. Eng. Pat. 8098, April 24, 1894.

To produce this combustible, the inventors mix and heat together—

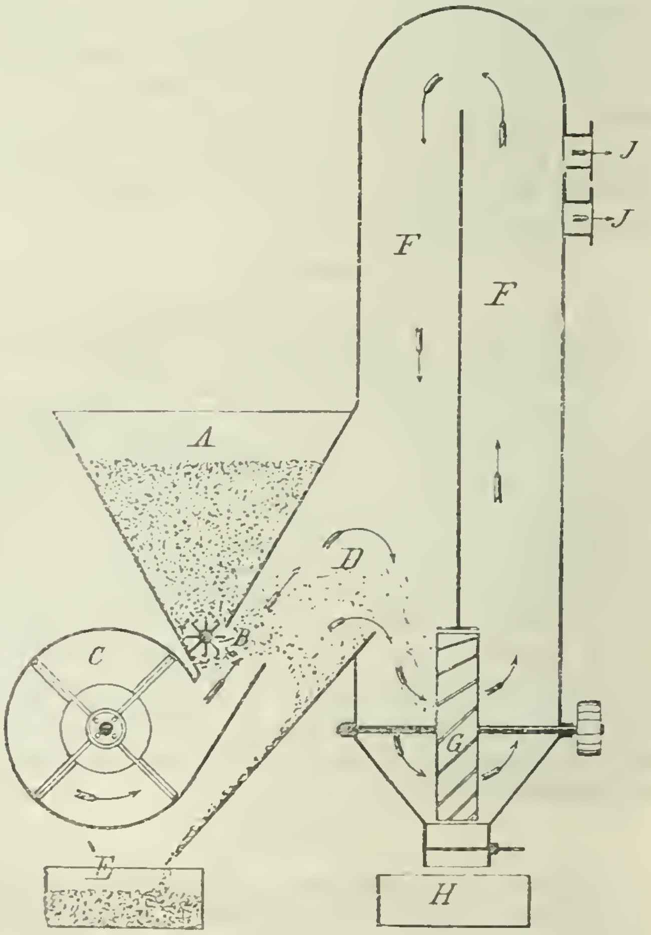
| | Per Cent. |
|---|---|
| Oil of naphtha, or of petroleum ........... | 60—70 |
| Soap (preferably resin soap) or the like... | 19—15½ |
| Fir cones or spent tan..................... | 19—15½ |
| Soda, if employed.......................... | 1—½ |
| Pine soot ................................. | 1—½ |

As soon as the mixture commences to solidify, it is poured, either into moulds, which have the shape of briquettes, or on to a smooth surface; in the latter case, sheets, which may afterwards be cut up, are formed. If a harder product be desired, it is preferable to surround the moulds with continously circulating cold water.

The inventors state that the new combustible "is lighter, of much greater heating power, and cheaper in price than any other solid combustible."—E. R. B.

### *Improvements in or relating to the Combustion of Fuel.* C. Schmitz, Berlin, Germany. Eng. Pat. 9387, May 11, 1894.

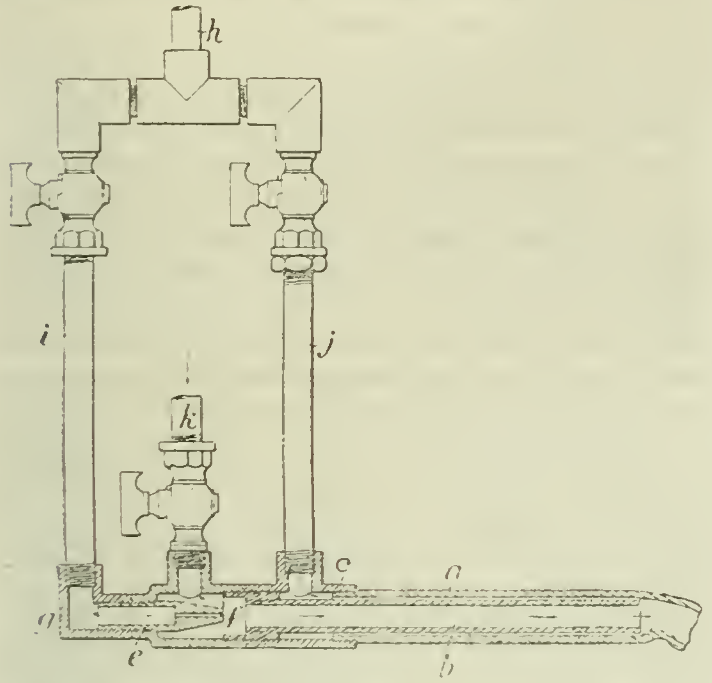
This is an apparatus for burning coal-dust. The coal-dust is placed in a hopper A, whence it issues past a feed roller B, and meets a current of air from a fan C. The velocity of the air current as it passes along D is so adjusted that any heavy or large particles mixed with the dust are dropped, and fall into E, whilst the coal-dust suitable for burning passes, in suspension, into the chamber F F, round which it is kept circulating by means of a second fan G. From F it is drawn by any suitable means through the openings J J, to the furnaces where it is to be burned. The velocity of the air in F F is so regulated that it carries the exact percentage of coal-dust that it can burn most advantageously; should more be injected by the fan C, it falls into the store chamber at the bottom, whence it can be discharged from time to time into H.—R. B. P.



### *Improvements in Spraying Apparatus for Liquid Fuel.* G. Warren, Exmouth. Eng. Pat. 9607, May 16, 1894.

In this apparatus steam is employed solely for the subdivision of the liquid fuel, but it is applied in two ways; for it is injected in a fine jet into the liquid fuel on its way to the nozzle of the apparatus, and then the mixture of steam and oil so formed is atomised, at the nozzle, by a second supply of steam. A further peculiarity of the apparatus is that it is entirely constructed of commonly-occurring plant-material, such as steam-piping, ┬-pieces, bends, nipples, &c.

The figure shows an elevation, mostly sectional, of the apparatus. Steam, entering by *h*, passes through *i*, *g*, and *e* successively, and, escaping from the contracted passage *f* of *e*, meets the liquid fuel arriving by *k*. The mixture of steam and fuel is now urged forward through the tube *b* to the nozzle of the apparatus, where it meets the second current of the steam, which has arrived through *j*, *c*, and *a*.



The tubes *a* and *b* are concentric, and in practice have their ends "upset and burred," or "otherwise contracted," to assist the atomising of the fuel as it issues from the nozzle.—E. R. B.

### *An Improved Method of Removing Deposits from Gas Retorts.* R. Good, Surrey, and S. Spencer, London. Eng. Pat. 10,110, May 24, 1894.

The deposit of carbon found inside the retorts, is caused to scale off by being suddenly cooled on one side, whilst heated on the other side. The cooling is effected by causing jets of water to play upon the carbon lining the interior of the retorts, but only to an extent just sufficient for the purpose. The operation is best performed whilst the carbon is at a dull red heat, and it is asserted that no injury is thus sustained by the retorts.—W. S.

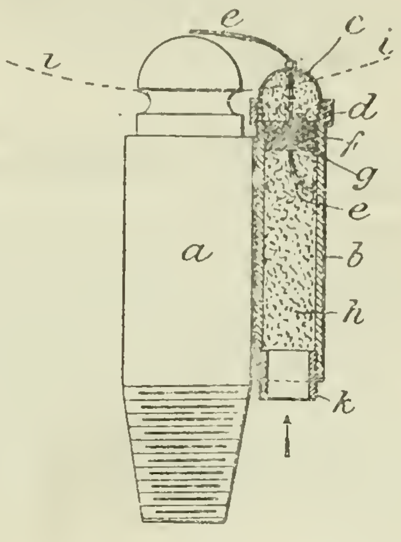
### *An Improved Composition for Use with Fuel.* A. W. Summers, Bristol. Eng. Pat. 18,715, October 3, 1894.

The object of this composition, which consists of "common salt, sodium, and potassium," is to supply "free oxygen" to fuels, such as coke, coal, wood, &c., to which it is to be applied in a "liquid state."—R. B. P.

### *Improvements in the Means for Automatically Lighting Gas.* J. F. Duke, London. Eng. Pat. 21,032, November 2, 1894.

The patentee proposes to employ a mixture of 1 part of palladium black or spongy palladium with 9 parts of platinum black, 1 part of such mixture being, preferably, incorporated with 3 parts of finely-teased asbestos; the intention of the inventor being to obtain an occlusion of hydrogen from the coal-gas by the palladium, "one of oxygen, from the atmosphere, by the platinum," having been previously obtained. The now more concentrated combustion of the hydrogen and oxygen is capable of affording heat sufficient to keep the igniting wire incandescent.

In the figure (which shows a vertical section of the inventor's apparatus, *b*, attached to an ordinary gas burner, *a*), *d* is a screw cap holding in position the cage *c*, which is made of very fine (120 meshes to the square inch) platinum wire gauze; *f* is a partition, also of platinum gauze, forming the bottom of the cage. In the cage is placed the platinum and palladium mixture. *e* is the platinum wire which is rendered incandescent, *g* is a fairly dense plug of asbestos, and *h* is loose asbestos, held in position by the hollow screw *k*. The use of this asbestos is to catch any particles of the metallic mixture which may fall through the gauze *f*. The dotted line *i i* indicates the current of gas which issues from the burner.—E. R. B.



### *Improvements in and relating to the Method of and Apparatus for Manufacturing Gas.* J. L. Hastings, Philadelphia, U.S.A., and C. D. Hauk, Chicago, U.S.A. Eng. Pat. 24,624, December 18, 1894.

The method specified, consists of generating water-gas and without superheating it, introducing a suitable hydrocarbon during the first part of the run. The combined gas and vapours are then carried through a body of heated fixing material. In the latter part of the run, the water-gas is superheated before the hydrocarbon is introduced. In the first half of the run, the heated fixing material serves both to vaporise and fix the gas, whilst in the second half these operations are effected by the superheating. The burning of a suitable gas and passing the products of complete combustion through a mass of carbon, which thereby becomes highly heated, and then passing the hydrocarbon-bearing water-gas through it, is also claimed. The apparatus consists of an annular casing divided up into a series of cupola generators which communicate with each other at the top. Over each is a gas fixer with a mass of checker work in it and communicating at its upper end with the adjoining cupola, the air, steam, and oil inlet pipes being arranged in a suitable manner.—R. B. P.

### *Improvements in Apparatus for Vaporising and Burning Hydrocarbon Oils.* W. F. Beasley, Baltimore, U.S.A. Eng. Pat. 520, January 8, 1895.

This invention relates to an apparatus in which the gases resulting from the vaporisation of a hydrocarbon oil are mingled with the gases given off by water at a high temperature, in order that the carbon which is thrown down by the "cracking" of the oil may be seized upon by the gases formed from the water, and so form gases which may be burnt with the vaporised oil. The apparatus consists of a special-shaped burner, to the oil vaporising and mixing chamber of which, an automatic water vaporiser is attached.
—R. B. P

*Improvements in Water-Gas Apparatus.* J. M. Rusby, Jersey City, New Jersey, U.S.A. Eng. Pat. 988, January 15, 1895.

In this invention, which is applicable to any water-gas apparatus of the "Lowe" type, the waste heat still remaining after the air blast has been sufficiently heated, is used for generating the steam, which has to be supplied to the gas apparatus. By an arrangement of conduits and valves, the blast can be heated to any required degree, and the waste gases, which are still hot, conducted to a boiler and there used for generating steam.—R. B. P.

*Improvements in Mantles for Incandescent Gas Lights, and in Supports therefor.* T. Terrell. Middlesex. Eng. Pat. 4324, February 28, 1895.

The inventor refers to the present method of supporting the mantle by means of a rod of steatite or other refractory material, and states that an unequal strain is thus thrown upon the upper part of the mantle, and rocking or swinging is possible. If, instead of the present simple fork which forms the support at the upper part of the rod, a circular disc or ring of steatite, &c. be used, so as to form its summit, the mantle being so made as to lap or project slightly over and inwards upon the ring or disc, it is claimed that then the upper portion of the mantle will receive the equal and uniform interior support desired and claimed, and no rocking or oscillation will now be possible.—W. S.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*The Glasgow Iron and Steel Company's Works, Wishaw.* Engineering. April 5, 1895, 427.

Plant for recovery of oil, pitch, and ammonia has been erected in connection with the coal-fed blast furnaces of this company. The results from all the works of the company cannot be given, since the new plant has not yet been long enough in operation, but at one of these works the average yields obtained with such plant over a period of several months, showed that the by-products were 119 lb. of pitch, 10 gallons of oil, and 23·3 lb. of sulphate of ammonia, all per ton of coal consumed in the blast-furnace.

From the coal consumed in four furnaces in a week of seven days, the following by-products were obtained :—

*By-Products recovered from Four Furnaces Per Week.*

| | |
|---|---|
| Coal consumed................. | 2,000 tons. |
| Pig iron produced ............ | 1,400 ,, |
| Pitch recovered............... | 100 ,, |
| Oil recovered ................ | 20,000 galls. |
| Sulphate of ammonia ......... | 20½ tons. |

—W. S.

*Pine Tar.* A. Renard. Comptes rend. 1894, **119**, 1276—1277.

The portion boiling above 300° C., which forms the principal part of pine tar, consists principally of terebenthyl, $C_{20}H_{30}$ (b.p. 332°—338° C.), and bi-terebenthylene, $C_{20}H_{28}$ (b.p. 340°—345°). A small quantity of retene is also present. The creosote from pine oil, separated by the method of Béhal and Choay (this Journal, 1894, 1187), consists of monophenols, about 40 per cent.; guaiacol, 20 per cent.; cresol and its homologues, 37 per cent. (See also this Journal, 1894, 1187 and 1188.)—L. T. T.

## IV.—COLOURING MATTERS AND DYES.

*Tetramethyldiamidodiphenylmethane.* J. Pinnow. Ber. **27**, 3161—3167.

By acting with nitrous acid on tetramethyldiamidodiphenylmethane a nitro derivative is obtained melting at 87°—88° C., whilst the further action of nitrous acid gives a dinitro derivative which melts at 123°—124° C. and crystallises from acetic acid in thin red needles. The yield is 26 per cent. of the theoretical. Attempts to reduce this substance gave an uncrystallisable product. Another dinitro derivative is obtained by acting on tetramethyldiamidodiphenylmethane dissolved in sulphuric acid, with the theoretical quantity of nitrosulphuric acid, the temperature being kept below 0° C. The product is poured into iced water and the dinitro compound precipitated by sodium carbonate and crystallised from acetic acid. It forms red prisms melting at 191·5° C. (uncorr.). The yield is 86 per cent. of the theoretical. This dinitro compound is more easily precipitated by water from acid solutions than its isomeride; it is also distinguished by being altered by nitrous acid, which the first isomer is not, but no definite products have been isolated. On reduction with tin and hydrochloric acid it yields a tetramethyltetramidodiphenylmethane crystallising from alcohol in thin white needles melting at 142° C. (uncorr.), unaltered by air and insoluble in water. This substance gives the iso-nitrile reaction. With nitrous acid it yields a cherry-red colour, but no acetyl derivative could be obtained from it. The action of nitric acid on tetramethyldiamidodiphenylmethane in glacial acetic acid gives rise to a mixture of nitro- and nitros-amines. Among the products of the action of nitrite and hydrochloric acid upon tetramethyldiamidodiphenylmethane, are, besides nitro bodies, nitroso compounds, the methyl group being readily displaced by the nitroso group under these conditions. In an experiment with hydrochloric acid of sp. gr. 1·19, nitrite and tetramethyldiamidodiphenylmethane from pure dimethylaniline hardly any *p*-nitrodimethylaniline was obtained, but in its place a yellow powder, which after repeated crystallisations from alcohol proved to be dimethyldinitrosamidodiphenylmethane, $C_{15}H_{16}N_4O_2$. It forms light straw-coloured needles melting at 101·5° C. In order to prepare tetramethyldiamidodiphenylmethane, 25 grms. of dimethylaniline, 10 grms. of 40 per cent. formaldehyde and 80 grms. of acetic acid were mixed. The temperature rises spontaneously, but must be kept below 60° C. After cooling, caustic soda is first added until precipitation commences, and then water. The precipitate is crystallised from alcohol and then distilled at 250° C. under 55 mm. pressure, when the substance forms a crystalline mass. The reaction between this base and formaldehyde may be carried out as follows: 10 grms. of dimethylaniline, 10 grms. of formaldehyde solution, and 15 grms. of acetic acid are boiled for 4 hours, the base precipitated with sodium carbonate, extracted with ether, and dissolved in amyl alcohol, from which it separates on cooling. After further purification the substance gave, on analysis, numbers corresponding to the empirical formula $(C_{18}H_{22}N_2)_x$. It differs from tetramethyldiamidodiphenylmethane in being more sparingly soluble in hot alcohol and acetic ether. Chromic acid yields an abundant quantity of quinone, proving that the condensation product cannot be a dihydranthracene derivative. Bromine produces a rose-red coloration in acetic acid solution, whilst tetramethyldiamidodiphenylmethane gives a blue with the same reagent. The constitution of the new condensation product remains uncertain. By the action of diazobenzene sulphonic acid on tetramethyldiamidodiphenylmethane a colouring matter is obtained which, on reduction with tin and hydrochloric acid, gives *p*-amidodimethylaniline and *p*-sulphanilic acid.—T. A. L.

*Mixed Ethers and Ammonia-Derivatives of Hexamethyltriamidotriphenylmethane.* A. Rosenstiehl. Comptes rend. 1895, **120**, 192—194.

The author describes several derivatives of the above compound, and finds that when acting on the chloride (crystal violet) with caustic soda, the hydroxide is not formed, but the ether of the alcohol which is used as a solvent. This reaction forms another instance of the alcoholic character of rosaniline.—L. T. T.

### *Tetramethyldiamidodiphenylcarbinol.* H. Weil. Ber. 1894, 27, 3316.

If tetramethyldiamidodiphenylcarbinol is boiled with water for some days the solution gradually loses its characteristic property of imparting a blue colour to hot acetic acid. The products of the decomposition which were isolated were methylanilines, *p*-dimethylamido benzaldehyde, and leuco-violet. They had been formed as follows:—

$$(CH_3)_2N.C_6H_4.CH(OH).C_6H_4.N(CH_3)_2HCl =$$
$$C_6H_5N(CH_3)_2HCl + O : CH.C_6H_4.N(CH_3)_2.$$

Both the aldehyde and the undecomposed carbinol condense with the dimethylaniline to form leuco-violet.

A better yield of the aldehyde can be obtained by heating the solution of the carbinol in glacial acetic acid on the water-bath till its blue colour disappears. 5 grms. of the carbinol yield on the average 0·9 grm. of aldehyde.

It is characteristic of dimethylamidobenzaldehyde that it very easily forms benzylidene compounds with primary aromatic amines. A very dilute solution of the aldehyde gives a brick-red coloration with a solution of benzidine in dilute hydrochloric acid; stronger solutions give a red precipitate. Aniline and para-toluidine under similar circumstances give greenish-yellow colorations, α-naphthylamine a yellow colour, and β-naphthylamine an orange precipitate.—T. E.

### *Condensations with Formaldehyde.* H. Weil. Ber. 1894, 27, 3314.

In the presence of strong sulphuric acid, formaldehyde and *p*-nitrotoluene combine, even in the cold. A mixture with seven parts of concentrated sulphuric acid deposits, after standing for eight days, about 60 per cent. of the nitrotoluene in the form of dinitroditolylmethane. On reducing this with tin and hydrochloric acid in the usual way a colourless, crystalline, diamido compound, melting at 98°—100°, is obtained. This base does not yield an acridine derivative, nor does it split off ammonia when heated with dilute hydrochloric acid to 160° for 36 hours. This makes it probable that the methane carbon atom is in the meta position to the amido groups. The base yields azo colouring matters, which are, however, of no special value.
—T. E.

### *Diphenylmethane Colouring Matters.* K. Albrecht. Ber. 27, 3294—3299.

By the action of potassium cyanide on auramine, the author obtains a nitrile of the constitution—

$$(CH_3)_2:N.C_6H_4.C(NH_2)(CN).C_6H_4.N:(CH_3)_2$$

which he terms hydrocyanauramine. It behaves very similarly to leucauramine, and when treated with dilute hydrochloric acid, the $NH_2$ group is replaced by OH. On elimination of water from this compound or directly from hydrocyanauramine by the action of nitrite in acid solution, and addition of zinc chloride or sodium chloride, there results—

$$(CH_3)_2:N.C_6H_4.C(CN):C_6H_4:N(CH_3)_2Cl,$$

which crystallises in greenish needles. The same compound has been obtained by Weil (Ber. 17, 1403) by oxidising the nitrile obtained by the action of hydrocyanic acid on tetramethyldiamidodiphenylcarbinol. The substance dyes tannined cotton a yellowish-green, which is very unstable, easily decomposing into hydrocyanic acid and tetramethyldiamidobenzophenone. The usual reaction of the nitriles can be carried out with hydrocyanauramine, as, for instance, by the action of concentrated sulphuric acid it is converted into the amide, which on hydrolysis yields the carboxylic acid. In this way compounds of the leucauramine type are obtained, in which the aliphatic hydrogen of the leucauramine is replaced by groups containing carbon, the shades obtained being considerably greener than that of the tetramethyldiamidodiphenylcarbinol. The corresponding carbinol derivatives are obtained by replacing $NH_2$ by OH. The following compounds have been prepared:—*Tetramethyldiamidodiphenylamidoacetamide*—

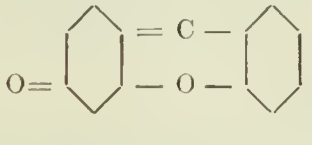
$$H_2N.C[C_6H_4N(CH_3)_2]_2CONH_2$$

by the action of concentrated sulphuric acid in the cold on hydrocyanauramine. It forms colourless needles melting at 170° C., and, like leucauramine, gives a blue solution with acetic acid. On hydrolysis with alcoholic potash it is converted into *tetramethyldiamidodiphenylamidoacetic acid*, which separates in yellowish granular crystals melting at 171° C., and very sparingly soluble. Both the sodium salt and the hydrochloride are crystalline and easily soluble. Acetic acid gives a deep blue solution, and nitrous acid with elimination of carbonic acid regenerates auramine. By warming the amide with concentrated hydrochloric acid and zinc chloride, and decomposing the solution of the crystals which separate out with soda-lye, a crystalline precipitate of *tetramethyldiamidodiphenylglycollamide* is obtained. This melts at 140°—142° C., and is a weak base, the blue colour of the solution of a salt gradually disappearing owing to dissociation. It dyes greenish-blue on tannined cotton, much greener than the carbinol, but, like this, is very unstable.—T. A. L.

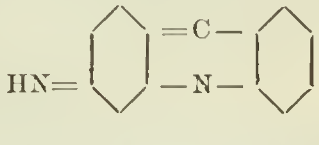
### *Colouring Matters of the Fluoresceïn Group.* R. Möhlau and P. Koch. Ber. 27, 2887—2897.

The fluoresceïn colouring matters comprise four groups: fluoresceïn and its derivatives, the rhodamines, the rosamines, and the pyronines. The first two groups stand in the relation of phenol to the corresponding amine; the phenol corresponding to rosamine is resorcinbenzeïn, and the authors have succeeded in preparing from methylenediresorcinol the phenol corresponding to pyronine, which may be considered as formofluoresceïn. The present paper deals with homologues of this substance and with allied compounds. As regards nomenclatures the terms *fluorone* and *fluorime*—

I.



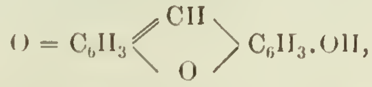
II.



are applied to substances containing the groups I. and II. respectively, the latter becoming *fluorimium*, as Nietzki has suggested, when NH becomes $NH_2$. The name of the acid or aldehyde from which the central group is derived is prefixed, and hence rhodamine is phthalic acid tetra-ethylfluorimium chloride. *Formaldehyde-hydroxyfluorone* is obtained by heating methylenediresorcinol—

$$(HO)_2:C_6H_3.CH_2.C_6H_3(OH)_2$$

(Ber. 25, 917) with concentrated sulphuric acid or with zinc chloride and a little aluminium chloride. The product, which has the formula—

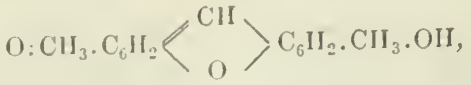


$$O = C_6H_3\begin{matrix}\diagup\!\!\!\diagup CH \diagdown \\ \diagdown\; O \;\diagup\end{matrix}C_6H_3.OH,$$

has not been obtained quite pure. It dissolves easily in caustic and carbonate alkalis with a brown colour, dilute solutions showing a strong green fluorescence. On distillation with zinc dust it yields xanthene (methylene diphenylene oxide). *Methylene diorcinol*—

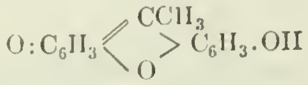
$$(HO)_2.CH_3.C_6H_2.CH_2.C_6H_2.CH_3.(OH)_2$$

is obtained from orcinol and formaldehyde in presence of sulphuric acid. It forms small white crystals, insoluble in water, and decomposes on heating without melting. In a damp state it easily polymerises to an indifferent orange-yellow substance. When heated with zinc chloride and ammonium chloride it forms *formaldehyde-hydroxytolufluorone*—



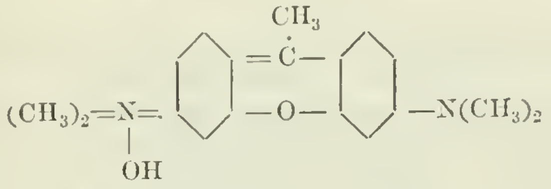
$$O:CH_3.C_6H_2\left\langle\begin{matrix}CH\\O\end{matrix}\right\rangle C_6H_2.CH_3.OH,$$

which crystallises from methyl alcohol in dark brown crystalline granules. By the action of acetaldehyde on resorcinol two products are obtained, and on further condensation *acetaldehyde-hydroxyfluorone*—



$$O:C_6H_3\left\langle\begin{matrix}CCH_3\\O\end{matrix}\right\rangle C_6H_3.OH$$

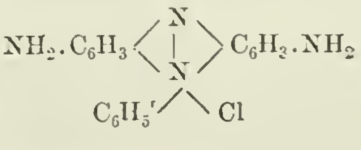
can be separated by means of its solubility in acetone. Orcinol gives similar products. The action of acetaldehyde on dimethyl-*m*-amidophenol in presence of hydrochloric acid gives rise to ethylidene-tetramethyl-di-*m*-amidophenol, which forms light violet-coloured crystals, melting at 140° C. (see below, Biehringer, Ber. 27, 3299), insoluble in water and carbonates, but soluble in acids, caustic alkalis, alcohol, ether, and acetone. When heated with concentrated sulphuric acid it forms tetramethyl-diamido-diphenylethylidene oxide, which, on oxidation in hydrochloric acid solution, preferably with sodium nitrite and precipitation with sodium chloride, yields *acetaldehyde-tetramethylamidofluorimium hydrochloride;* zinc chloride precipitates the double salt. Alkalis precipitate the colour base, which melts at 152° C., and has the constitution—



The chloride and sulphate are easily, the iodide and picrate sparingly, soluble, whilst the platinochloride forms dark green bronzy plates. The same colouring matter is obtained by fusing dimethyl-*m*-amidophenol with paraldehyde and zinc chloride. In a similar manner tetramethyldiamidodihydroxydiphenylmethane is obtained by condensing dimethyl-*m*-amidophenol with formaldehyde. This, on further condensation and subsequent oxidation, yields formaldehyde-tetramethylamidofluorimium, which in the form of its zinc chloride double salt is known commercially as pyronine.
—T. A. L.

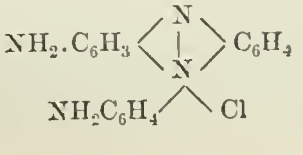
### *The Constitution of the Safranines.* C. Ris. Ber. 1894, 27, 3318.

By oxidising indamine (or dimethyl indamine) together with *p*-amido-acetanilide, red colouring matters, acetamido-safranine or acetamidodimethyl safranine, are obtained. They resemble the corresponding safranines very closely. By boiling with 10 per cent. sulphuric acid, the substances are saponified. The free amido safranine thus obtained gives exactly the same shades of colour as ordinary safranine. The author regards this as an argument in favour of the symmetrical safranine formula proposed by Bernthsen, viz.:—



$$NH_2.C_6H_3\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_2.NH_2 \qquad \overset{\displaystyle N}{C_6H_5\diagup\;\diagdown Cl}$$

For if Witt's formula, viz. :—



$$NH_2.C_6H_3\left\langle\begin{matrix}N\\|\\N\end{matrix}\right\rangle C_6H_4 \qquad \overset{\displaystyle N}{NH_2C_6H_4\diagup\;\diagdown Cl}$$

were correct, the new amido group in the amido-safranine must have been introduced into the nucleus of the chromogen, and should therefore have produced a considerable change of colour.

With 2 mols. of nitrous acid, amidodimethyl-safranine gives an indigo-blue-coloured tetrazo compound, which yields with β-naphthol a derivative with difficulty soluble in dilute acids, with a blue-black colour. The diazo colouring matter obtained with β-naphtholdisulphonic acid R, dyes black on wool. (The corresponding compound obtained from dimethyl-safranine gives a blue colour.)—T. E.

### *Pyronines.* J. Biehringer. Ber. 27, 3299—3305.

The pyronines are red colouring matters of the di- and triphenylmethane series, and are obtained by condensing 1 mol. of a fatty or aromatic aldehyde with 2 mols. of a dialkylated *m*-amidophenol and subsequent oxidation (Eng. Pats. 13,217 of 1889 and 18,606 of 1891; this Journal, 1890, 934, and 1892, 808). Of the last-mentioned compounds, *dimethyl-m-amidophenol* melts at 85° C., whilst the corresponding diethyl compound melts at 74° C. Both are easily soluble compounds, and reduce ammoniacal silver solution and gold chloride in hydrochloric acid. *Tetramethyldiamidodihydroxydiphenylmethane*, $H_2C:(C_6H_3.N(CH_3)_2OH)_2$, from dimethyl-*m*-amidophenol and formaldehyde, melts at 178° C., and crystallises from benzene in shining red plates. The hydrochloride, $C_{17}H_{24}O_2N_2Cl_2.H_2O$, melts at 110° C., and crystallises in pale rose-coloured plates. The benzoyl derivative melts at 141° C., and in acetic acid solution gives a blue coloration with lead peroxide. *Tetramethyldiamidodiphenylmethane oxide*, $H_2C:[C_6H_3.N(CH_3)_2]_2:O$, is obtained by the action of concentrated sulphuric acid on tetramethyldiamidodihydroxydiphenylmethane. It crystallises in shining needles or plates, and melts at 116° C. It is rapidly oxidised by exposure to light. If the action of the sulphuric acid be prolonged, the anhydro base is converted into a red substance which shows a blue fluorescence in alcohol-ether, changing to green on the addition of acid. This substance is probably formed by the elimination of the dimethylamine group; it is unaltered by oxidising agents, and is contained in the commercial product. On oxidising the anhydro base in a benzene solution with chloranil, the colour base is obtained as a bulky red precipitate. By extracting with hydrochloric acid, the hydrochloride is produced, which crystallises from dilute hydrochloric acid in shining steel-blue needles. By condensing acetaldehyde with dimethyl-*m*-amidophenol, Möhlau and Koch (Ber. 27, 2887; see above) obtained ethylidene-tetramethyl-di-*m*-amidophenol—

$$H_3C.CH:(C_6H_3N(CH_3)_2OH)_2$$

which, the author finds, melts at 167° C., and not at 140° C. The compound yields a benzoyl derivative, which, however, only gives a pale blue coloration on oxidation in alcoholic solution with acetic acid and lead peroxide.—T. A. L.

### *The Colouring Principle of "Toddalia Aculeata" and "Evodia Meliæfolia."* A. G. Perkin and J. J. Hummel. Proc. Chem. Soc. 1895 [150], 54.

*Toddalia aculeata* is an Indian plant belonging to the Rutuaceæ. Its root bark is used in Madras as a yellow dyestuff; it also possesses valuable medicinal qualities. The authors find that the colouring matter is berberine, contrary to the statement of Flückiger and Hanbury, who were unable to detect this alkaloid.

*Evodia meliæfolia*, belonging to the same natural order, is a tree growing in China and Japan, whose bark is largely employed in medicine and in dyeing. The authors confirm previous statements that the bark contains berberine.

Comparative dyeing experiments on wool indicated that Evodia and Toddalia bark possess the same tinctorial power as a 3 per cent. solution of berberine hydrochloride.

## PATENTS.

*Manufacture of New Colouring Matters varying from Blue-Violet to Blue-Green.* J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, St. Fons, Rhone, France. Eng. Pat. 10,333, October 31, 1893. Under Internat. Convention.

The colouring matters are obtained by condensing mono-, di-, or poly-sulphonated dialkyl-amido azobenzenes, or their salts, with gallic acid, methyl- or ethyl-gallic ether, gallamic acid, gallanilic acid or its homologues, or with the gallonaphthylamides. A mixture of 10 kilos. of gallic acid, 17 kilos. of dimethyl-amido-azobenzene sodium sulphonate, 100 kilos. of glacial acetic acid, and 5 kilos. of hydrochloric acid, is heated in an oil bath to 120° C. until the dimethylamidoazobenzene sulphonic acid has disappeared. The melt is then poured into water and the colouring matter filtered off. It dyes unmordanted wool and silk violet-blue from an acid bath and chromed wool a greener-blue. The colouring matter dissolves to a violet solution in alkalis, changing to blue on the addition of a small quantity of acid, passing back to violet with an excess of acid.—T. A. L.

*Improvements in the Manufacture and Application of a New Diazo Compound for Use in Dyeing and Printing.* J. Altschul, Manchester. Eng. Pat. 4870, March 8, 1894.

In a previous specification (this Journal, 1895, 145), the patentee has described the production of a substance which he terms "nitraniline S." This product, which has the composition $C_6H_4.NO_2.N_2ONa$, detonates violently when dry, at about 230° C. This explosive character can be lessened to a great extent by mixing suitable inorganic matters, such as common salt, sodium or magnesium sulphate, with the product, and these admixtures do not interfere with the reactions of the substance. In order to convert nitraniline S into *p*-nitrodiazobenzene solution for obtaining *p*-nitraniline red, it is dissolved in a mineral acid, and this latter is then neutralised with sodium acetate. For using acetic acid, the following directions are given :—2 kilos. of nitraniline S are dissolved in 50 litres of water, and this solution is stirred into 4 kilos. of 99—100 per cent. acetic acid and 50 litres of water, heated for a short time to 50°—60° C., and filtered, when the solution is ready for use, no addition of sodium acetate of course being necessary. If the nitraniline S be diluted as above mentioned with salt or sodium sulphate, the proportions of water and acid must be taken corresponding to the amount of pure nitraniline S present.—T. A. L.

*Improvements relating to the Lixiviation of Dye-Wood, Barks, Hops, and other Materials, and to Apparatus therefor.* C. L. W. Albach, Höchst-on-the-Maine, Germany. Eng. Pat. 8643, May 1, 1894.

The substance to be lixiviated is packed into a closed casing, between two sieves, and steam from a boiler, entering from above or below, is conducted through the mass and afterwards escapes to a condenser arranged so that the condensed steam runs back through the mass and carries away the extractive substances, which are collected by a suitable pipe. In some cases alcohol may be added to the water in the evaporating boiler, and the lighter alcoholic vapours, rising through the mass, dissolve the oils and resins, so that these will subsequently combine with the water vapours and enable a complete lixiviation to take place.—E. G. C.

*Improvements in the Manufacture of Artificial Indigo-White, and of Bodies related to the Indigo Group.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 9291, May 10, 1894.

In Eng. Pat. 10,509 of 1890 (this Journal, 1891, 633) the production of what was termed artificial indigo-white is described. This consisted in suitably treating phenylglycocoll-*o*-carboxylic acid with alkalis or alkaline earths. The product so obtained consisted of a mixture of unaltered alkali, together with indoxyl and indoxylic acid, and the present invention describes methods of so conducting the operation that only one or other of these two compounds shall be obtained. In order to prepare indoxylic acid, 10 kilos. of dry and neutral sodium phenylglycocoll-*o*-carboxylate is intimately mixed and ground with twice its weight of dry caustic soda. The mixture is then heated in thin layers to 265° C., in an atmosphere free from oxygen, until the whole has become lemon-yellow, which usually takes about an hour. For the purpose of separating pure indoxylic acid, 50 kilos. of the above product are ground and dissolved in 400 kilos. of ice and 175 kilos. of dilute sulphuric acid containing 22 per cent. pure $H_2SO_4$. The acid separates as a white precipitate, and is filtered and washed with ice-cold water. It may be dried at a temperature not exceeding 50° C., and preferably in an atmosphere of nitrogen or hydrogen. If indoxyl be required, 10 kilos. of dry neutral potassium phenylglycocoll-*o*-carboxylate and 20 kilos. of dry caustic potash are mixed and heated for about an hour to 280°—290° C., oxygen being excluded. One kilo. of this product is dissolved in about 2—3 litres of cold boiled water at a low temperature, and the solution is saturated with carbonic acid, the indoxyl being subsequently extracted with ether, air being excluded during the whole of the operations.—T. A. L.

*The Manufacture or Production of Dyestuffs.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 9441, May 12, 1894.

In Eng. Pat. 4756 of 1893 (this Journal, 1894, 245), the patentees described the production of colouring matters by combining diazotised dehydrothiotoluidine, its homologues, and the sulphonic acids of these compounds, with 1.3-naphtholsulphonic acid. The colouring matters so obtained are fast to alkalis, acids, and light, and in a subsequent specification, Eng. Pat. 1062 of 1894 (this Journal, 1895, 31), a further series of similar colouring matters is described, in which the sulphonic acid and hydroxyl groups are also in the meta position. These dyestuffs possess similar valuable properties, and, according to the present specification, dyestuffs obtained by combining diazotised thio-amido bodies and their sulphonic acids with chloronaphthol sulphonic acids, in which the OH and $SO_3H$ groups are in the meta position, are also valuable. The acids employed are—

$$1.3'.3.C_{10}H_5.OH.Cl.SO_3H,\quad 1.2'.3.C_{10}H_5.OH.Cl.SO_3H,$$
$$1.3'.3.4'.C_{10}H_4.OH.Cl.(SO_3H)_2,\ \text{and}$$
$$1.1'.3.3'.C_{10}H_4.OH.Cl.(SO_3H)_2,$$

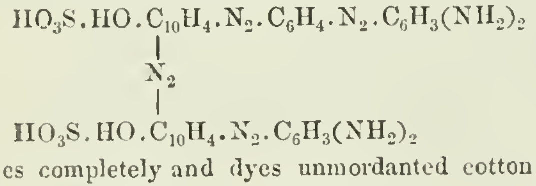
all of which can be prepared by the action of cuprous chloride on the diazo compounds of the corresponding amidonaphthol mono- and disulphonic acids. The diazo solution from 26·8 kilos. of dehydrothio-*m*-xylidine is run into a cold solution of 28·1 kilos. of the sodium salt of 2'.1.3-chloronaphthol sulphonate kept alkaline by means of sodium carbonate. The combination is completed by heating the solution to about 90° C., after which the colouring matter is salted out, filter-pressed, and dried. It dyes bluish-red shades on unmordanted cotton from an alkaline soap-bath, fast to acids and alkalis. In place of the chloro compounds, other halogen substitution products, such as the bromonaphthol sulphonic acids, may be employed, providing always that sulphonic acid and hydroxyl groups are in the meta position.—T. A. L.

*Manufacture of Colouring Matters applicable to Unmordanted Fibres or Fabrics.* J. Imray, London. From R. Vidal and La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, Paris, France. Eng. Pat. 9443, May 12, 1894.

This process consists in heating with sulphur, bodies of the amidophenol class, or those which give amidophenols on reduction. Such substances are nitrosophenols or naphthols, nitrophenols or naphthols, amidophenols or naphthols, and azo compounds, such as oxyazobenzene. It is stated that the colouring matters produced, give bottle-green solutions in alkaline sulphides, possess great affinity for fibres, and, after dyeing, are fixed by oxidising agents. The colours produced are black, dark blue, or dark green. The following is an example of the method employed:—One kilo. of nitroso-α-naphthol is heated in an iron pan in a concentrated solution containing 4 kilos. of sodium sulphide until the temperature reaches 120°—140° C. The liquor being colourless, 0·75 kilo. of sulphur is quickly added, and the melt is raised to 190°—200° C. The product, after well drying, may be used directly for dyeing. —T. A. L.

### *The Production of Polyazo Dyestuffs from Gamma-amidonaphthol-sulpho Acid.* S. Pitt, Sutton, Surrey. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 9529, May 15, 1894.

This is an extension of Eng. Pat. 16,699 of 1889 (this Journal, 1890, 935), and also of Eng. Pat. 19,330 of 1890 (this Journal, 1891, 917), and describes further combinations obtained by the use of γ-amidonaphthol sulphonic acid. The first claim relates to the production of dyestuffs by combining the tetrazo-derivatives obtained from equimolecular proportions of γ-amidonaphthol sulphonic acid and a p-diamine with one molecular proportion of γ-amidonaphthol sulphonic acid and one molecular proportion of an amine or phenol. The following is an example of the dyestuffs produced according to the second claim:—The diazo solution from 15 kilos. of acet-p-phenylene diamine is combined in an alkaline solution with 24 kilos. of γ-amidonaphthol sulphonic acid. The acetyl group having been removed, the diamido-azo compound is converted into its tetrazo derivative, and this is combined in an alkaline solution with 24 kilos. (one molecular proportion) of γ-amidonaphthol sulphonic acid. The intermediate compound formed, is diazotised by means of hydrochloric acid and 7 kilos. of sodium nitrite, and this tetrazo compound finally may be combined in an alkaline solution with 24 kilos. of m-phenylene diamine. The dyestuff, which has the following constitution—



$$\begin{array}{l}HO_3S.HO.C_{10}H_4.N_2.C_6H_4.N_2.C_6H_3(NH_2)_2\\ \qquad\qquad\quad |\\ \qquad\qquad\quad N_2\\ \qquad\qquad\quad |\\ HO_3S.HO.C_{10}H_4.N_2.C_6H_3(NH_2)_2\end{array}$$

separates completely and dyes unmordanted cotton a deep black.—T. A. L.

### *The Manufacture or Production of Colouring Matters and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 9610, May 16, 1894.

When m-phenylene diamine hydrochloride is heated with aniline or p-toluidine to about 265° C., it yields diphenyl- or ditolyl-m-phenylene diamine. If, however, tolylene diamine be employed, the reaction stops half way, phenyl- or tolyl-tolylene diamine being produced. A mixture of 1 kilo. of m-tolylene diamine hydrochloride and 4 kilos. of p-toluidine is heated in an autoclave for 20 hours to about 265° C. Caustic soda is then added in excess, and any unaltered p-toluidine is blown off by steam. The oil remaining, is extracted with very dilute hydrochloric acid which extracts the hydrochloride of p-tolyl-m-tolylene diamine. On cooling, this separates out in scales or flat needles. The base having the formula $1.2.4.C_6H_3.CH_3.NH_2.NHC_6H_4CH_3$, crystallises from petroleum spirit in stellate groups of white prismatic crystals, and melts at 69°—70° C. It is insoluble in water, but dissolves easily in alcohol, ether, and benzene. In place of the method employed above, the same compound is produced by heating together m-tolylene diamine with p-toluidine hydrochloride or by heating a mixture of p-toluidine and m-tolylene diamine together with benzoic acid or the like. Thus phenyl-m-tolyiene diamine—

$$1.2.4.C_6H_3.CH_3.NH_2.NHC_6H_5$$

is obtained by heating together 1 kilo. of m-tolylene diamine. 1·5 kilos. of aniline hydrochloride, and 3 kilos. of aniline for 10 hours to about 245° C. in an autoclave. The hydrochloride is separated as in the preceding example, and the base, which crystallises from petroleum ether in groups of prismatic crystals, melts at 76°—77° C. All these substances form azine colouring matters either by condensation with the nitroso derivatives of secondary and tertiary amines or their derivatives, or with substances which behave analogously, such as the quinone chlorimides or p-amido-azo compounds. Similar colouring matters are also produced by oxidising the substances described, together with alkylated p-diamines or p-diamine sulphonic acids. The following are some examples of the methods employed:—28 kilos. of nitroso-methyl-o-toluidine hydrochloride are gradually added to a cold solution of 24·8 kilos. of m-amidoditolylamine hydrochloride in 100 litres of alcohol, and the mixture is gently heated until a reaction sets in. This then proceeds spontaneously, and the dyestuff separates out on cooling. After filtering off, it is washed with spirit, and dyes red shades on cotton mordanted with tannin. 1·8 kilos. of quinone dichlorodi-imide are gradually stirred into an alcoholic solution of 2·5 kilos. of p-tolyl-p-amido-o-toluidine hydrochloride, and gently heated until the quinone dichlorodi-imide has disappeared. The alcohol is then distilled off, the residue mixed with hot water, and the solution precipitated with soda-lye. After filter-pressing, the press cakes are repeatedly extracted with boiling water, the filtrates are acidulated with hydrochloric acid, and the colouring matter is salted out, filter-pressed, and dried. It gives red shades on cotton mordanted with tannic acid, fast to light and washing. The same colouring matter is produced by reacting with amido-azobenzene sulphate on p-tolyl-p-amido-o-toluidine hydrochloride in presence of a suitable diluent or solvent, such as phenol. A hot solution of 2 kilos. of phenyl-p-amido-o-toluidine, 1·4 kilos. of p-amido-dimethylaniline in 50 per cent. acetic acid, has gradually added to it, a solution of 3 kilos. of sodium bichromate in 10 litres of water. The melt is heated until the colour is a pure magenta-red and no longer increases in intensity. The dyestuff is salted out, filtered off, and redissolved in water. The solution is then made alkaline with ammonia, filtered, and made acid with hydrochloric acid, after which the dyestuff is again salted out, filter-pressed, and dried. The same colouring matter can be obtained by condensing dimethylamido-azobenzene with phenyl-p-amido-o-toluidine, and dyes tannined cotton violet-red.—T. A. L.

### *Improvements in the Manufacture of Colouring Matters Dyeing Blue with Mordants.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 9856, May 21, 1894.

By condensing o-quinones or their sulphonic acids with alkylated p-phenylene diamines, and treating these condensation products with sulphur and fuming sulphuric acid, colouring matters have been produced (this Journal, 1894, 1189). The patentees have now discovered that certain sulphonic acids of ethyl- or methyl-benzyl-p-phenylene diamine can be employed in a similar manner. The alkaline solution of benzyl-ethyl-p-phenylene diamine sulphonic acid obtained by nitrating and reducing 19 kilos. of benzylethylaniline sulphonic acid, is mixed, under constant agitation, with 27·6 kilos. of the potassium salt of 1.2.4-naphthoquinone sulphonic acid. The complete separation of the condensation product is effected by adding salt. 20 kilos. of this dry product and 4 kilos. of flowers of sulphur are dissolved in 160 kilos. of sulphuric acid containing 23 per cent. of anhydride and heated for about five hours to 40°—60° C. The melt is poured into iced water, and the precipitate, after filtering, is dissolved in dilute soda solution. After again filtering, the colouring matter is salted out. It dyes chrome-mordanted wool blue, fast to light, acids, and alkalis.—T. A. L.

*Manufacture of Naphthylendiaminesulpho Acids.* C. D. Abel, London. From A. Fischesser and Co., Lutterbach, Alsace, Germany. Eng. Pat. 13,156, July 6, 1894.

The patentees describe a method for the preparation of 1.4′ and 1.1′-naphthylenediamine sulphonic acids by the action of sodium bisulphite on the 1.4′ and 1.1′-dinitronaphthalenes. 20 kilos. of finely-ground 1.1′-dinitronaphthalene are boiled with 200 kilos. of a 40 per cent. sodium bisulphite solution until dissolved. The solution is concentrated so that the greater part of the sodium sulphate crystallises out on cooling, and an excess of concentrated hydrochloric acid is added to the filtrate, which precipitates the acid sodium salt of a naphthylene diamine trisulphonic acid, having the formula—

$$C_{10}H_3(NH_2)_2(SO_3Na)_2SO_3H.2H_2O.$$

The salt is easily soluble in water, and has a very slight greenish fluorescence. Ferric chloride colours the solution yellowish-brown. The acid, which probably has the constitution—

$$C_{10}H_3(NH_2)_2(SO_3H)_3\ [1:1':2:4:3']\ \text{or}\ [1:1':2:4:2']$$

combines with one molecular proportion of a diazo compound to form colouring matters, and is converted by nitrous acid into an azimido compound. By treating 1.4′-dinitronaphthalene in the same manner, a naphthylene diamine disulphonic acid is produced, which is easily soluble in water, and gives a tolerably soluble tetrazo compound, differing in these respects from the 1.4′.3.2′-naphthylene diamine disulphonic acid of Ger. Pat. 61,174. Ferric chloride added to an alkaline solution of this new acid gives a reddish-blue coloration.—T. A. L.

*Manufacture of a New 1.8-Amidonaphtholdisulpho Acid from 1.8-Naphthylendiaminetrisulpho Acid.* C. D. Abel, London. From A. Fischesser and Co., Lutterbach, Alsace, Germany. Eng. Pat. 13,203, July 7, 1894.

When the sodium salt of the 1.1′-naphthylenediaminetrisulphonic acid of Eng. Pat. 13,156 of 1894 (see above) is boiled with water for some time, a new 1.1′-amido-naphthol disulphonic acid is produced. The proportions given are: 1 kilo. of the sodium salt to 5 litres of water, the solution being boiled under an inverted condenser for 48 hours. This operation may be shortened by heating 1 kilo. of the acid sodium salt with 4 litres of water in an autoclave for 10 hours to about 125° C., or by boiling 1 kilo. of the salt with 7 kilos. of a 10 per cent. sulphuric acid under a condenser for 24 hours. The new substance is readily soluble in hot water and moderately in cold. The solutions have a blue fluorescence, give a green coloration with ferric chloride, and are easily salted out. Nitrous acid gives a sparingly soluble diazo compound, crystallising in yellow needles. The compound is to be used for the production of colouring matters.—T. A. L.

*Improvements in Vessels for containing Volatile Liquids.* P. P. Monnet, Lyons. Eng. Pat. 3265, February 14, 1895.

*See under XX., page 506.*

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*Increase in Temperature of Fibrous or Porous Materials containing Fatty Oils.* R. Kissling. Zeits. angew. Chem. 1895, 44—49.

The experiments were suggested to the author by the occurrence of two fires originating through the spontaneous ignition of fibrous material saturated with fatty oils. For the purpose of estimating the oxidising action of air upon linseed oil, the author passed a current of air free from water and carbonic acid through 100 grms. of raw linseed oil kept at 100° C. for six days. The air containing the volatile products of oxidation was passed through an absorption apparatus containing, first, concentrated sulphuric acid, and then normal soda solution. The increase in the weight of the linseed oil averaged 0·41 grm. (0·412 per cent.) daily, and the sulphuric acid 0·39 grm., whilst the soda solution showed an increase corresponding to 0·07 grm. $CO_2$. The linseed oil actually took up 0·87 per cent. of its weight of oxygen daily, or over 5 per cent. in the six days. The generation of heat by the oxidation of linseed oil depends upon the extent of the surface exposed to the oxygen or air, being most favourable when a fibrous or porous material is saturated with the oil.

In making his experiments, the author placed 1 kilo. of cotton-wool shreds saturated with 500 grms. of boiled linseed oil in a fine net, which was suspended so that the outer air had as little cooling effect as possible. Another method was to saturate 150 grms. of cotton-wool shreds with 150 grms. of boiled linseed oil and press them into a glass vessel into the middle of which a thermometer was placed. This was suspended in a somewhat larger glass vessel, the opening being closed with a wooden cover. The results of a great number of experiments are summarised by the author as follows:—

(1.) By conducting a stream of dry air through unboiled linseed oil at 100° C. the amount of oxygen taken up corresponded to 0·87 per cent. of the weight of oil per day, and of which 0·41 per cent. remained in the oil and 0·46 per cent. was carried over with the stream of air as volatile gases. These volatile gases consisted of 15 per cent. $CO_2$ and 85 per cent. of volatile acids of the methane series and other organic substances.

(2.) With a sufficiently large surface for the absorption of oxygen by the fatty oils, and with due precaution against cooling from the exterior, the oxidation causes a distinct rise in temperature, and if the surface is considerable, as is the case when fibrous materials are saturated with the oils, the temperature may rise to ignition point.

(3.) The extent of the generation of heat by atmospheric oxidation depends (*a*) upon the chemical composition of the oil and its affinity for oxygen; (*b*) upon the extent of the contact surface between the oil and air, and upon the physical structure of the fibrous or porous material; (*c*) upon the protection against the radiation of heat; and (*d*) upon the influence of light.

(4.) Of the above conditions (3, *a* to *d*) the following should be noted:—

(*a*.) The four oils examined behaved very differently: the rape oil developed an extremely small amount of heat; the cotton-seed oil very little; the raw linseed oil somewhat more; but the heat generated with boiled linseed oil was very considerable.

(*b*.) The nature of the fibrous material also has considerable influence upon the amount of heat generated, being greatest with silk fibres, after which come animal wool, cotton wool, jute and hemp.

(*c*.) The protection against radiation has naturally a considerable effect upon the rise of temperature. The oxidation of the oils and power of generating heat depend largely upon the temperature being more energetic at higher than lower degrees of heat, and the effect of light is similar to that of an increase in temperature.

(5.) The effect of micro-organisms upon the process of oxidation may be considered very insignificant, the action being a purely chemical one.—S. P. E.

### PATENTS.

*Improvements in Waterproofing Fabrics.* E. M. Turner, Brockley, Kent. Eng. Pat. 9746, May 18, 1894.

Pure paraffin- or other wax is to be dissolved in "pure benzine" (both ingredients must be free from grease) in the proportion of 3 to 10 grains per fluid ounce. The fabric is wetted with this solution by painting, spraying, or soaking, and allowed to dry; it is then run between hot rollers, or otherwise heated to the melting-point of the wax, and passed over one or two blunt edges to remove any initial stiffness. Velveteen, velvet, or plush should be painted and ironed on the back only; silk plush for hats should be painted on the face, and ironed on the back first, or on both sides at once. Most other materials may be treated on either side. The wax should have a high melting point, and may with advantage be mixed with a small percentage of camphor to improve the toughness.

—W. G. M.

*Process and Composition for Waterproofing Textile Materials or Fabrics and Finished Garments.* H. Cohrs and J. Oesterreich, Berlin. Eng. Pat. 10,337, May 28, 1894.

The fabric or garment to be treated is spread out upon a long plate and suitably heated; it is then brushed over upon the face with a mixture of 200 grms. of powdered alum, 175 grms. of sodium (or potassium) silicate, and 3,000* grms. of white vaseline, with 5 litres of hot water. After drying for 10 to 15 minutes at 70° C., the material is ready for use; its softness and colour are unaffected, and it remains pervious to air although water-repellent.

—W. G. M.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*The Application of Electricity to the Bleaching of Textile Fibres.* L. J. Matos. J. Franklin Inst. **139**, 177.

An appreciative account of the processes of Hermite and C. Kellner. The subject of a lecture delivered November 30, 1894.—C. F. C.

*Some Aluminium Compounds.* E. Schlumberger. Bull. Soc. Ind. Mulhouse, 1894, 425—453.

Information is contained in this paper with regard to the nature and composition of certain aluminium precipitates hitherto imperfectly investigated.

1. *Protosulphate.*—By precipitation of a known quantity of alum with a standard solution of caustic potash, it is found that 5 mols. KOH are required to completely precipitate 1 mol. of alum. The precipitate contains 2 mols. aluminium to 1 of $H_2SO_4$. Carefully washed, first by decantation, then on the filter, and dried at 100° C., it is obtained as a white, friable, slightly transparent substance, and an analysis shows in 100 parts: $Al_2O_3$ 49·95, $SO_3$ 18·75.

The formula $(Al_2O_3)_2SO_3.7H_2O$ would require: $Al_2O_3$ 49·76, $SO_3$ 19·51 per cent.

The substance is most probably a di-aluminium sulphate-hydrate with 2 mols. water, and its formula may be written: $Al_2(OH)_5.SO_4.(HO)_5Al_2, 2H_2O$.

It is readily soluble in cold dilute HCl, and this solution on evaporation yields normal aluminium sulphate. The solution in acetic acid is less readily affected, is precipitated on boiling, and redissolves on cooling the liquid. This solution represents the calico-printers' "red liquor" in a state of purity. Between 100° and 130° C. the sulphate-hydrate loses 2 mols. water and becomes less soluble in acetic acid. The action of ammonia on alum solutions is the same as that of caustic potash, except that the precipitate is less soluble in excess of alkali. The sulphate-hydrate is obtained also when a solution of an alkaline aluminate is poured into alum solution to exact neutrality; also by boiling a solution of alum to which an alkaline hydrate or carbonate has been added in the cold as long as the precipitate redissolved. Lastly, the same precipitate results on boiling a solution of aluminium sulphate-acetate, *i.e.*, pure "red liquor."

2. *Carbonates.* — The precipitate formed when an alkaline carbonate is added to a solution of an aluminium compound, varies according to the nature of the aluminium compound; *e.g.*, alum or aluminium sulphate yield a different precipitate from a salt of a monobasic acid such as the chloride. When alum is used, the precipitate contains sulphate, unless a large excess of carbonate be employed. Using every precaution, a white, pulverulent, opaque body may be prepared, free from sulphate and alkaline carbonate, and giving these numbers on analysis:—$Al_2O_3$ 57·52, $H_2O$ 32·36, $CO_2$ 10·12.

The formula $Al_2(OH)_5.CO_2.(HO)_5Al_2$ would require $Al_2O_3$ 57·3, $H_2O$ 30·3, $CO_2$ 12·4 per cent.

It would thus appear that this body is derived from di-aluminic sulphate-hydrate by replacement of $SO_4$ by $CO_2$, but that owing to its unstable nature there is a loss of $CO_2$ during its preparation. To prepare it in a pure state it would be necessary to decompose the sulphate-hydrate with an alkaline carbonate. It is readily soluble in cold dilute acids with formation of normal aluminium salts, and it is decomposed below 100° C. with evolution of water and $CO_2$.

When aluminium chloride is precipitated by an alkaline carbonate, the precipitate obstinately retains traces of the alkali. Dried in air, it forms a translucent mass, decomposed below 100° C. The precipitate obtained by passing a current of $CO_2$ into a cold dilute solution of an alkaline aluminate is also a carbonate. By precipitating alum with sodium carbonate, calico printers obtain a product known as "aluminium jelly," but it is evident that this precipitate cannot have a constant composition.

3. *Hydrates.*—It has not been found possible to isolate normal aluminium hydrate of the formula $Al_2(OH)_6$. The precipitate either retains acid, according to the salt used for its preparation, or it is found to be incompletely soluble in cold dilute acids, and on ignition yields too great an amount of $Al_2O_3$, or both these departures from the normal may be found in the same precipitate. For instance, in precipitating aluminium chloride with ammonia, the precipitate either contains chlorine, or if quite free from chlorine, it yields about 72 per cent. $Al_2O_3$, while $Al_2(OH)_6$ would yield 65·4 per cent. This product is evidently a mixture; by treatment with HCl and careful filtration a solution of aluminium chloride in excess of acid is obtained, whilst a gelatinous mass remains on the filter, and this, if digested with water, without previous washing, yields an opalescent colloid solution precipitated by sodium sulphate or $H_2SO_4$.

The hydrates of K, Na, Ba, act like ammonia, and a similar result is arrived at by the decomposition of an alkaline aluminate with hydrochloric acid.

When, in quantitative analysis, alumina is precipitated with ammonia, and the precipitation accelerated by boiling, care must be taken not to entirely remove excess of ammonia from the liquid; for if this occurs the colloid hydrate tends to redissolve, causing the filtration to be retarded, and also bringing about a loss of alumina.

4. *Colloid Hydrates.*—It has been shown that together with the normal hydrate are formed other hydrates, containing less water than the normal, and soluble in very dilute acids to colloid solutions. These hydrates result from using a large excess of the alkaline precipitant. It is very difficult to obtain precipitates of constant composition.

Walter Crum has described a so-called soluble hydrate, a colloid solution prepared by heating a dilute solution of aluminium acetate for some time at a temperature approaching boiling. This solution, on precipitation with ammonia, yields a hydrate with 79·5 per cent. $Al_2O_3$.

None of the latter compounds appear to be applicable as mordants for colouring matters.—R. B. B.

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* This number is given as 300 in the provisional specification.

### *Dianisidine Blue Discharge on Paranitraniline Red.* Bloch and Schwartz. Bull. Soc. Ind. Mulhouse, 1894, 421—425.

Blue discharged on red, a colour for which a satisfactory process has long been sought, may now be obtained by combining dianisidine blue with paranitraniline red. To produce the blue, the fabric is impregnated with β-naphtholate of soda, and then so completely saturated with diazotised dianisidine that a subsequent passage through diazoparanitrobenzene, which transforms the unaffected portions into red, does not sensibly alter the blue. The best results are obtained by padding the β-naphtholate of soda with a light roller, and then printing the blue bottom with strong pressure to effect complete saturation of the naphthol. The blue is at once developed, and the goods are passed into the bath of diazo red; this red very slightly deepens the shade of the blue ground. The colours at first obtained were not so fast as desired, and a subsequent improvement has been to make use of the effect of copper salts in increasing the fastness to light of dianisidine blue. The original process was as follows :—

Pad the goods, by means of a light roller, with this mordant:—3½ lb. β-naphthol, 3½ lb. caustic soda (40° B.), 5 galls. water, 5 galls. gum tragacanth thickening (60 grms. per litre); then print with colour prepared thus:—Mix well together 2 lb. 6 oz. dianisidine sulphate paste, 2 lb. 6 oz. hydrochloric acid (21° B.), 6½ pints cold water; add, at 0° C., 3¼ pints nitrite of soda solution (150 grms. per litre), then add further 2 lb. 6 oz. sodium acetate, make up to 32 pints, and thicken with 32 pints gum tragacanth thickening.

Pass into the diazo red bath, which is thus made up :—10 lb. paranitraniline N paste, 6 pints hydrochloric acid (21° B.), 8 pints cold water.

After diazotisation add 9 lb. sodium acetate, make up to 40 pints, filter, and add 80 pints cold water. The paranitraniline N paste is constituted as follows:—1¼ lb. paranitraniline powder, ½ pint gum thickening, 9½ oz. sodium nitrite, 2½ pints cold water.

*Copper Blue.*—On printing the copper blue on the naphtholate and then passing into the diazo red bath, a certain amount of copper compounds will be discharged from the blue ground into the bath and tend to change the red to a cutch-brown. To prevent this, a small quantity of potassium ferrocyanide is added to the diazo bath, and this precipitates the copper before its injurious effect can take place. The addition of ammonium chloride to the final soaping bath also improves the red colour. The process is carried out on the large scale as follows :—

Pad with mordant made with 3 lb. β-naphthol, 4 pints caustic soda (22° B.), 8 pints oil A, 40 pints water, 32 pints tragacanth liquor (60 grms. per litre), 3 lb. sodium acetate.

The oil A is made from 8 pints oxyoleic acid A (Schmitz and Tœnges), 5 pints cold water, 1 lb. caustic soda (40° B.).

Print the following colour for the blue ground:—5 oz. dianisidine, ½ pint hydrochloric acid (21° B.), 6 pints boiling water; to this add, at 0° C., 1¼ pints sodium nitrite solution (150 grms. per litre), and after 20 minutes add ¾ pint copper chloride solution (40° B.), and 1 pint cold water; dilute to 12 pints and thicken with 12 pints tragacanth thickening. The red is then dyed by passing between rollers covered with cotton cloth in a bath containing 10 lb. paranitraniline N paste, 6 pints hydrochloric acid (21° B.), 8 pints water, 9 lb. sodium acetate; dilute to 40 pints, and add further, 60 pints water, 2 lb. potassium ferrocyanide, 20 pints tragacanth liquor. After dyeing, the goods are well washed, and soaped in a bath containing 200 gallons water, 8 lb. Marseilles soap, 6 lb. ammonium chloride, 16 pints hot water, and finally soaped again without addition to the bath.—R. B. B.

### *Alkylated Azo Compounds and the Theory of Dyeing.* R. Meyer and J. Schäfer. Ber. 27, 3355—3361.

In dyeing animal fibres with organic colouring matters, in general only those can be used directly which contain salt-forming groups, such as the amido or hydroxyl group. This is taken as evidence in support of the theory hat the dyeing of animal fibres is a chemical interaction and that the fibre, like an amido acid, can react as acid or base to form salts with a colouring matter containing basic or acid groups. The case with regard to cotton is not so clear, as cellulose, of which it almost entirely consists, shows very little tendency to enter into chemical combination, and the dyeing of cotton would appear to be a mechanical process. Against this, however, it is remarkable that the substantive cotton colouring matters do contain salt-forming groups, although instances are known in which these groups are supposed to be absent. The authors have examined several of these cases and find that in every instance a salt-forming group is present. The colouring matters investigated were alkylated diazo compounds. To this class belongs Chrysophenin (Eng. Pat. 4243 of 1886), obtained by ethylating Brilliant Yellow (Eng. Pat. 4387 of 1886; this Journal, 1887, 507), and supposed to have the constitution—

$$H_2C_2[C_6H_3.SO_3Na.N{=}N.C_6H_4.OC_2H_5]_2$$

Analysis, however, shows that it only contains one ethoxyl group and, furthermore, on reduction with zinc and acetic acid it yields *p*-amidophenol as well as *p*-amidophenetol. A colouring matter of the same class, Diamine Gold (Eng. Pat. 15,346 of 1890; this Journal, 1891, 761), said to have the formula—

$$(NaSO_3)_2{:}C_{10}H_4{:}(N{:}N.C_6H_4.OC_2H_5)_2$$

was also found to contain only one ethyoxyl group and to give both *p*-amidophenol and *p*-amidophenetol on reduction. The former substance can be detected in presence of the latter by means of the thionolin reaction with sulphuretted hydrogen and ferric chloride, or else by conversion into the benzoate $C_6H_4.OC_7H_5O.NHC_7H_5O$, melting at 231° C. In order to obtain dialkylated compounds, the authors treated Brilliant Yellow with an excess of benzyl chloride, but only succeeded in producing a monobenzyl derivative An attempt was also made to obtain the dialkylated derivative of a compound free from sulphonic acid groups, for which purpose diphenyldisazophenol was treated with benzyl chloride and caustic soda, but only the monobenzyl derivative could be obtained. Hence, in all cases examined, the alkyl derivatives of symmetrical dihydroxyazo compounds are unsymmetrical mono-ethers. The presence of a free hydroxyl, however, scarcely confers any acid properties on the compounds, and, bearing in mind the insolubility in caustic soda of the unsulphonated azo derivatives of β-naphthol, it might be supposed that Chrysophenin and Diamine Gold were similarly constituted. However, on the alkylated half of the molecule the constitution is that of a normal azo compound, since *p*-amidophenetol is obtained on reduction.—T. A. L.

### *Analyses of Cotton Dyed with Alizarin.* C. Liebermann and P. Michaelis. Ber. 27, 3009.

*See under* XXIII., *page* 514.

### *The Colouring Principle of "Toddalia Aculeata" and "Evodia Meliafolia."* A. G. Perkin and J. J. Hummel. Proc. Chem. Soc. 1895 [150], 54.

*See under* IV., *page* 476.

## PATENTS.

### *Improvements in Dyeing and otherwise Treating Cotton and other Piece Goods, and in Machinery or Apparatus to be used for the Purpose.* G. N. Midwood and C. Edmeston, Manchester. Eng. Pat. 8969, May 5, 1894.

Dyeing and other operations, such as scouring or crabbing, &c., are carried on in a closed chamber. This chamber is such as would be made by lowering one vessel with its open end downwards into a larger vessel, so that two sides of the inverted vessel rest on the bottom of the lower vessel, and the other two sides extend to within a short distance of the bottom, thus leaving on the two latter sides a space between the vessels. Through these spaces the cloth enters and leaves the closed chamber; the spaces also prevent any escape of steam or liquor or admission of air. The cloth passes through the closed chamber in its passage from one roller to the other. In the chamber, the cloth passes under and over a series of rollers in such a manner that it is alternately immersed in the liquor in the lower part, and subjected to the action of steam in the upper part of the chamber.—R. B. B.

*Improvements in Apparatus for Dyeing or otherwise Treating with Liquids, Textile Materials in a more or less Manufactured Condition.* F. A. Blair, Galashiels. Eng. Pat. 10,391, May 29, 1894.

This apparatus is of the kind in which the liquid is made to circulate through the textile materials. The materials are so disposed that the cross-sectional areas of material successively passed through by the liquid, diminish approximately in proportion to the diminishing strength of the liquid. To bring this about, the material is wound in the form of a slightly coned roll. This roll is placed in a conical box, between two perforated diaphragms. The liquid finds its way into a space separated from the interior of the box by the larger diaphragm, and proceeds through the material towards and out at the smaller end of the box. Or, instead of a conical box may be used a cylindrical box having within it a cone. The materials are then placed between the cone and the sides of the box. Generally a number of boxes will be combined in each vat, their axes being arranged either vertically or horizontally.—R. B. B.

*Improvements in Printing upon Calico and other Woven Fabrics.* E. Potter and Co., Limited, and J. Barr, Dinting Vale, Derbyshire. Eng. Pat. 18,258, September 26, 1894.

A reserve colour is printed on the fibre by a roller preceding the roller which prints the "blotch" or other fitted ground, and fine effects in white or colours are thus obtained by the reserve under the "blotch" printing colour.

—R. B. B.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Analysis of Sodium Peroxide.* L. Archbutt. Analyst, 20, 1895, 3.

*See under* XXIII., *page* 513.

*Electrolytic Production of Hypochlorites and Chlorates.* F. Oettel. Zeits. f. Elektrotechnik u. Elektrochem. 1894, 354.

*See under* XI., *page* 492.

*Use of Sulphurous Acid* ($HNaSO_3$) *in the Manufacture of Glucose Syrup and Grape Sugar.* H. E. Horton. J. Amer. Chem. Soc. 1895, 17, 281.

*See under* XVI., *page* 497.

### PATENTS.

*Improvements in making Potassic Cyanide, and Apparatus therefor.* W. McD. Mackey, Leeds, and J. F. Hutcheson, Glasgow. Eng. Pat. 6925, April 7, 1894.

A mixture of potassium carbonate, or other potassium compound capable of reduction by carbon, with charcoal, coke, or coal, is fed from the top into a cupola furnace containing previously ignited fuel. The furnace has a tapping-hole at the bottom, and two sets of tuyères at different elevations for admission of two heated blasts, and a lateral outlet between for passage, into suitable condensing apparatus, of vapour or fumes of the cyanide formed. The lower blast only is used on starting the fire, and, when the furnace is sufficiently heated, the upper blast is also admitted, and then the mixture of the potassium compound and carbon is charged in as described. The mixture, with this arrangement, is dried and heated by the combustion maintained by the one blast, before being acted on by the other blast. A lateral passage is provided near the top of the furnace for the products of combustion, controlled by a damper, so that more or less of such products may descend through the materials below. A feeding door is shown at the top of the furnace. Baryta or suitable fluxes may be added to the mixture of the potassium compound and carbon. The furnace, though preferably vertical, may be inclined, and has a basic lining.

—E. S.

*A New and Improved Method of Heating Brine or similar Substances by Utilising the Heat of the Vertical Flue Pipe of the ordinary Salt-Pan, by the Erection of a Cistern round the Outside of the Flue Pipe, and Inserting in the Flue Pipe, Cross-Tubes at Equal Intervals, open so as to permit of the Free Passage of the Brine from one side of the Cistern to the other.* J. Hodkinson, Carrickfergus, Ireland. Eng. Pat. 7179, April 11, 1894.

The cistern erected, as described in the title, about the flue pipe to a salt-pan, is charged with brine, which circulates through the cross-tubes, and is warmed, thus effecting an economy of fuel in the process.—E. S.

*Improvements in Utilising Acid Sulphates and Acids, and in Obtaining Nitric Acid and Hydrochloric Acid.* A. Campbell, Upton Park, Essex, and A. Walker, Irvine, N.B. Eng. Pat. 9782, May 19, 1894.

A dry acid sulphate is obtained by adding to an alkali monosulphate, or to "salt-cake" either dilute sulphuric acid, or a mixture of dilute sulphuric and nitric acids, occurring as a residue of certain chemical operations, and heating to about 300° F. to expel water or water and nitric acid.

The dry acid sulphate formed as described, or "nitre-cake," is ground up with sodium nitrate or potassium nitrate, and the mixture is fed continuously by a hopper and rotating screw into a vessel containing an alkali sulphate already heated to the "proper temperature." The vessel is provided with a mechanical agitator and other suitable appliances. The nitric acid evolved passes through an outlet to condensers. Hydrochloric acid is similarly obtained from a mixture of the acid sulphate and sodium chloride, except that a higher temperature, namely, from 600° to 800° F., is employed.—E. S.

*Improvements relating to the Manufacture of Sodium Bicarbonate, and to Apparatus therefor.* T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 9979, May 22, 1894.

The invention consists in a continuous process for the manufacture of sodium bicarbonate by the electrolysis of brine. The electrolytic apparatus consists of a series of metallic vats, arranged vertically, each vat being divided into two compartments by a diaphragm supported by a metal frame forming the cathode, a layer of carbon resting on the diaphragm, forming the anode. A series of carbon pencils are suitably supported in connection with the carbon layer. All the anode compartments are connected together by feed and discharge pipes, as are likewise the cathode compartments. Salt brine is fed into the anode compartment of the top vat of the series, in such quantity as to produce a constant flow through the whole series of corresponding compartments, the portion escaping from the lowest vat being reserved as a by-product, the treatment of which forms no part of the invention. The cathode compartments, which in the first instance are filled with water, discharge into a receiver, whence the liquid is pumped through suitably arranged pipes into the upper part of a capacious and high stand-pipe, into which, near its bottom, a stream of carbonic acid gas is forced. As the electrolysis of the brine proceeds, caustic soda solution is formed and enters the stand-pipe, where it becomes bicarbonate solution, and passes up a branch to the stand-pipe, communicating by a pipe from its upper part with the highest cathode compartment of the electrolytic apparatus, into which it is forced by action of the pump. The caustic soda solution in the cell, combining with the bicarbonate solution thus injected, forms a solution of monocarbonate, the formation of which is claimed as a distinct sub-process, valuable as reducing the electrical horse-power needed in the operation. As the electrolysis of the brine advances, and the caustic or carbonated solution becomes stronger, solid sodium bicarbonate is precipitated in the stand-pipe. The deposit falls through a valved aperture into a receiver, whence it passes to a centrifugal separator, and then, by a conveyor, to a drier, the drying being preferably effected by a mixture of hot air and carbonic acid gas from the apparatus. The separator is connected to the first receiver by a pipe, so as to return the liquid separated into the circulatory system, and also by another pipe to an independent receiver, in which sodium bicarbonate solution is stored, in order to wash, if necessary, any undecomposed salt from the bicarbonate in the separator. A grinding mill, hot-blast apparatus, and gas-pump, with connections, are also shown. By charging the apparatus at the start with a solution of mono- or bicarbonate of soda, it is more quickly brought into systematic action.—E. S.

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### *A Process of Manufacture of Chlorine from Hydrochloric Acid Gas and Nitric Acid by the Employment of Sulphuric Acid.* J. Y. Johnson, London. From Verein Chemischer Fabriken of Mannheim, Germany. Eng. Pat. 10,604, May 31, 1894.

The reactions that take place in combinations of nitric and hydrochloric acid vary according to conditions of pressure and concentration. The reactions to be considered are :—

(1) $2HNO_3 + 6HCl = 2NOCl + 4Cl + 4H_2O$.

(2) $2HNO_3 + 4HCl = N_2O_3 + 4Cl + 3H_2O$.

(3) $HNO_3 + HCl = NO_2Cl + H_2O$.

(4) $NOCl + HNO_3 = N_2O_4 + HCl$.

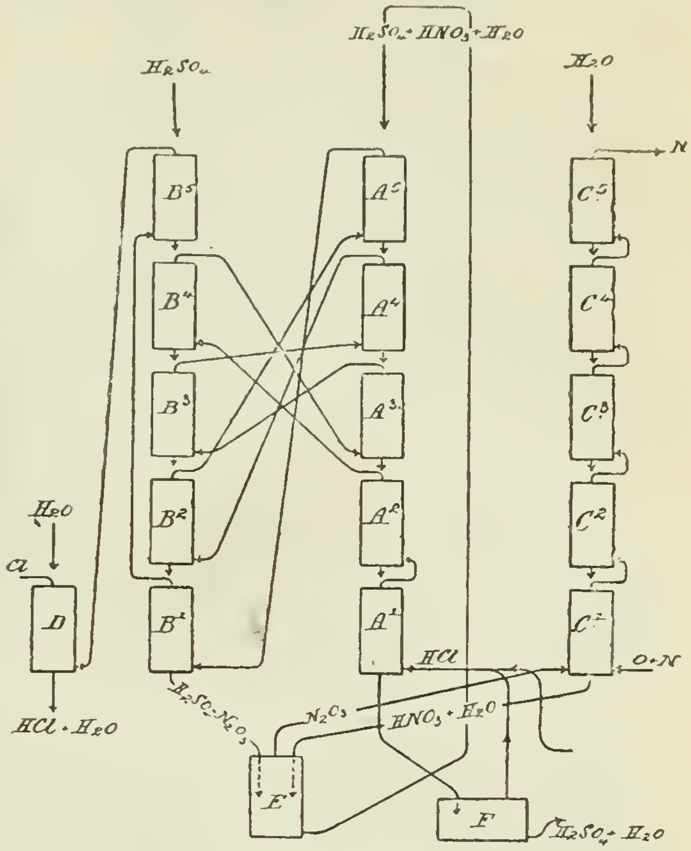
The first equation represents the most useful reaction, and takes place only when there is no liquid pressure, and even then is liable to be complicated by the other reactions. When the mixed acids are treated with concentrated sulphuric acid, $N_2O_4$ and $NO_2Cl$ remain unabsorbed or unattacked, and hence it is desirable to minimise their formation. The following equations represent the products formed on absorption of nitrous acid by sulphuric acid :—

(5) $NOCl + H_2SO_4 = HSO_3NO_2 + HCl$.

(6) $N_2O_3 + 2H_2SO_4 = 2HSO_3NO_2 + H_2O$.

But when concentrated sulphuric acid has acted according to equation (5), so that the mixture contains a certain proportion of $HSO_3NO_2$, addition of HCl brings about a reverse action, thus: (7) $HSO_3NO_2 + HCl = H_2SO_4 + NOCl$, and this reaction is the more energetic as the hydrochloric acid is the less dilute. The reaction vessels are therefore so arranged that the reaction gases richest in HCl may meet the sulphuric acid poorest in $HSO_4NO_2$ and *vice versâ.* Further, the mixture of acids remaining after evolution of chlorine are capable of absorbing hydrochloric acid gas to an extent not exceeding 5 per cent., and on heating to 130° C. hydrochloric acid gas escapes with violence, leaving an acid free from nitro compounds.

The $A_1$, $A_2$, &c. series of superposed chambers are made of clay or stoneware, and are filled with porous acid-proof material in fragments. The mixture of hydrochloric and nitric acids is passed as a jet or current into the upper chamber, and traverses the other chambers as shown by the arrows. The $B_1$, $B_2$, &c. series consists of lead chambers, packed as mentioned, and are traversed by a controlled current of concentrated sulphuric acid for decomposing the NOCl formed in the A chambers. The C chambers, which may be of earthenware, constituting the regeneration apparatus, are similarly constructed and arranged to the preceding series, and are traversed by a jet of water and by air, for oxidation into nitric acid of the nitrous acid formed during the reactions. HCl from the sulphate furnace or other source, enters the chamber $A_1$ and passing upwards through that series, is taken to the bottom of chamber $B_1$ and up to $B_5$, entering successively into reaction with nitric acid in the A chambers and with sulphuric acid in the B chambers, according to equations (1) and (5). The chambers $A_1$ and $A_2$ are directly connected, so that the acid mixture flowing downwards becomes saturated with HCl in the lowest chamber, and then enters the closed vessel F, which is heated to decompose nitrogen compounds, and set free HCl, which gases return to chamber $A_1$ and so again enter into reaction. The residue in F is dilute sulphuric acid. The chamber $B_1$ communicates directly with $B_5$, so that the NOCl escaping decomposition in the former, encounters in the latter, fresh strong sulphuric acid. The chlorine produced is taken off from the vessel D, into which water is passed to free it from HCl. The sulphuric acid saturated with $HSO_3NO_2$ passes from $B_1$ into the vessel E, to meet the dilute nitric acid regenerated in the C chambers, and the gaseous $N_2O_3$ evolved passes to the said chambers for regeneration to nitric acid by the action of air and water. —E. S.



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### *Improvements in treating certain Waste Materials to produce valuable Products, such as Plaster or Stiffening, Weighting, and Whitening Materials, therefrom.* J. H. Lester, Manchester, and T. E. Thomlinson, Bury, Lancashire. Eng. Pat. 13,198, July 7, 1894.

A form of sulphate of lime suitable for use as a stiffening and weighting material for textiles and paper ("pearl hardening") is prepared by treating any waste calcareous product, such as the mass left by the action of slaked lime on ammonium sulphate or other ammonium salt, with sulphuric acid, so as to convert the whole of the lime into calcium sulphate. The mixing is carried out in a tank provided with an agitator, and the resulting sulphate of lime is washed, if necessary, with a slight excess of acid, separated, and dried by ordinary methods.—B. B.

*Improvements in the Manufacture of Sulphides of the Alkalis.* B. Peitzsch, Höchst-on-the-Main, Germany. Eng. Pat. 22,569, November 22, 1894.

The invention consists in heating a mixture of the sulphate of an alkali with carbon, in a vessel to which air has no access, to a temperature under, or not exceeding, the melting point of the sulphide. The admission of air, by promoting the formation of polysulphides and hyposulphites, tends to cause fusion, and consequent attack of the material of the containing vessel. With exclusion of air, on the other hand, complete reduction takes place at a comparatively low temperature, and the product, being of loose consistency, is readily dissolved by water.

The finely-ground and mixed raw materials are charged into light iron pots or vessels, which are placed in a hermetically closed horizontal retort or muffle, and heated for some hours. On completion of the reaction, which is known by the diminished temperature of the escaping gases, the retort is opened, the pots are withdrawn, and the sulphide is either placed in hermetically closed receptacles, or preferably is dissolved in water. If a vertical retort is used, the materials are charged into casings of thin sheet metal, of about 10 cm. diameter. It is desirable that in no case should the material be heated in vessels of greater depth or thickness than 10 cm., as the conduction of heat through it is slow. The lye obtained may be treated with carbonic acid gas, for making sodium or potassium carbonate, in the usual known manner. Sodium or potassium sulphate may be replaced in the process, wholly or partially, by the double salts of potassium and magnesium sulphate, or sodium and magnesium sulphate, or a mixture of these.—E. S.

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*Process for the Production of Concentrated Sulphuric Acid by Means of Electrolysis.* L. Wacker, Munich, Bavaria. Eng. Pat. 3183, February 13, 1895.

This is a process for the production of concentrated sulphuric acid, which consists in subjecting an aqueous solution of sulphurous acid to the action of an electric current, while at the same time sulphur dioxide is supplied thereto.

The invention is carried out as follows:—

I. A solution of sulphurous acid in water is subjected to the action of an electric current. The cathode liquid is separated from the anode liquid by a diaphragm. Into the anode liquid is continuously introduced a slow stream of gaseous sulphurous acid. The cathode liquid soon shows a milky appearance, which consists of separated sulphur. As soon as this milky appearance shows itself in the cathode liquid, the presence of sulphuric acid is shown to exist in the anode liquid by the formed precipitate, insoluble in mineral acid. By filtration after the boiling of the electrolysed liquid, the continuance of the concentrating process can be easily controlled. If the process be continued long enough, there will be produced in this way a concentrated sulphuric acid. Also in the cathode liquid will there be sulphuric acid in addition to the sulphur.

II. According to another method the electrolysis is effected without a diaphragm, by introducing continuously, a slow stream of sulphurous acid into the water, which is subjected to electrolysis under cooling. The concentration is advanced in proportion to the addition of sulphurous acid and the separation of an equivalent quantity of sulphur. For separating the sulphur from the sulphuric acid produced, the mass is heated to above the melting point of the sulphur, and, after cooling, the clear acid is siphoned off from the melted sulphur. This sulphur can, after washing and drying, be again introduced into the process in the form of sulphurous acid.

III. According to another modification, chlorinated water, for example, or dilute hydrochloric acid, or a solution of common salt, is electrolysed, and sulphurous acid is introduced under cooling, so that the chlorine evolved is always in excess. By this means the separation of sulphur is prevented. If, however, the sulphurous acid is in excess, there will be separation of sulphur. The sulphuric acid in this case contains chlorine or hydrochloric acid, and there is obtained sodium bisulphate as by-product. The chlorine or the hydrochloric acid can be separated by heating the acid and forcing a dry current of air through.—J. C. R.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*Influence of Oxidising and Reducing Gases on the Colours imparted to Porcelain by Cobalt and Iron.* E. Damour. Bull. Soc. d'Encouragement, 9 [108], 966—968.

Small pieces of porcelain were placed in a tube heated to 1,400° C., the average temperature employed when working on the large scale, and a regulated current of gas was passed through the tube. The gas may either be oxidising, or a reducing mixture of carbon monoxide and carbonic acid. In some of the experiments, the colour was put on the "biscuit" beneath a colourless glaze, in others the glaze was coloured. The results with cobalt were not of especial interest. The chief point noticed was that the blue colour was more vivid with an oxidising than with a reducing atmosphere. In the case of iron the results were more remarkable. In a strongly reducing atmosphere, a glaze containing 2 per cent. of iron and 10 per cent. of carbon gave shades of greenish-blue similar to the Chinese *céladon* or "sea-green." Various shades, some of which were very pleasing, were obtained with underglaze colours, but the most interesting result obtained in this part of the experiments was the discovery that porcelain containing as much as 2 per cent. of iron, was completely decolorised in an atmosphere containing 20 per cent. of oxide of carbon.

The author intends to continue the experiments upon iron.—V. C.

### PATENTS.

*Improvements in Tank Furnaces Used in the Manufacture of Glass.* Chance Brothers and Co., Lim., West Smethwick, and J. E. Scott, West Bromwich. Eng. Pat. 6264, March 28, 1894.

The improvements consist in making the furnace in two chambers, a certain distance apart, and connecting the adjacent ends by means of a tubular channel or neck, instead of in the form of a single chamber divided into two compartments by a bridge, as is now usual.—R. B. P.

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*Improvements in the Construction of Kilns and the Methods of Firing the same for Burning Bricks, Clay Goods, and Pottery, and the like Ware generally.* E. Howl, Dudley, Staffordshire. Eng. Pat. 8088, April 24, 1894.

The kilns patented, are built with side grates provided with forced draught by means of steam-jets or fans. One type is of the arched class of kilns used for burning Staffordshire blue bricks. In this kiln, the exit gases are taken off by a flue at the bottom, and the grates are set in just below the spring of the arch of the kiln, the fuel upon them being retained by curtain walls carried on pillars rising from the floor of the kiln. The fuel is fed in through vertical shafts descending from the top of the kiln, and air is supplied by side openings. The air conduits below the grates are kept clean by the use of a chain carrying a scraper and running the whole length of the conduit. For open-topped brick-kilns, special grates, sloping downwards, and set in through side openings at the bottom of the kiln, are employed. These grates are removable, and may be used for any kiln of the right size. The fuel from the grate is burnt by the help of a forced draught obtained in a manner similar to that already described for arched kilns.—B. B.

# IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### *Experiments for Determining the Fusibility of Fire-Clays.*
Eng. and Min. J. **59**, 295.

In a paper read at the Florida meeting of the American Institute of Mining Engineers, the author continues a description of his experiments on the fusibility of fire-clays. He gives a set of tables and analyses, showing the fusibility and composition of various kinds of clay. After describing the furnace, crucible, and mixture used, he gives the details of his tests. The material was slightly calcined, and, when cool, moistened on a glass plate with water containing 5 per cent. of dextrin, and worked to a stiff paste. After pressing this into a mould, the resulting pyramid was air-dried overnight, and then slowly heated on an iron plate to drive off the remaining moisture. Usually two dried samples were placed with three Seger cones in a crucible. Crushed gas-retort carbon ignited with charcoal was found to be the best fuel, and the blast was gradually increased to a pressure of two inches, and was maintained at the necessary pressure during the experiment, by increasing the air supply in proportion to the amount consumed by the carbon.—A. W.

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### *Sand from Stamping Mills for Cement Mortar.*
E. Kidwell. Eng. and Min. J. 1895, 173—174.

It is a matter of common belief in the West that sand from a stamp mill yields stronger cement mortar than standard sand does, the latter being the quartz sand recommended by the American Society of Civil Engineers.

This standard sand is caught between a 20- and a 30-sieve, the wire of the former being No. 31, Stubb's gauge. The stamp sand was taken direct from the mill without cleaning, the rock from which it is derived being a bed of melaphyr, locally called an amygdaloid. Such sand is very coarse, variable in size, and it contains some dirt. The following results, excerpted from the tables accompanying the paper, indicate the difference of strength of cement mortar made with the two kinds of sand.

It may be noted that No. 1 is a Portland cement of English make, the remainder being American "natural cements." The figures quoted in the table show conclusively a superior strength of mortar made from stamp sand:—

Table I.—Neat Cement.

| — | Fineness. Cement rejected by Sieves. No. of Meshes per Sq. In. | | | 7-Day Tests. | | 28-Day Tests. | |
|---|---|---|---|---|---|---|---|
| | 2,500. | 6,400. | 10,000. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. |
| | Per Cent. | Per Cent. | Per Cent. | Average. | Average. | Average. | Average. |
| I. | 4 | 13 | 16 | 368·8 | 1,483·5 | 506·4 | .. |
| II. | 16 | 24 | 26 | 107·6 | 691·5 | 260·3 | 1,320·5 |
| III. | 5 | 15 | 18 | 45·4 | 328·0 | 137·5 | 629·0 |
| IV. | 16 | 25 | 28 | 81·3 | 403·0 | 130·5 | 619·4 |
| V. | 6 | 8 | 11 | 44·5 | 188·5 | 108·0 | 377·0 |

Table II.
One Part Cement to One of Standard Sand.

| — | 7-Day Tests. | | 28-Day Tests. | |
|---|---|---|---|---|
| | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. |
| | Average. | Average. | Average. | Average. |
| I. | 213·6 | 1,252·5 | 311·0 | .. |
| II. | 46·6 | 280·0 | 131·0 | 532·5 |
| III. | 47·0 | 157·0 | 69·6 | 375·0 |
| IV. | 37·0 | 254·0 | 68·5 | 235·5 |
| V. | 15·6 | 108·0 | 84·8 | 264·0 |

Table III.
One Part Cement to One of Stamp Sand.

| — | 7-Day Tests. | | 28-Day Tests. | |
|---|---|---|---|---|
| | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. |
| | Average. | Average. | Average. | Average. |
| I. | 223·5 | 1,587·5 | 415·0 | .. |
| II. | 55·5 | 322·0 | 167·1 | 1,117·5 |
| III. | 45·1 | 222·5 | 82·3 | 468·5 |
| IV. | .. | 235·0 | 102·8 | 469·5 |
| V. | 14·6 | 134·5 | 72·0 | 335·0 |

Table IV.
One Part Cement to Three of Standard Sand.

| — | 7-Day Tests. | | 28-Day Tests. | |
|---|---|---|---|---|
| | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. |
| | Average. | Average. | Average. | Average. |
| I. | 51·1 | .. | 105·8 | .. |
| II. | 17·1 | 49·5 | 21·6 | 92·5 |
| III. | 15·1 | 42·0 | 21·8 | 81·0 |
| IV. | 5·75 | 38·0 | 15·3 | 52·0 |
| V. | .. | 21·5 | .. | 43·5 |

Table V.
One Part Cement to Three of Stamp Sand.

| — | 7-Day Tests. | | 28-Day Tests. | |
|---|---|---|---|---|
| | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. | Tensile Strength in Lb. per Sq. In. | Compressive Strength in Lb. per Sq. In. |
| | Average. | Average. | Average. | Average. |
| I. | 132·2 | 506·5 | 315·0 | 1,156·5 |
| II. | 33·0 | 150·0 | 67·8 | 502·5 |
| III. | 24·0 | 163·5 | 34·5 | 252·5 |
| IV. | 17·0 | 91·5 | 34·1 | 180·5 |
| V. | 6·8 | 75·0 | 36·0 | 88·5 |

—B. B.

*The Asphalt Question.* S. F. Peckham. J. Amer. Chem. Soc. 1895, **17**, 55.

*See under* XXIII., *page* 524.

*Bricks for Glover Towers.* J. Amer. Chem. Soc. **17**, 1895, 303.

These bricks, manufactured from the Aiken S.C. clays (U.S. America), are in physical appearance and colour like the famous blue Welsh brick, and in quality rival them. Sp. gr., 1·93; hardness, 7·5; colour, "umber blue"; fracture, blue.

| | | Per Cent. |
|---|---|---|
| Silica, | $SiO_2$ | 72·11 |
| Alumina, | $Al_2O_3$ | 20·53 |
| Iron oxide, | $Fe_2O_3$ | 5·48 |
| Calcium oxide, | CaO | 0·92 |
| Magnesium oxide, | MgO | 0·54 |

A whole brick placed in the bottom of a working Glover tower, acid at 62° B. and 310° F., lost as follows:—

| | Grms. |
|---|---|
| Weight of brick | 2934·22 |
| " " at expiration of 1 week | 2933·01 |
| " " " 2 weeks | 2931·92 |
| " " " 3 " | 2929·41 |
| " " " 4 " | 2928·36 |
| " " " 5 " | 2927 11 |
| " " " 6 " | 2925·26 |
| " " " 7 " | 2923·99 |
| " " " 8 " | 2922·78 |
| " " " 9 " | 2921·53 |
| " " " 10 " | 2920·05 |

Whole brick immersed in boiling acid gave:—

| | | | | | Per Cent. |
|---|---|---|---|---|---|
| | 66° B. sulphuric acid, | 5 | hours, | lost | 0·08 |
| Same re-weighed | 60° B. " | 5 | " | " | 0·07 |
| " | 50° B. " | 5 | " | " | 0·06 |
| " | 47° B. " | 10 | " | " | 0·06 |

A piece from interior of brick immersed in boiling acid gave:—

| | | | | | Per Cent. |
|---|---|---|---|---|---|
| | 66° B. sulphuric acid, | 5 | hours, | lost | 0·15 |
| Same re-weighed | 60° B. " | 5 | " | " | 0·07 |
| " | 50° B. " | 5 | " | " | 0·07 |
| " | 47° B. " | 5 | " | " | 0·04 |

The edges still remained firm and sharp.—W. S.

## PATENTS.

*An Improved Apparatus for Drying Phosphates, Marl, Clay, Sand, and other Materials.* D. W. Anderson and G. W. Parsons, Virginia, U.S. America. Eng. Pat. 4952, March 9, 1894.

*See under* I., *page* 468.

*An Improved Material for Wall-Plastering, Priming, Casting or the like, and Process for Producing the same.* A. Keim, Munich, Germany. Eng. Pat. 8468, April 28, 1894.

A mixture is made in about the following proportions:—China clay, 8·8 per cent.; white chalk, 58·9 per cent.; potassium water glass (30° B.), 27·4 per cent.; powdered glass, 4·2 per cent.; sodium sulphide, 0·7 per cent. The product is made into lumps, and burnt, ground, and mixed with 8 per cent. of barium carbonate, and then with powdered marble or chalk which has been caught between two sieves of suitable mesh. The resulting mass may be used for wall plastering, and its colour may be regulated by the addition of suitable pigments or by the use of pigmentary oxides before burning.—B. B.

*Improvements in Continuous or Running Kilns for Burning Lime, Cement, and other similar Materials.* A. Bauchère, Boulogne, France. Eng. Pat. 9545, May 15, 1894.

The patent relates to running kilns, designed to burn the charge of lime or cement in a uniform manner, and without causing adherence of the charge to the walls of the kiln. The kiln has a conical charging dome, around which are two series of gas inlets, the lower being fed continuously with gas from the combustion zone, and the upper having its inlets automatically controlled by dampers connected with the cap of the charging dome by a chain running over overhead pulleys. Between the charging dome and the kiln proper a break is provided, so as to prevent the close packing of the charge against the walls of the lower part of the kiln, such packing tending to cause the plastic clinker to stick to the walls. A steam jet is set under the grate at the bottom of the kiln with the view of breaking up the top charge previous to its withdrawal from the kiln.—B. B.

*A Process for the Production of Cement from Furnace Slag.* J. Brasseur and N. Lambert, Luxembourg. Eng. Pat. 10,607, May 31, 1894.

In the customary process for manufacturing slag cement, the granulated slag is dried and ground together with slaked lime. In order to assist the drying, the patentees mix the damp slag with quicklime in the usual proportion, the quicklime being slaked by the water in the slag and correspondingly drying the latter.—B. B.

*An Improved Method and Apparatus for the Continuous Working of Annular and the like Kilns for Bricks, Tiles, and the like.* W. P. Thompson, Liverpool, Manchester, and London. From F. Schofer, Würtemberg, Germany. Eng. Pat. 12,554, June 28, 1894.

The apparatus described is essentially a ring kiln, having, however, its individual parts separated from each other save for their connection by flues, and having exterior grates. The mode of working is that usual in ring kilns, the heat in the exhaust gases being utilised by passage through several members of the ring before passing to the common shaft. The separate chambers can be rapidly cooled by damping down, that is, moistening sand contained between the inner and outer walls of the kiln, the water being introduced by means of siphons so as to prevent the entrance of air by the formation of a trap or seal.—B. B.

*Improvements relating to the Manufacture of Cement from Schist and Bituminous Marl.* L. Mack, Stuttgart, Germany. Eng. Pat. 14,846, August 2, 1894.

A cement is made from schist or bituminous marl mixed with 30 per cent. of its weight of lime and 6 per cent. of its weight of tar. The bituminous matter naturally present in the schist and the tar added are said to suffice to allow balls or bricks made of the mixture, to provide sufficient fuel for their own burning. A separate calcination may be used if desired, and sodium or potassium chloride may be added to the incandescent schist, together with water vapour, so as to form alkaline silicates in the mass and hydrochloric acid as a by-product, the latter being collected from the exit gases.—B. B.

## X.—METALLURGY.

*Superiority of Barium Hydroxide Solution as an Absorbent in Carbon Determinations in Steel.* J. O. Handy. J. Amer. Chem. Soc. 1895, **17**, 217.

*See under* XXIII., *page* 510.

*Determination of Zinc.* P. W. Shimer. J. Amer. Chem. Soc. 1895, **17**, 310.

*See under* XXIII., *page* 510.

*Cyanogen Bromide and Potassium Cyanide for Dissolving Gold.* Eng. and Min. J. **59**, 1895, 267 and 291.

In the correspondence column, E. A. Schneider confirms the statement by Sulman that the solution of gold in potassium cyanide is accelerated by the presence of cyanogen bromide. Such a solution can be prepared by simply adding bromine to a solution of potassium cyanide. He discontinued his own experiments on the subject some time ago, owing to the pronounced decomposition of the cyanide solution indicated by the formation of dark-coloured products, and he doubts the practical success of the process on this account.

In reply, H. L. Sulman states that 1 mol. of cyanogen bromide added to 3 mols. of potassium cyanide in a 0·1 to 0·5 per cent. solution of the latter, renders the solubility of the gold 300 to 600 times more rapid. This rapidity of course, is modified in the case of ores, &c. by the condition in which the gold exists, but it is seldom, even with pyritic concentrates, that more than 24 hours are necessary for complete extraction. Half a ton of Australian concentrates, chiefly pyrites, but containing some copper and antimony, and assaying 3 oz. 15 dwt., yielded 3 oz. 12 dwt. in 9 hours with a 0·3 per cent. solution. On account of this celerity of extraction and the non-formation of caustic potash as a reaction product, this process is applicable to ores hitherto unsuccessfully treated with cyanide. The product, potassium bromide, now formed is inert with respect to mineral sulphides. The cyanogen bromide, it is true, is pungent, but its volatility is not very great, being comparable to that of camphor. It is prepared by the action of bromine on potassium or other cyanide, and the initial difficulties experienced, especially with regard to the formation of paracyanogen, have now been overcome.

—A. W.

*Nickel and Nickel Steel.* F. L. Sperry. Eng. and Min. J., 1895, **59**, 294.

The impurities in commercial nickel are iron, copper, silica, sulphur, arsenic, carbon, and in some cases a kernel of unreduced oxide. Cast bars are likely to be porous or spongy, but after hammering or rolling are compact and tough. By this treatment the tensile strength is increased from about 14 to nearly 31 tons per sq. in., the reduction of area from 6·5 to 31·5 per cent., and the ultimate elongation from 6·5 to 31·4 per cent. The author deals with the uses to which nickel and its alloys are and may be applied. Amongst others are some nickel steel forgings for an 8-in. gun recently made for the United States navy. Experiments show that small-arms barrels containing 4½ per cent. of nickel possess great endurance, and the good qualities of the Gruner gun are attributed to the 2·75 per cent. of nickel in its steel barrel. Plates of iron or steel and nickel, when laid together and heated, may be rolled into thin plates with the nickel surface on one or both sides, the metals uniting, not merely as a weld, but as a kind of cementation or alloy. A vessel, sheathed in part with this material, fastened with iron nails, showed after eight months' service, corrosion of the nails and the ordinary plates, but no corrosion of the nickel sheathing.—A. W.

*Resistance to Corrosion of some Light Aluminium Alloys.* J. W. Richards. J. Franklin Inst. **139**, 69—72.

The tensile strength of pure aluminium in castings is 15,000 lb. per sq. in.; in sheet, 25,000 lb. The strength is increased from 50 to 100 per cent. by the addition of 3 per cent. of nickel or German silver, or 2 per cent. of titanium; the specific gravity of these alloys is not over 3. Strips of rolled aluminium alloys were tested with different reagents, with the following results:—The alloys resisted the action of 3 per cent. caustic potash, strong nitric acid, strong acetic acid (at 60° C.), and strong solution of salt (at 65° C.). Three per cent. hydrochloric acid attacked them rapidly. The exact results obtained with the different alloys are given in tables, showing the relative resistance to corrosion as compared with that of pure aluminium, the actual losses per day (in mgrms. per sq. cm. of surface), and the time required by the solutions to eat through 1 mm. of metal. The results show that the pure metal resists the corrosive action of alkali far better than any of the alloys examined; if strength be required, the copper alloy (one with 3 per cent. of Cu) is the best of the alloys, and it casts with less shrinkage than pure aluminium. For resistance to hydrochloric acid, the titanium alloy (2 per cent. of titanium) is much the best, being superior to the pure metal. For use in nitric acid, the pure metal stands first; for battery plates, the very purest aluminium should be employed. The Pittsburgh Reduction Company's aluminium contains 99·9 per cent. Acetic acid has but little effect on any of the alloys, but still less on the pure metal; the titanium alloy is the best where strength is required.

For cooking utensils, the German silver alloy (3 per cent. of German silver) seems to be the best; it has a good colour, is strong and elastic, and a good conductor of heat. It has a specific gravity of 2·73 (cast) and 2·83 (rolled); elastic limit, 20,500 lb. cast, 40,000 rolled; tensile strength, 22,450 lb. cast, 42,040 lb. rolled.

For out-of-door exposure, demonstrated by resistance to water charged with carbonic acid, the titanium and copper alloys are suitable; the copper alloy has the better colour.

—N. H. J. M.

*Aluminium for Construction Purposes, such as Building Torpedo Boats, &c.* A. F. Yarrow. Inst. Naval Architects. Engineering, **59**, 1895, 470—472.

The author has built a torpedo boat for the French Government, in compliance with a specification making stringent restrictions as to weight. Plates of pure aluminium proving insufficiently stiff, even after cold rolling, an alloy of aluminium containing 6 per cent. of copper was adopted. This alloy, if "soft-rolled," *i.e.*, annealed after the last rolling, has a tensile strength of 11—12 tons per sq. in., with a large amount of elongation; if "hard-rolled" the material has a much higher tensile strength, but is brittle. When rolled to a medium degree of hardness, however, the alloy has a tensile strength of 14—16 tons per sq. in., and is tough enough to be bent and hammered cold without cracking. The framework of the hull was made of angles of the same alloy. The plates and frames were all shaped cold without difficulty. The mechanical properties of this 6 per cent. copper-aluminium alloy are shown in the accompanying table (see next page).

On examining the figures in this table, it is evident that the elastic limit is particularly high as compared with the ultimate strength.

With regard to the construction, it may be said that all parts exposed to the action of sea or bilge-water were riveted with aluminium rivets, the remaining portions being riveted with soft iron rivets. A direct bursting experiment on a hollow cylinder of the alloy riveted with aluminium rivets, proved that there was no difficulty in obtaining a tight

RESULTS OF EXPERIMENTS TO ASCERTAIN THE ELASTIC AND ULTIMATE TENSILE STRENGTH, &c. OF ALUMINIUM PLATES, 6 PER CENT. COPPER, USED IN THE FRENCH TORPEDO BOAT.

| Description. | Original. | | Stress. | | Ratio of Elastic to Ultimate. | Extension in 10 in. | |
|---|---|---|---|---|---|---|---|
| | Size. | Area. | Elastic per Square Inch. | Ultimate per Square Inch. | | | |
| 8 in. × 20 in. × ⅛ in. | In. | Sq. In. | Lb. | Lb. | Per Cent. | In. | Per Cent. |
| Lengthway .......................... | 2·00 × 0·109 | 0·218 | 28,900 | 32,716 | 88·3 | 0·36 | 3·6 |
| „ .......................... | 2·00 × 0·111 | 0·222 | 32,430 | 36,117 | 89·8 | 0·38 | 3·8 |
| | | Mean = | 30,665 = | 34,416 = | 89·1 | .. | 3·7 |
| | | | 13·7 tons. | 15·4 tons. | | | |
| Crossway.......................... | 2·00 × 0·109 | 0·218 | 31,650 | 34,454 | 91·9 | 0·30 | 3·0 |
| „ .......................... | 2·00 × 0·112 | 0·224 | 33,480 | 38,156 | 87·7 | 0·30 | 3·0 |
| | | Mean = | 32,565 = | 36,305 = | 89·8 | .. | 3·0 |
| | | | 14·5 tons. | 16·2 tons. | | | |
| Crossway annealed .................. | 2·00 × 0·112 | 0·224 | 8,480 = | 26,210 = | 32·4 | 2·09 | 20·9 |
| | | | 3·8 tons. | 11·7 tons. | | | |

joint with the material in question. Corrosion experiments showed that where no galvanic action arose from contact with a more electro-positive metal, the wasting of the alloy from the corrosive effect of sea-water might be taken at 4 per cent. per annum; this amount would be diminished by careful painting with a paint free from action on aluminium. An instance of the susceptibility of aluminium to corrosion when in contact with a more electro-positive metal is afforded by the case of the Vendenesse, a sailing yacht built of aluminium in Paris about 18 months ago. Of this vessel it was said "it has stood very well excepting in a few places where copper fittings have been fixed in direct contact with the aluminium hull, which has produced a galvanic action. A similar action was produced when the boat was moored to a quay near another boat, the bottom of which was coppered, both being fastened to the same post by means of chains. With the above exceptions, direct contact with salt water has had no deteriorating effect." Two precautions are necessary in using aluminium. It must not be exposed, in use, to a high temperature, as it is rapidly annealed and its tensile strength is lowered; it also oxidises rapidly. On account of the ease with which alkalis act upon it, it should not be used for a condenser where soda may be required for cleaning purposes.

Concerning heavy alloys containing aluminium—those of the aluminium-bronze type—the author gives two curves showing (1) the influence of increasing percentages of aluminium upon the tensile strength and elongation of aluminium-bronze (Fig. 1). In this case the tests were made on specially cast bars, and therefore show higher

Fig. 1.

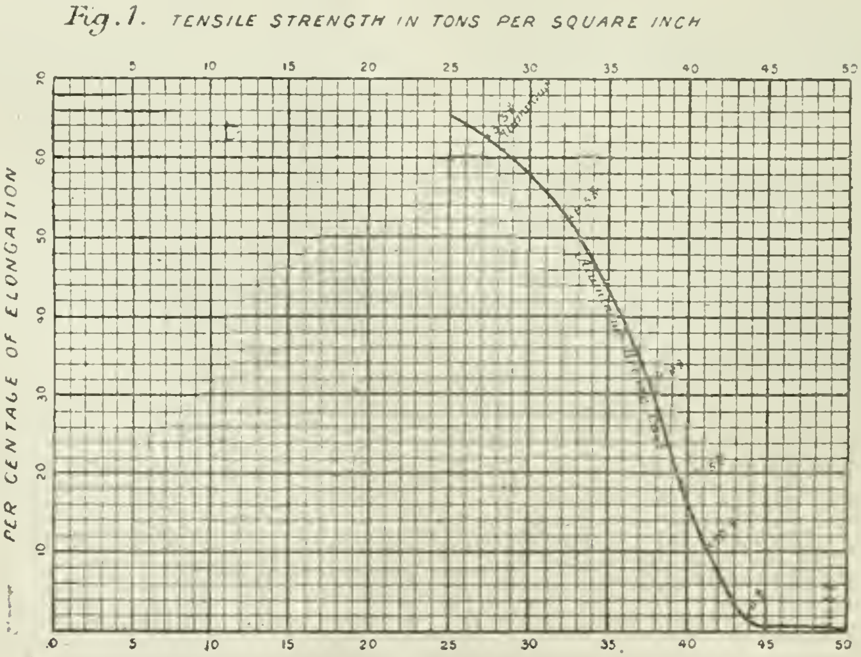


DIAGRAM ILLUSTRATING THE EFFECT OF DIFFERENT PROPORTIONS OF ALUMINIUM UPON THE TENSILE STRENGTH AND ELONGATION OF ALUMINIUM BRONZE results than those which would be obtained from ordinary test pieces attached to sand castings. (2) The second curve (Fig. 2) illustrates the loss of strength of aluminium-bronze with rise of temperature.

*Fig. 2.*

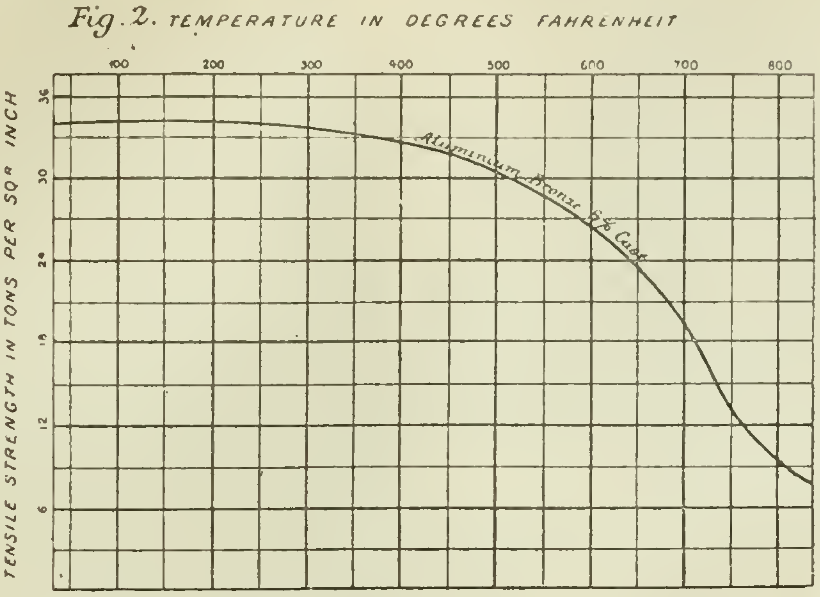


DIAGRAM ILLUSTRATING THE EFFECT OF TEMPERATURE UPON THE STRENGTH OF ALUMINIUM BRONZE.

In conclusion, the author pleads for uniformity in size of test pieces, pointing out that percentage of elongation increases *cæteris paribus* with the diameter of the test piece. The reduction of area on the other hand is nearly constant, and affords a better basis for comparing the ductility of test pieces of different diameters than does the percentage of elongation.—B. B.

### *Desulphurisation of Liquid Pig Iron.* A. Vathaire. Eng. and Mining J. 1895, **59**, 317, 318.

The author has successfully employed barium ferrocyanide to remove sulphur from iron. It decomposes by heat into iron, carbon, and barium, and the last-named element combines with and eliminates the sulphur. The salt is obtained by mixing boiling concentrated solutions of potassium ferrocyanide and barium chloride. If the former is in excess, a double salt of potassium and barium ferrocyanide is obtained which gives better results than the single salt. It is necessary that the salt be freed from water of crystallisation before being used, as the oxygen therein, on the sudden decomposition produced by contact with the molten iron, would combine with the potassium and barium forming inactive oxides. The action must be effected with the exclusion of air and oxidising influences. Practically, the metal from the blast furnace and the reagent might be revolved in a vessel lined with limestone, mixed with tar, and allowed to settle to separate the sulphurous slag. This process is applicable more especially to practically pure iron, when very little reagent is necessary. In the case of highly sulphurous metal, a preliminary reduction of the sulphur by one of the known methods is recommended. (See Ball and Wingham, this Journal, 1892, 751.)
—A. W.

### *Graphites from Iron.* H. Moissan. Comptes rend. 1894, **119**, 1245—1250.

The author has previously studied the formation of graphite by the solution of carbon in many different metals at high temperatures, and subsequent separation of the graphite when the metal solidifies. In the present communication, he gives the results of an investigation into the various forms of graphite produced by solution in one metal, iron, under varying conditions of temperature and pressure.

*Grey cast iron fused at about* 1,150° C.—The graphite formed small crystalline groups, showing hexagonal points, had a density of 2·17°, and burned in oxygen at 670° C. With strong nitric acid it is tolerably readily oxidised to a green or yellow graphitic oxide.

*Cast iron at very high temperatures.*—When the mixture of iron and carbon was subjected for 10 minutes to the action of the electric furnace the iron dissolved much carbon and became of a pasty consistency. On cooling, the graphite formed regular crystals of several millimetres in diameter. The density of the graphite was 2·18, it burned in oxygen at 650°, and contained 99·15 per cent. carbon, 0·17 per cent. ash, and 0·28 per cent. hydrogen. It was very resistent to reagents, only showing signs of oxidation after the third treatment with nitric acid (monohydrate).

*Cast iron under pressure.*—The pressure was obtained by suddenly cooling the molten mass by plunging it into water. The graphite was quite different in form from that obtained at ordinary pressures, its rounded edges showing signs of incipient fusion. Its density was 2·16, it burned in oxygen at 660° C., and contained 1·29 per cent. ash, and 0·64 per cent. hydrogen. It was very stable, only yielding the yellow crystalline oxide on its fourth treatment with nitric acid.

*Separation of graphite by silicon.*—When silicon is dissolved in cast iron it displaces some of the carbon which separates in the form of graphite. This forms regular crystals, has a specific gravity of 2·20, and contains 0·85 per cent. ash, and 0·20 per cent. hydrogen. It is pretty readily attacked by oxidising agents.

In these experiments the iron and amorphous carbon were removed by treating the mass with chlorine at a dull red heat, then several times with strong nitric acid (monohydrate), and finally with hydrofluoric acid. When the iron was removed by strong *aqua regia*, the graphite was found to contain more hydrogen, and also contained nitrogen and oxygen. When particles of graphite were detached from the iron mechanically, they were found to be free from hydrogen, nitrogen, and oxygen. It thus appears that at high temperatures the acids used for removing the iron matrix react on the graphite to some extent with formation of hydrogenised compounds.

The author concludes from his experiments—

(*a*) that the higher the temperature of formation the purer and more stable is the graphite produced; and

(*b*) that under the influence of pressure the graphite shows signs of fusion.—L. T. T.

### *Estimation of Tellurium in Copper Bullion.* C. Whitehead. J. Amer. Chem. Soc. 1895, **17**, 280.

*See under* XXIII., *page* 513.

## PATENTS.

*Improvements in Obtaining Gold and Silver from Ores and other Compounds, and Apparatus therefor.* J. Nicholas, Waterloo. Eng. Pat. 3680, February 20, 1894.

The finely-pulverised ore is saturated with a solution of oxalic acid, in a vessel with a perforated false bottom covered with a filtering web. The superfluous liquid is drawn off, and a solution of hypochlorite of lime allowed to percolate through the mass, until a strong chlorous odour is obtained. After allowing to remain for about an hour, during which time the gold is converted into chloride, the liquor is drained off and the ore well washed with water. The vessel is furnished with an upright geared shaft, to which arms or stirrers are fixed. To the latter are appended brushes or scrapers, which lightly rub and keep clean the filtering web. The gold is precipitated from the solution by stannous chloride. The silver remains as chloride with the ore, and is extracted by any suitable solvent. The application of oxalic acid to existing processes of extraction, as a preliminary treatment, is also claimed.—A. W.

*Improvements in Utilising spent Iron Pyrites, and Apparatus therefor.* W. Mills, London. Eng. Pat. 5300, March 14, 1894.

The refuse from burnt iron pyrites is first screened to remove stones and then ground to a fine powder, and passed through a magnetic separator which removes the ferroso-ferric oxide, and part or all of the ferrous sulphide. The substance, after this treatment, is mixed and heated with amorphous metallic iron, by which means it is converted into ferrous oxide. This is then heated with a reducing gas, hydrogen, coal gas, water gas, or carbonic oxide, in a revolving iron cylinder. Thus there is produced amorphous metallic iron mixed with some ferrous sulphide, silica, and generally other metals such as copper. The iron is removed from the mixture by again passing through a magnetic separator.—A. W.

*Improved Process and Apparatus for Extracting Metals from their Ores.* W. P. Thompson, Liverpool. From L. R. Bonehill and E. T. Gautier, both of Brussels, Belgium. Eng. Pat. 8183, April 25, 1894.

The inventor proposes "to smelt and refine ore" in a single operation, in a furnace the construction of which he claims. It is one in which ore and fuel are charged on to a bed inclined towards a series of tapping-holes, arranged one above the other, in order that the molten metal may flow over a part of the bed in contact with the gases of combustion, and that there may always be above the metal only a thin layer of slag. In connection with the furnace, there is to be a "depositing chamber" for the volatile substances, and a third claim refers to a firebrick projection above each tuyère to prevent molten metal from solidifying on coming in contact with the blast.—A. W.

*Improvements in the Manufacture of Steel and Iron.* B. P. Stockman, London. Eng. Pat. 8370, April 27, 1894.

Pig iron is converted into steel by treatment with a mixture of nitrate of soda and iron sand, such as is found in New Zealand and elsewhere. Manganese dioxide, lime, chloride of sodium, and chlorate and nitrate of potassium are sometimes added according to the nature of the impurities to be eliminated. The ingredients are placed under a perforated metal plate at the bottom of a vessel called a converter. This vessel, which runs on a tramway, is raised up to and fixed underneath a chimney stack, and the molten iron is poured from a cupola, through a measuring vessel, into it by means of a suitable opening provided with a plug. The metal runs on to the mixture through the perforated plate, which then melts and mixes with the bath, and the impurities are oxidised The iron sand promotes oxidation, at the same time acting as a diluent and retarding the violence of the reaction with the nitrate of soda. It may also be used in the refining furnace, in which case it is made into cakes or lumps and thrown into the molten metal.

—A. W.

*Improvements in or connected with the Preparation or Coating of Aluminium Surfaces, and in Alloys or Metallic Mixtures therefor, and for Soldering.* H. Ramage, Dublin. Eng. Pat. 8401, April 27, 1894.

It is found that metals or alloys which as they cool deposit crystals and become pasty previous to complete solidification, are exceedingly effective in this condition in attacking the resisting surface of the aluminium, and that a gentle rubbing causes the metals to combine. Zinc is the most suitable metal for the purpose, either alone or alloyed with tin or cadmium or both. Various mixtures are given, but the alloy of equal parts of zinc and tin is said to be the best, as it possesses the greatest range of temperature between the points of first depositing crystals and of final solidification. Pieces of the alloy are placed on the aluminium and the whole heated in any convenient manner until the former is liquid. If the metal be now rubbed no action will result, but on continued rubbing during the cooling and partial crystallisation of the alloy, the metals unite. The surface produced is rough and crystalline, but it becomes smooth and bright by once more heating the aluminium to the melting point of the crystals. The rubber which is found to be most convenient consists of asbestos fibres bound together with wire and held in a tube, so that a short length may be kept protruding for use. Only the parts touched by the rubber are attacked, so that a limited area only may be prepared, the remainder of the aluminium being preferably protected by a shield of thin metal, or mica, &c. Surfaces thus prepared will unite with any ordinary solder, but an alloy of equal parts of tin and cadmium is stated to be the best for this purpose.—A. W.

*Improvements in Obtaining Gold and Silver from Ores, Mattes, or other Compounds.* G. Thomson, Elizabeth, U.S.A. Eng. Pat. 10,249, May 28, 1894.

If the ore contain sulphur, a preliminary calcination is necessary. It is then maintained at a strong red heat in the furnace, and to it is added some hydrochloric acid or alkaline chloride and sulphuric acid, "whereupon the gold and silver become volatilised, probably as chlorides," and are recovered partly by the flues and partly by condensing apparatus. Two condensers should be used, the first to contain water and a small quantity of ferrous sulphate to precipitate the gold, and the second to contain dilute nitric acid to ensure the retention of all the silver.

—A. W.

*A Method of Utilising certain By-products of Iron and Copper Sulphides, and other Iron and Copper Ores, for the Production of Persulphate of Iron, to be used as a Disinfectant for the Purification of Sewage, and for other Purposes.* G. Dalton, Leeds, and T. B. Provis, Highbury, Middlesex. Eng. Pat. 12,708, June 30, 1894.

*See under* XVIII. C., *page* 503.

*Improvements in Treating Fume in Lead Works, applicable also to other Metallic Fumes, and to Coal Smoke.* J. Warwick, Newcastle-upon-Tyne. Eng. Pat. 1858, January 26, 1895.

This patent relates to the use of scrubber appliances in combination with siphon flues acting on the principle described in the previous patent by the same author (12,861, 1886). The scrubbers may be made of any suitable material and are fixed in the flues in vertical lines, so that the fume deposited on them after a certain degree of accumulation falls off by its own weight into spaces below. The scrubbers are therefore self clearing and require no washing with water.

The siphon flues are now built in blocks in order to economise space by enabling both sides of the interior walls to act as depositing surfaces. These flues may be used in conjunction with any furnace producing lead, arsenic, &c., fumes, either with chimney or forced draught, or with the employment of suction fans.—A. W.

# XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

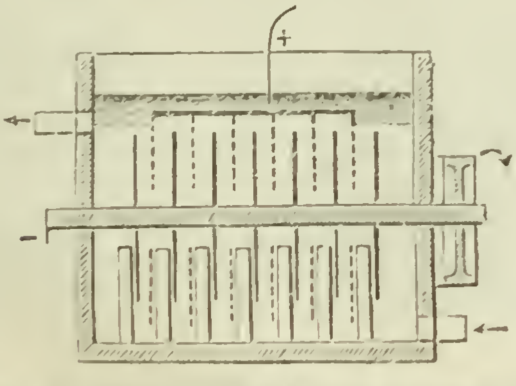
*Circulation in Electrolytic Apparatus.* P. Schoop. Zeits. f. Elektrotechnik u. Elektrochem. 1894, 349—353.

When an electrolyte of uniform composition and properties is subjected to electrolysis, its composition and properties alter during the process, especially at the electrodes, and this happens whether the electrodes are attacked by the products of decomposition or not. Now, in general, the course of any electrolytic process and the products of it, depend upon the properties of the electrolyte; and any changes in these, cause changes not always of a simple nature, in the results. This is not simply a matter of purely scientific interest, but is of great importance in practice. In the electrolytic purification of metals, in the production of bleaching-fluids from chlorides, and in the working of primary and secondary batteries, it is of importance that the electrolyte should be thoroughly mixed. The simplest way of doing this is to keep up a continuous flow of fresh electrolyte past the electrodes, and to make the latter in the form of grids or sieves through which the fluids can easily circulate.

This, however, necessitates a large supply of the electrolyte, and would be too costly a method for most of the cases which occur in practice. Nor is it necessary always to replace the partially used by quite fresh fluid: *e.g.*, in the electrolytic precipitation of copper all that is necessary is to ensure uniformity in the composition of the fluid. For ensuring the mixture and circulation of the electrolyte in a primary battery (bichromate battery), Lagarde uses a bucket-wheel revolving in a vertical plane around the battery. Below the battery is a reservoir into which the buckets dip and raise up the solution. Above the battery is a smaller reservoir into which the buckets empty the solution, and from this it is distributed into the cells. By means of a siphon overflow arrangement, the solutions flows out from below as soon as the cells are filled to a certain height; thus a continuous circulation is kept up.

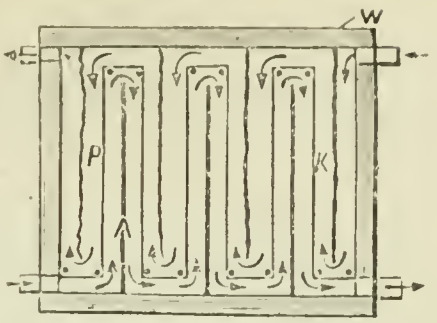
In the Hermite bleaching apparatus, the electrolyte consists of a mixture of magnesium chloride, calcium chloride, magnesium hydrate and water. The cathode consists of round discs of zinc fixed at right angles to a zinc shaft and parallel to each other. The anode consists of pieces of platinum wire gauze placed in fixed positions between these zinc discs. During the process of electrolysis, the latter are made to rotate and impart a rotary motion to the electrolyte. At the same time, the electrolyte is driven through the series of vats by means of a centrifugal pump, so that it is very thoroughly mixed. Magnesium and calcium hydrates are gradually deposited upon the cathode. If these were allowed to remain they would increase the internal resistance. In order to avoid this, fixed knives are placed near the zinc discs so as to remove the deposit. Fig. 1 gives a diagrammatic representation of the vat.

Fig. 1.



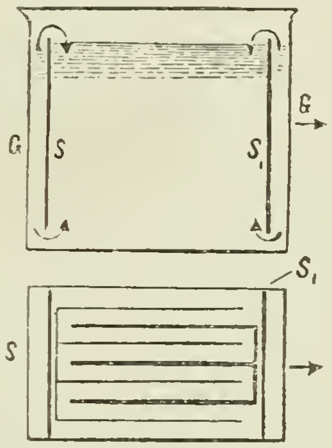
When the two sets of electrodes are immersed in different electrolytes, each of which has to be kept in circulation separately, the arrangement shown in Fig. 2 may be adopted.

Fig. 2.



W is a wooden frame in which parchment-paper P is fixed zig-zag fashion, and is made tight at the bottom by means of a layer of gypsum. The cathodes are placed on the one side and the anodes on the other. The two electrolytes circulate in the direction of the arrows.

Fig. 3.



A neat method of securing the automatic circulation of the electrolyte in tramway accumulators is the following, which depends upon the fact that the trams have so often to stop and start again and that, on account of its inertia, the liquid is thrown into motion on each such occasion. Two partitions, S and $S_1$ (Fig. 3) are fixed near opposite sides of the cell, and the electrodes are placed between these, and at right angles to them. In filling the cell the liquid is allowed to reach nearly to the top of the partitions. When the cell suffers an acceleration in the direction of the arrow, a wave is set up, and this flows over the partition S into the small chamber between this partition and the neighbouring cell-wall. As the partition does not reach quite to the bottom, the level is re-established by a portion of the fluid flowing from the small chamber below the partition into the main chamber. Similarly, when a cell moving in the direction of the arrow is suddenly brought to rest, a wave flows forward over the partition $S_1$, and a corresponding quantity of the liquid flows from the small chamber on the right hand underneath $S_1$ into the main chamber. In charging such cells, a continuous circulation of the electrolyte can be secured by a rocking arrangement.
—D. E. J.

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*Action of the Electric Current on Mixtures of Metallic Sulphides in a State of Fusion.* J. Garnier. Comptes rend. 1894, **120**, 184—185.

The apparatus used was a fireclay tube laid in a reverberatory furnace. In the part of the tube to be heated, the material was placed, and was situated between the two carbon electrodes, the current being furnished by a Gramme machine.

The spaces between the carbon poles and the walls of the tube were filled with a mixture of refractory earth and wood charcoal, so as to prevent the intrusion of oxygen, but not the exit of gases, under feeble pressure.

The experiments were made with a nickel ore containing 21·1 per cent. of sulphur, 33·3 per cent. of iron, 16·3 per cent. of nickel, and 29·0 per cent. of copper. The air being excluded, a current of 23 ampères was employed. The negative electrode remained intact, the positive was much worn away. About half the sulphur was eliminated, probably as bisulphide of carbon; the copper rather accumulated towards the anode, the iron and nickel towards the cathode. The copper being the best conductor, appears to retain the greatest proportion of sulphur. The conductivity gradually increased as the percentage of sulphur was reduced.—L. T. T.

### *Electrolytic Production of Hypochlorites and Chlorates.* F. Oettel. Zeits. f. Elektrotechnik u. Elektrochem. 1894, 354—361, and 474—480.

According to the well-known equations—

$$2KOH + 2Cl = KOCl + KCl + H_2O$$
$$6KOH + 6Cl = KClO_3 + 5KCl + 3H_2O$$

equal molecules of potash and chlorine may by this reaction produce either the hypochlorite or the chlorate. Potash and chlorine are produced in these proportions by the electrolysis of a solution of potassium chloride. The author has investigated the electrolysis of such solutions under varying conditions of concentration, temperature, and current-density, with the intention of finding what conditions are favourable for the production of hypochlorites and chlorates respectively. The solutions were electrolysed between platinum electrodes for periods of two hours or more. The hypochlorous acid was determined iodometrically, the total active chlorine by titration with ferrous sulphate and bichromate, and the chloric acid estimated by difference.

It is generally held that in the electrolysis of aqueous solutions of potassium chloride, hypochlorite is formed in the cold, and chlorate when warm. But experiments made at the ordinary temperature of the room showed that the hypochlorite was not the only product; chlorate was always produced, and probably a small quantity of perchlorate as well. If the current is kept on, the hypochlorite is partially reduced, so that it does not appear possible to produce electrolytically, solutions containing a high percentage of hypochlorite. Under the most favourable conditions found, and when the electrolyte was kept, by cooling-water, at a temperature of 20°—22° C., the highest concentration obtained corresponded to 12·7 grms. of bleaching chlorine per litre of solution.

The author's experiments on the formation of potassium chlorate and on the action of a current on solutions containing mixtures of potassium chloride and chlorate lead him to doubt whether the potassium chlorate is formed simply by the decomposition of the hypochlorite into chlorate and chloride, according to the equation—

$$3KClO = KClO_3 + 2KCl.$$

He is of opinion that, in the electrolytic formation of potassium chlorate, the course of the reactions is as follows:—The first products, KOH and Cl, give rise to KClO. In the neighbourhood of the cathode, part of this is reduced to KCl. The rest accumulates in the solution to an extent depending upon the experimental conditions, but never exceeding 17 grms. of KClO (13 grms. of bleaching chlorine) per litre. The chlorine set free at the anode now reacts upon this hypochlorite, and the following reactions take place:—

$$KClO + 4Cl + 2H_2O = KClO_3 + 4HCl$$
$$HCl + KClO = KCl + HClO$$
$$HCl + HClO = 2Cl + H_2O.$$

Undoubtedly, free hypochlorous acid is always present. The formation of chlorate only occurs in presence of excess of chlorine. The yield is poor, and in his first paper the author gives it as his opinion that the direct electrolytic method of preparing potassium chlorate cannot compete with the older method by passing chlorine into milk of lime.

The above experiments on the production of chlorates were, however, made with only a small proportion of caustic potash present (*e.g.*, in one typical experiment, 20 grms. of KCl and 0·3 grm. KOH per 100 c.c.). In his second paper, the author describes a later series of experiments, and announces that when the proportion of alkali present is increased, the course of the reactions is modified in a quite unexpected manner. The following experimental results will illustrate this (the electrolysis in all cases being carried on between 12° C. and 19° C.): (1.) Solution containing 20 per cent. KCl and 1 per cent. KOH. After electrolysis, the amount of chlorine present as chlorato was to the amount present as hypochlorite in the proportion of 1·00 to 0·945, or nearly equal. (2.) Solution containing 20 per cent. KCl and 2 per cent. KOH. A much larger amount of chlorate produced; proportion as 1·786 to 0·096. (3.) Solution containing 20 per cent. of KCl and 4 per cent. of KOH. Proportion as 1·608 to 0·075. The last two experiments show that by electrolysis in strongly alkaline solutions, the chlorate is formed directly, without the intermediate production of hypochlorite. Thus, potassium chlorate can be prepared by a direct electrolytic process in a simple and elegant manner, the only practical difficulty being the expense of the necessary platinum anodes. From his results, the author estimates that 88·14 grms. of $KClO_3$ should be obtained per effective (electrical) horse-power per hour; or that the production of a kilogramme of $KClO_3$ would require $11\frac{1}{3}$ effective horse-power hours.—D. E. J.

## PATENTS.

### *Improvements in Apparatus for Electrolysing Chloride Solutions employed for Disinfecting.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 6497, March 31, 1894.

The apparatus described, is designed for electrolysing sodium chloride solutions, so that they may be applied to disinfecting purposes in private houses. The apparatus consists of any suitable number of elements composed of an outer tube of glass containing a tube of zinc or galvanised iron, and centrally within the zinc, a wire of platinum. The tubes are closed with suitable insulating stoppers, through one of which pass the wires leading to the electrodes, and through both are led glass or ceramic tubes for the ingress and outlet of the solution to be treated. These elements are electrically connected in series, the first zinc being connected to the negative, and the last platinum to the positive terminal of any suitable source of electricity, such as the house supply. The apparatus is preferably so arranged that the solution passes through the elements to the cistern supplying the closet, and that the electrical circuit is regulated by the ball-tap controlling the cistern, being broken when the cistern is full.—G. H. R.

### *Improvements relating to the Manufacture of Plates or Electrodes for Electric Accumulators or Secondary Batteries, and to Machinery or Apparatus therefor.* A. J. Smith, Kingston-on-Thames, and H. J. Wright, Chelsea. Eng. Pat. 6975, April 7, 1894.

These improvements relate to plates or electrodes for secondary batteries, such as described in the specification of Eng. Pat. 14,658 of 1892 (this Journal, 1893, 768). The present object is to provide a suitable machine for kneading the oxide, mixed with water, into the metal plates in the manufacture of such electrodes. The mechanical details are not capable of useful abstraction here. They are fully detailed and shown in five sheets of drawings. The required feed-movements can be advantageously effected by mechanism such as described in Eng. Pat. 2886 of 1893. Better results are obtained in respect of the quality and charge-bearing capacity of the electrode by gradually increasing (instead of diminishing), in successive operations, the depth to which the pointed rods or needles are driven into the plate.—J. C. R.

### *An Improved Process and Means used therein for the Production of an Alloy of Tin with the Alkaline Metals or Metals of the Alkaline Earths.* C. T. J. Vautin, London. Eng. Pat. 9878, May 21, 1894.

According to the improved process, the cathode consists of molten tin, contained in a suitable vessel provided with a cover, and so arranged that the tin and the fused electrolyte may be kept in a molten condition without danger of volatilisation. The anodes, which are placed in the electrolyte, are composed of carbon, protected from the heat of the furnace by refractory tubes.—G. H. R.

*Improvements relating to the Manufacture of Sodium Bicarbonate, and to Apparatus therefor.* T. Craney, Bay City, Michigan, U.S.A. Eng. Pat. 9979, May 22, 1894.

*See under* VII., *page* 482.

*Improvements in and connected with Secondary Galvanic Batteries.* G. Hubner, Gernsbach bei Baden, Germany. Eng. Pat. 19,934, October 19, 1894.

The object of this invention is to produce a filling material for electric accumulators, and to provide an accumulator specially for the employment of such filling material. In order to produce the filling material, cellulose is treated with a solution of lead oxide dissolved in a large quantity of caustic alkali, and "sulphuret of carbon" is worked into the resulting thick mass. The slimy liquid thus obtained can be applied direct for electric accumulators, or may be previously converted into a stiff porous tissue by spontaneous combustion. The decomposition of the liquid may be facilitated by heating and oxidising the liquid. By the addition of a small quantity of nitrated cellulose (which also dissolves in the liquid) and an alkaline salt, the change of the liquid is facilitated very much, and an almost untearable and very effective filling material is produced. The accumulators to which the new filling material is to be applied may be constructed in the usual well-known way, but preferably with a porous electrode filled with the above described mass, with or without the addition of a suitable proportion of powdered carbon, and placed in and insulated in a similar outer electrode covered or surrounded with the active mass, and filled with the electrolyte, sulphuric acid, for example.—J. C. R.

*Improvements in and relating to an Apparatus and a Method for causing Chemical Changes of Gases and Mixtures of Gases by Dark Electric Discharges.* N. van der Sleen and A. Schneller, Alfen-Oudshoorn, Holland. Eng. Pat. 23,297, December 1, 1894.

The improvements consist in the insertion of a liquid resistance between the transformer and the discharge plate, and in providing a chamber in which the gas may be cooled down after treatment, before it is passed into a second apparatus, so that the effect produced in the latter may be equal to that produced in the first.—G. H. R.

*An Improved Primary Battery.* V. Ludvigsen, Copenhagen, Denmark. Eng. Pat. 25,289, December 29, 1894.

This is a zinc-carbon battery with a depolariser surrounding the carbon. The exciting salt is chloride of ammonium mixed with some porous material, such as slag wool. To keep the electrolyte from drying up, a hygroscopic mixture, composed of 80 parts chloride of zinc, 10 parts chloride of magnesium, and 10 parts chloride of calcium, is introduced from small glass tubes, which are broken when the battery is required for use. These glass tubes project into, and are broken within, a perforated tube set in the exciting salt mixture, through an opening at the top by which water is introduced.—J. C. R.

*Improvements in Galvanic Batteries.* C. B. Schoenmehl and C. M. Platt, Connecticut, U.S.A. Eng. Pat. 1116, January 22, 1895.

This battery consists of a jar, preferably of glass, provided with a porcelain cover, through the centre of which is passed a zinc rod. This cover has an annular recess pierced with openings communicating with its under surface. The carbons are inserted in these, and secured by molten lead cast into the recess, so that the metallic connection is not exposed to the action of the electrolyte, nor of the gases evolved.—G. H. R.

*Process for the Production of Concentrated Sulphuric Acid by means of Electrolysis.* L. Wacker, Munich, Bavaria. Eng. Pat. 3183, February 13, 1895.

*See under* VII., *page* 484.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Coula or Koumounou.* H. Lecomte and A. Hébert. Comptes rend. 1895, **120**, 200—202.

The fruit of this tree consisted of about 72 per cent. of husk and 28 per cent. of kernel. The kernel contained about 22 per cent. (5·5 per cent. of the whole fruit) of *coula* oil, which was found to be almost pure trioleïn (glycerin oleate), and it is a curious example of a fatty matter containing but one single fatty acid. The first specimens of coula were brought from the Gaboon in 1845 by Aubry-Lecompte.
—L. T. T.

*Separation of Solid and Liquid Fatty Acids.* E. Twitchell. J. Amer. Chem. Soc. 1895, **17**, 288.

*See under* XXIII., *page* 515.

*Increase in Temperature of Fibrous or Porous Materials containing Fatty Oils.* R. Kissling. Zeits. angew. Chem. 1895, 44.

*See under* V., *page* 479.

*The Phosphomolybdic Acid Test as applied to Lard Analysis.* G. F. Tennille. J. Amer. Chem. Soc. 1895, **17**, 33.

*See under* XXIII., *page* 513.

### PATENTS.

*Manufacture of Saponaceous Products from Petroleum.* C. Weygang, Child's Hill, Middlesex. Eng. Pat. 3025, February 12, 1894.

This inventor describes the production of, a "petroleum oil or oleaginous liquid more or less soluble or miscible in water," other oils (such as odourless oils, oils applicable for varnishes, and for vehicles for paints), lubricants, soaps, and fuels, the thickening or consolidating substance, used with the petroleum, being generally some salt of the resin-acids; the various products and their manufactures being the subject of 13 claims.

*The soluble or miscible oils* may be manufactured by melting 50 lb. of rosin in 100 lb. of petroleum, and to the still hot mixture, gradually adding about 1½ pints of a saturated solution of caustic soda; during the addition, active stirring taking place. After cooling, the clear oil is decanted, and to it is added gradually and with active stirring, 4—5 pints of the soda solution. The mixture is allowed to settle, and the clear oil decanted off. The "black gummy residue," left at the first decantation, and any precipitate or residue, left at the second, may be employed in the manufacture of common soap, &c. To increase the viscosity of the oil, the foregoing process and addition of soda may be repeated yet a third time.

Alternative modifications of this process are proposed: thus to the solution of resin in petroleum, the strongest liquor ammoniæ may be added, until the mixture becomes solid, and then, to this mixture, upon liquefaction by heat, caustic soda (or other alkali) may be added. Again, the rosin (50 pts.) and petroleum (100 pts.), may be fused with an alkaline carbonate (*e.g.*, soda crystals 20 pts.) and an alkaline borate (*e.g.*, borax, 10 lb.), while with active stirring, 10 lb. of water are also added during the heating.

*Inodorous oils* are produced from any of the foregoing soluble or miscible oils, though preferably from the ammonia and the borax preparations aforesaid, by adding thereto an equal bulk of water, and boiling the resulting emulsion. Upon settling, the pale yellow petroleum separates, and, after agitation with caustic soda, ammonia, silicate of soda, or with caustic lime, is "in an almost colourless and odourless condition." Ammonia produces the best results. Every trace of petroleum odour may be removed from the original mixtures by the addition of 1—2 per cent. of naphthaline, turpentine, or the like.

*Soaps.*—To 20 lb. of rosin, dissolved in 120 lb. of petroleum, 1 pint of the caustic soda solution is added, with active stirring during heating. The clear oil, so formed, is decanted, and reheated with 30 lb., more or less, of "ordinary fat soap;" about 4 quarts more of the caustic solution, according to the character of the petroleums, are added, and ebullition continued, until, upon dissolving some of the mixture in distilled water, no appreciable quantity of free oil globules are seen. Towards the end of the saponification, water (up to 25 per cent. of the whole) is gradually added, and the boiling and stirring continued for one hour or more; the addition of more water, if necessary, cooling and separation of the lye, concludes the manufacture. Alternatively, fat may be mixed in, and saponified during the foregoing manufacture; or, it may entirely replace the fat soap, as an ingredient, corresponding additional alkali being then employed.

*Jelly-like and grease-like substances.*—These are obtained, by treating the foregoing soap ("or equivalent mixture") with a soluble salt of an alkaline earth, *e.g.*, with a very strong solution of calcium chloride, energetically mixing and kneading the mass, washing it with water, and then heating it, when the remaining excess of water separates upon cooling. Softer consistency, in the final product, is obtained by working with soaps with a minimum of alkali, while, by combining more caustic alkali with the soap, more alkaline earth salt is decomposed, and harder greases are obtained. Alternative modes of manufacture of these substances, many of which may be used as *lubricants*, are described.

*Substances applicable for varnish or as vehicles for paint.* — These are made from the before-mentioned "soluble oils," those containing excess of rosin being preferred. To such oil is added a siccative agent, such as dry powdered zinc sulphate, with agitation and heating, the mixture being afterwards settled. The decanted liquid may be used for varnish.

By mixing the "soluble oil" with oils, such as linseed oil, cotton-seed oil, or castor oil, and then "neutralising the alkali" of the "soluble oil" with a siccative, such as zinc sulphate, more "elastic products," particularly suitable for paint vehicles, are obtained.

*Fuels.*—Rosin or equivalent material is dissolved in petroleum, and to the solution is added a mixture of an alkali with an alkaline silicate. This mixture is then treated with calcium chloride or other soluble alkaline earth salt. The greasy or solid product is applied as a fuel, as is also a similar solid product obtained by mixing with petroleum a rosin soap and some calcium sulphate. It is proposed to harden the product by the further admixture of carbonaceous matters.—E. R. B.

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*Improvements in the Manufacture of Soap.* S. Rosenblum and F. L. Bartelt, Bristol. Eng. Pat. 14,946, August 4, 1894.

These consist in the addition to finished soap in a melted condition of about one-half per cent. of a solution containing 2 to 3 lb. of an alkaline peroxide in 28 lb. of water. The product is said to have the advantage of floating in water, and to possess disinfecting properties.—J. J. K.

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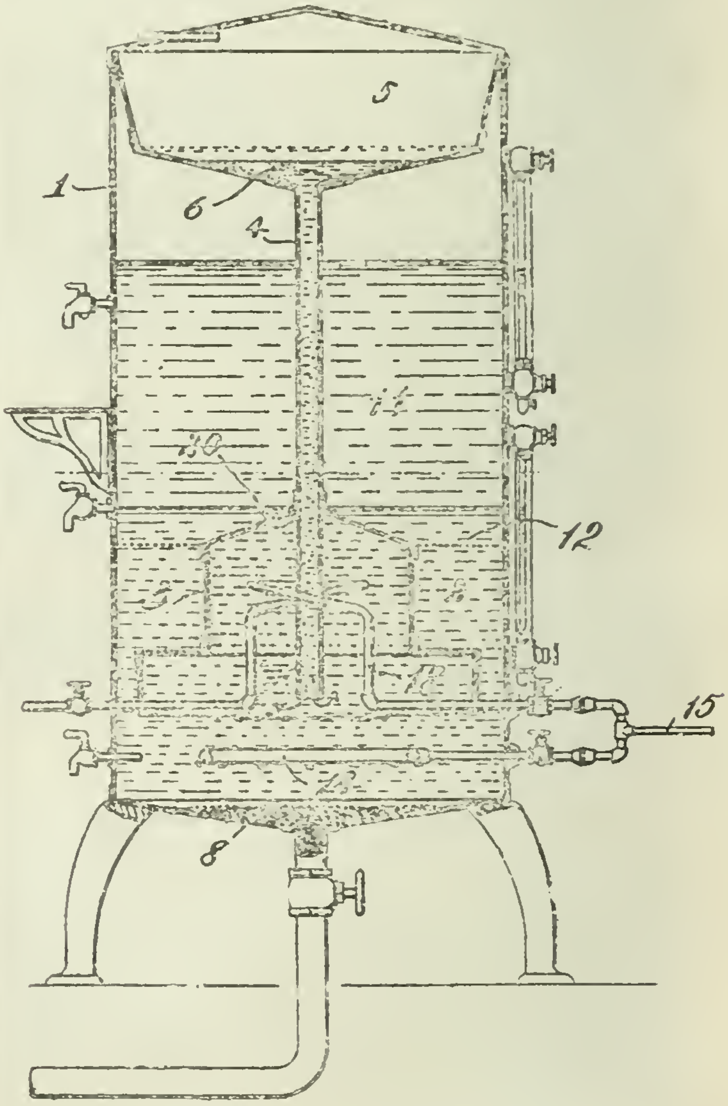
*Improvements in and connected with Oil Purifiers.* D. H. McClelland and R. D. Jackson, New York, U.S.A. Eng. Pat. 24,080, December 11, 1894.

This invention relates to that class of oil-purifiers where the oil is passed through water (or other purifying liquid) heated or otherwise, any dirt or precipitate being separated by standing, if heavier than water, or by filtration if lighter. The objects of the present improvements are, firstly, to retard the impure oil in its passage through the purifying liquid so that matters already separated into the water may not be stirred up and again enter the oil; and, secondly, to obstruct the passage of any impurities lighter than water, as the oil rises through the water. There is also described a clearing-out device which may be operated without emptying the purifier.



The figure depicts a vertical section of a purifier embodying the inventions. In the purifier, 1, a layer of oil, 11, is shown (by a difference in the shading), supernatant to the water, 2. The impure oil is placed in the reservoir, 5, and passes through 6 (a strainer to obstruct any coarse dirt), by the tube 4, into the bell, 3.

When the bell is full of oil, all water or purifying liquid having been displaced, and any air having escaped by apertures in 4, situate near 20, the entrance of any further oil causes some of that already therein to escape at the rim of the bell, and this oil rises through the water to join that lying upon the water.

In its upward passage, the oil passes through a very fine screen or sieve, 12, where it parts with any particles which did not separate from it by gravitation, when it was in the bell. These latter, the heavier particles, collect in the conical bottom, 8, of 1, and are drawn off from time to time. To facilitate the separation of sediments from it, the oil, when in the bell, may be warmed by steam, which may be delivered from 15, through the coil 18.

The clearing-out device consists of an annular pipe 14, carrying downwardly-directed nozzles, through which steam can be passed from 15, stirring up the sediment and causing it to be washed down the waste-pipe.—E. R. B.

*Improvements in Apparatus for Separating Fluids from Solids.* E. J. O'Brien, Little Rock, Arkansas, U.S.A. Eng. Pat. 2540, February 5, 1895.

This invention is intended to be mainly applied to the extraction of oils from seeds by pressure. Its chief distinguishing features are the combination of a rotating platform carrying a series of presses—the materials in which are exposed to a continuous pressure from a central hydraulic accumulator—with a charging apparatus capable of being raised or lowered in such a manner that the several divisions of each press can be consecutively filled with material.—C. S.

*Process of Extracting Fat from Wool and other Fibrous Materials.* E. Fabrig, Baltimore, Md., U.S.A. Eng. Pat. 3615, February 19, 1895.

This consists in the use of volatile hydrocarbons for the purpose of extracting fat from fibrous materials. The material is first pressed into bales, which are then placed in a closed vessel, and the air exhausted. The hydrocarbon is then forced alternately in opposite directions through the material. After the fat has been extracted by the solvent, steam is admitted to expel all traces of the hydrocarbon. When the solvent contains about 25 per cent. of fat, it is filtered to remove foreign suspended matters, and the hydrocarbon is then recovered by distillation for use over again, leaving a pure fat or grease in the still.

—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

### PATENTS.

*An Improved Process for Manufacturing a Plastic Substance.* A. Ritter von Pischof, Vienna. Eng. Pat. 5414, March 15, 1894.

Fifty parts by weight of oil (preferably linseed oil) are heated in a boiler until bubbles rise to the surface; 80 parts of Vienna white are then gradually added with constant stirring, and lastly, 5 parts of zinc white and 2 of water-glass. Zinc white may be substituted for all or part of the Vienna white, but is usually too expensive. The water-glass prevents a hardening which, in its absence, would destroy the plasticity within three weeks. A further addition of 0·5 part of gum in concentrated solution, with 0·2 part of minium, and 1·5 to 2 parts of asbestos, is recommended. On digestion over a slow fire, the resulting mass is permanently soft and plastic, but the heating must be effected carefully, for, if it be overdone, the material will harden. A steam-heated, closed (but not necessarily air-tight) boiler should be used. If the mixture be too viscid, paraffin or linseed oil, or glycerin, may be added. The composition is proposed as a substitute for gypsum, for making plastic moulds.—W. G. M.

*Improvements in the Manufacture of White Lead.* R. Matthews, London. Eng. Pat. 7129, April 10, 1894.

Lead oxide is mixed with water, and afterwards with acetic acid and glycerol, as specified in Eng. Pat. 20,891 of 1892. (This Journal, 1893, **12**, 936.) The proportions now preferred are 14 lb. of acetic acid (sp. gr. 1·038) and 14 lb. of glycerol (sp. gr. 1·24) to 104 lb. of water and 50 lb. of lead oxide. After an hour's agitation, the mixture is transferred to a tank, in which it is allowed to deposit any suspended matter, and the clear solution of basic lead acetate is run off into a separate tank and precipitated by carbon dioxide. If the residue from the first settling-tank contains lead oxide, it is returned to the agitator. When the lead carbonate is completely precipitated, it is allowed to subside, and the clear liquid, which contains acetic acid and glycerol, is now available for the treatment of another batch of lead oxide in the agitators. The precipitated carbonate is filter-pressed, washed well, first with water, then with weak ammonium carbonate, to neutralise the last traces of free acid, and then again with water, to remove alkaline salts. After a second filtration the pigment is dried in the usual way.

—W. G. M.

*Improved Quick-Drying Antifouling Paint.* J. McLintock, Glasgow. Eng. Pat. 16,381, August 28, 1894.

The following paint is to be applied cold:—40 per cent. of zinc oxide, 12 of linseed oil, 28 of tallow, and 20 per cent. of thinnings, which latter consist of 60 per cent. of shale naphtha, benzoline, or the like, 30 of "gum dawar," and 10 per cent. of rosin.—W. G. M.

*An Improved Paint, specially applicable as a Substitute for White Lead, Zinc White, and the Like, and Process of Manufacturing the Same.* R. Alberti, Magdeburg, Germany. Eng. Pat. 2636, February 6, 1895.

Ground zinc sulphate is thoroughly mixed with an equivalent quantity of calcium or barium carbonate or of calcium oxide, and heated for several hours, until the resulting zinc carbonate and alkaline earth sulphates have been for the most part broken up. The mixture is greatly aided by the initial liquefaction of the mass in its water of crystallisation; and the decomposition of the mixed sulphates and carbonates, into oxides and gaseous compounds, occurs at a lower temperature than would be required to dissociate either ingredient singly. After cooling, the soft mass may be readily ground to a high degree of fineness. The zinc-lime or zinc-baryta so made, possesses a good body, while the paint made from it dries well, on account of the small quantity of zinc sulphate which is left undecomposed in the oxide. With pure materials, a white or yellowish-white paint results, less pure ingredients giving a rapidly-drying material, especially suitable as a ground or floor paint.—W. G. M.

### (*B.*)—RESINS, VARNISHES.

### PATENTS.

*Improvements in or Relating to Plating or Covering Articles with Metal.* S. F. Pichler, Buda Pesth, late of London. Eng. Pat. 9261, May 10, 1894.

The object to be covered is dipped momentarily into collodion (or analogous compound), thinned to the right strength (about 4 per cent. collodion), with alcohol and ether, and containing finely-powdered aluminium, or other metal, suspended in it. Bottles may thus be securely capsuled, or cigarettes provided with a water-proof mouthpiece. The mixture is best made by pouring an ounce of the collodion upon a drachm of fine aluminium-bronze powder.—W. G. M.

*Manufacture of Cellulose Acetate.* C. F. Cross and E. J. Bevan, London. Eng. Pat. 9676, May 17, 1894.

Cellulose, in any one of its dehydrated forms, is mixed with a concentrated solution of zinc acetate in the proportion of from one to two equivalents of zinc acetate to one equivalent of cellulose, which mixture is dehydrated by heating to 110° C. and then forms an intermediate product in the manufacture of cellulose acetate. This intermediate product is finely powdered and carefully mixed by successive doses with acetyl chloride in the proportion of two equivalents of acetyl chloride to one of the zinc acetate contained in the intermediate product. During the addition of the acetyl chloride, the mixture is kept stirred and its temperature is prevented from rising above 30° C. On the completion of the reaction, the product is washed with water to remove the zinc salts and then pressed and dried. To free it from cellulose, it is treated with chloroform, which dissolves the cellulose acetate. This solution is filtered and on evaporation leaves the cellulose acetate in transparent films or sheets.

It is claimed that it may be used as a substitute for collodion in many of its applications.—J. G. W.

*An Improved Material for Lacquering Surfaces.* D. Marcus, London. Eng. Pat. 1372, January 21, 1895.

A lacquer for leather, paper, wood, fabrics, or metals, which shall be more pliant and less liable to crack than the ordinary material, is made by mixing 70 parts of the sap of the *Rhus Vernicifera* (Japanese lac) with a solution of 16 parts of shellac in 14 parts of spirits of camphor or methylated spirit.—W. G. M.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

*Acid Leather.* Balland and Maljean. Comptes rend. 1894, **119**, 913—915.

*L'Administration de la Guerre* rejects all leather which contains sulphuric acid, on the ground that the acid eventually corrodes the socks and rusts the accoutrements. As is well known, the addition of sulphuric acid to the tanning liquor plumps the skins and hastens the tanning. Hides which are ready for the tan liquors, contain about 72 per cent. of water, and if they be immersed in water acidified with sulphuric acid they will absorb a further quantity of water. When the acid amounts to 1 in 500 or 1 in 1,000 of water, the hides may absorb as much as 100 per cent. of water; but this will fall to 50 per cent. when the bath contains as much as 1 of acid in 100 of water. Generally, the maximum absorption of water occurs in three days, and when this point is reached, the hide will have attained its maximum plumpness, and have absorbed its maximum of sulphuric acid. The amount of acid absorbed appears to be independent of the strength of the liquor and varies but little; 100 of green hide will absorb 1·32—1·64 grms., whilst 100 of dried hide will absorb 3·64—5·85 grms. of sulphuric acid.

Hides plumped with sulphuric acid lose the greater part of this during tannage, but always retain some, and the leather made from them only parts with a portion of its acid to water or absolute alcohol. The ash of leather not plumped by sulphuric acid, when obtained by direct calcination, contains sulphur, calculated as $H_2SO_4$, to the extent of 0·037—0·066 per cent. of the dry leather; leather plumped by acid does not generally yield an ash richer in sulphur than a leather not so plumped, when calcined directly. Occasionally, when a sulphide has been used as a depilatory, the sulphur may amount to 0·233 per cent. of $H_2SO_4$ on the dried leather.

When the leather is incinerated with potassium carbonate, it will yield 0·098—0·172 per cent. of sulphur calculated as $H_2SO_4$, if it has not been plumped with acid, and 0·196—0·550 per cent. if it has been so plumped; the hide after it has been unhaired only yields 0·071 per cent. when calcined with potassium carbonate, and 0·047 per cent. when incinerated by itself.

To estimate the amount of sulphuric acid in leather, 10 grms. of the finely-divided sample are moistened in a crucible with a 1 per cent. solution of potassium carbonate, dried and incinerated. The ash is extracted with a slight excess of dilute nitric acid, the solution is filtered, and the filtrate is precipitated whilst hot with barium chloride, the barium sulphate being weighed as usual. A second portion of 10 grms. is dried to ascertain the percentage of moisture in the sample, and is then directly incinerated and treated as described above; the weight of barium sulphate obtained in this determination is subtracted from that first obtained, and the difference is calculated into sulphuric acid and reported as a percentage on the dried leather.—A. G. B.

### PATENTS.

*Improvements in the Treatment of Raw Hide, and the Subsequent Use and Application of the same.* E. T. Day and T. W. Matthews, Forest Gate, Essex. Eng. Pat. 10,151, May 25, 1894.

The hide, after unhairing, is to be immersed in weak acid of suitable character and strength, for about the space of one day; it is then washed and treated with an aqueous solution of "muriate of ammonia." By this means it is rendered plastic, and may be cut, moulded, or pressed into any desired shape for utensils of various kinds, which shape will be retained after drying.—W. G. M.

*A New and Improved Method and Apparatus for Testing the Adhesiveness of Glue and such like.* G. Seligmann, Berlin. Eng. Pat. 615, January 10, 1895.

*See under* XXIII., *page* 524.

## XV.—MANURES, Etc.

*The Grand Connétable Phosphate.* A. Andouard. Comptes rend. 1894, **119**, 1011.

The island of Grand Connétable is 27 miles east of Cayenne, and possesses an important deposit of aluminium phosphate. The mineral is amorphous, light, very porous, and of a yellowish-red or brick-red shade; it has the following composition:

| | Per Cent. |
|---|---|
| Phosphoric acid | 39·10 |
| Silicic acid | 1·70 |
| Carbonic acid | Trace |
| Sulphuric acid | 0·06 |
| Chlorine | Trace |
| Alumina | 25·59 |
| Ferric oxide | 8·03 |
| Lime | 1·40 |
| Magnesia | Trace |
| Water lost at 105° | 21·24 |
| Water lost at a red heat | 2·50 |
| Not determined | 0·38 |
| | 100·00 |

The phosphate is insoluble in cold water; it is, however, very soluble in acids and in ammonium citrate, being superior in this latter respect to any natural calcium phosphate; it will probably be profitably applied directly in agriculture. (See this Journal, 1895, 374.)—A. G. B.

### *Agricultural Value of Aluminium Phosphates.* A. Gautier. Comptes rend. 1895, **120**, 356—359.

A propos of the recent note by Andouard (this Journal, 1895, 374), the author states that experiments on a large scale have shown that the aluminium phosphate which he discovered in the *Grotte de Minerve* (this Journal, 1893, 849), has a greater manurial value for an equal content of phosphoric acid, than the phosphates of lime have, which are usually employed, and even than superphosphate itself has, if the yield over three years be the basis of comparison. As a fact, all mineral phosphates of alumina which are of animal origin, and are more or less amorphous, may be said to be comparatively easily assimilable; but those which are of aqueous origin, such as crystalline double calcium and aluminium phosphates, and crystallised aluminium phosphate itself, are less assimilable than Canadian apatite.—A. G. B.

### *Determination of Potash in Manures.* W. E. Garrigues. J. Amer. Chem. Soc. 1895, **17**, 47.

*See under* XXIII., *page* 511.

### *Estimation of Ferric Oxide and Alumina in Mineral Phosphates.* W. Hess. Zeits. angew. Chem. 1894, 701.

*See under* XXIII., *page* 511.

## PATENTS.

### *Improvements in the Manufacture of Phosphatic Slags of a high Percentage of Soluble Phosphate with or without Magnesia or Potash.* E. Dietz, Rotterdam. Eng. Pat. 4988, March 9, 1894.

Instead of lime or magnesia alone, in the basic process for steel manufacture, natural or artificial phosphates are used together with free lime in sufficient quantity to extract the phosphorus from the crude iron. The operation is conducted in the usual basic converter or the Siemens-Martin furnace, the slag being run off and the process repeated two and sometimes three times. The result is said to be a slag containing a high percentage of soluble phosphate. This may be melted with felspar, magnesia, and more phosphate if a rich fertiliser containing potash and magnesia is required.—A. W.

### *Improvements in the Preparation of Manure, and in Appliances for effecting the Same.* H. Hencke, Darmstadt, Germany. Eng. Pat. 5911, March 21, 1894.

Excreta, solid and liquid, are mixed with about 1 per cent. of "a strong solution of oxide of iron, sulphate or peroxide of iron, sulphate of alumina, or chemicals of a similar nature," of the strength of about 20° B. The fluid mixture is pumped through a series of closed vessels, each of which is furnished with an agitator, so as thoroughly to mix the materials. The object is to deodorise the excreta, and at the same time to fix the ammonia. The material is finally dried, and used as manure.—L. A.

## XVI.—SUGAR, STARCH, GUM, Etc.

### *Use of Sulphurous Acid ($HNaSO_3$) in the Manufacture of Glucose Syrup and Grape Sugar.* H. E. Horton. J. Amer. Chem. Soc. 1895, **17**, 281—286.

The author reports his experience in the use of sodium bisulphite of 38°—40° B.

*In Preserving Colour of Glucose Syrups.*—All batches of 50 barrels each, to which 1 gallon of bisulphite and 8 fluid ounces of muriatic acid had been added, after one month had lost colour and brilliancy, after three months were decidedly brown, and after six months were dirty brown; whilst other batches to which twice the above proportions of bisulphite and acid were added, showed good colour and brilliancy after one month, good colour but want of brilliancy after three, and only a light straw colour after six months. The bisulphite, which may be added partly to the 39° B. liquor in the vacuum pan and partly to the finished product in the cooler, or all to the latter, has therefore a distinctly beneficial effect.

*Giving Brilliancy to Candy.*—By raising a mixture of 8 oz. of 45° B. glucose with $1\frac{3}{4}$ oz. of cane sugar and 150 c.c. of water and five drops of olive oil, to a temperature of 308° F., pouring the mass upon an oiled marble slab, cutting it in half as soon as possible, and moulding one half into a slab 6 in. × 3 in. × 1 in., which is wrapped in oiled paper; and by rolling over $1\frac{1}{2}$-in. strips from the other half into coils, without manipulation, the colour and brilliancy of a candy may be judged. By using this candy test, and comparing glucose with standard samples, it was found that the use of bisulphite always gave additional brilliancy and colour. Bisulphite is generally credited with imparting stickiness to candy, but detailed experiments show that samples, prepared simultaneously with and without it, behaved similarly under all conditions. Again, it is popularly supposed that glucose which has had more than 3 galls. of bisulphite per batch cannot be used for candy-making, but in reality those which received 8 galls. gave the best results.

*Influence of Bisulphite on Boiling Point of Candy.*—The addition of bisulphite allows a good candy to be boiled at a higher temperature than is otherwise possible; a batch with 2 galls. of bisulphite gave a candy with good colour when boiled at 308° F., but very bad colour at 330°; with 6 galls. the colour was very good at 308°, and with 12 galls. it was good even at 330°. In making hydrated grape sugar containing red substance, 70; water, 20; ash, 0·5; and nitrogenous bodies, &c., 9·5 per cent., sulphur dioxide from burning sulphur may with advantage be pumped into the liquor from the second filtration. It is said (without reason) that an acidity of over 0·034 grm. HCl in 100 grms. is not allowable (and this is equivalent to that of the action of 2 lb. of burned sulphur upon an amount of liquor representing 24,000 lb. of finished product); but experience shows that this is a mistake. Careful observations demonstrate that by adding bisulphite to grape sugar solutions, crystallisation is distinctly accelerated.—W. G. M.

### *Treatment of Juice with Baryta and Sulphurous Acid.* Dupont. Bull. Ass. Chim. 1895, **12**, 566.

The author considers that Beaudet's objections are partly irrelevant and partly misunderstood; he believes that failure of the operation, more especially from the presence of barium sulphite in solution, chiefly arises from insufficient alkalinity of the juice, and from an increased or decreased amount of saturation.—J. L. B.

### *Karez's Refining Value.* Holarek. Böhm. Zeits. Zuckerind. 1895, **19**, 333.

The author states that the most recent investigations of Karez (this Journal, 1894, 1210) do not serve to remove the errors which he has pointed out in the glycerin method of the latter. In his opinion, Karez's method has no practical value, for if the composition of the raw sugar and of the final molasses, as well as the amount of loss, be known, then the approximate yield may be calculated without the aid of this method, and nearly the same numbers obtained.—J. L. B.

### *Purity of certain Sugar Products recovered from Molasses.* Deltour. Bull. Ass. Belg. Chim. 1895, **8**, 182.

The value of recovered products and of their application is usually based on their purity-quotient, and this is best determined from the Clerget value. The author has now found that at times, and in some cases, the apparent purity-quotient (direct polarisation ÷ degrees Brix) approaches the Clerget value, calculated on the dry substance, more closely than the corrected apparent purity-quotient (inversion polarisation ÷ degrees Brix). In other cases this does not occur, so that the question is in urgent need of further investigation.—J. L. B.

*Levulose.* Sulz. Böhm. Zeits. Zuckerind. 1895, **19**, 316.

The pure preparation had the composition $(C_6H_{12}O_6)_5 + H_2O$; it was completely soluble in absolute alcohol, and was quite free from ash. On standing for some days *in vacuó* over sulphuric acid, it became anhydrous. The relation between the levulose ($x$) and the reduced copper ($y$) it was found could be expressed by the formula :—

$$y = 1 \cdot 08 + 1 \cdot 9674x - 0 \cdot 001054x^2,$$

when 25 c.c. of a copper sulphate solution (containing 69·278 grms. in the litre), 25 c.c. of a solution of 346 grms. of Rochelle salt and 250 grms. of sodium hydrate in the litre,—were mixed, the resulting 50 c.c. diluted with 50 c.c. of water, and heated to boiling, and then boiled for 15 minutes with 25 c.c. of the levulose solution, of a convenient degree of concentration.

The following table shows some of the values obtained for anhydrous levulose :—

| $y$ (mgs.) | $x$ (mgs.) | $y$ (mgs.) | $x$ (mgs.) |
|---|---|---|---|
| 0 | 9·67 | 230 | 124·69 |
| 0 | 14·82 | 240 | 130·57 |
| 0 | 19·99 | 250 | 136·51 |
| 0 | 25·21 | 260 | 142·49 |
| 60 | 30·45 | 270 | 148·51 |
| 70 | 35·71 | 280 | 154·48 |
| 80 | 41·02 | 290 | 160·69 |
| 90 | 46·35 | 300 | 166·86 |
| 100 | 51·72 | 310 | 173·07 |
| 110 | 57·11 | 320 | 179·33 |
| 120 | 62·54 | 330 | 185·66 |
| 130 | 68·01 | 340 | 192·03 |
| 140 | 73·51 | 350 | 198·46 |
| 150 | 79·05 | 360 | 204·94 |
| 160 | 84·62 | 370 | 211·49 |
| 170 | 90·23 | 380 | 218·09 |
| 180 | 95·87 | 390 | 224·75 |
| 190 | 101·55 | 400 | 231·48 |
| 200 | 107·28 | 410 | 238·28 |
| 210 | 113·04 | 420 | 245·13 |
| 220 | 118·84 | 430 | 252·05 |

—J. L. B.

*Glucose Nitrobenzhydrazide.* Herzfeld. Zeits. f. Rübenz. Ind. 1895, **45**, 115.

When equal parts of glucose and nitrobenzoylhydrazine are boiled for an hour with 96 per cent. alcohol, the compound $C_{13}H_{17}N_3O_8$ separates. It forms white crystalline needles, which are slightly soluble in cold water and alcohol, more easily in methyl alcohol, and readily in hot water, whereby it is partially decomposed into its constituents, and the original lævo-rotation becomes dextro. On boiling the compound with benzaldehyde, quantitative decomposition is effected. Glucose also forms compounds with semicarbazide and the hydrazide of erucic acid.—J. L. B.

*Action of Acetic and Hydrochloric Acids on Sucrose.* H. A. Weber and W. McPherson. J. Amer. Chem. Soc. 1895, **17**, 320—327.

The authors seek to find the truth concerning this action, in face of the very divergent statements by various authorities. Jungfleisch and Grimbert (this Journal, 1889, **8**, 295) claim that acetic acid completely inverts sucrose at 100°, and that it is without effect on the levulose of the invert sugar; whilst hydrochloric acid acts in some way upon the latter, increasing its rotatory power. Maumené states, however, that the proportions of levulose and dextrose in acid-inverted sugar are not equal; and Ost (this Journal, 1891, 858) asserts that acetic acid fails to produce complete inversion, whilst it acts perceptibly upon invert sugar. Ross found inversion to be incomplete even with 10 per cent. of glacial acetic acid, acting upon the sugar for 45 minutes, at the temperature of boiling water. Experiments were made with the object of discovering whether hydrochloric acid used in inversion, affected in any way by its presence, the reading of the invert sugar thus prepared. 500 c.c. of a normal solution of sucrose (polarising at 99·8) were placed in 100-c.c. flasks, and subjected to inversion by heating gradually for 10 minutes up to 68° C., after the addition of $\frac{1}{10}$th the volume of concentrated hydrochloric acid (sp. gr. 1·19). These solutions were all poured into a large flask and thoroughly mixed, so as to obtain a perfectly uniform solution. Five sets of experiments were tried; in the first, 55 c.c. of the inverted solution were made up with pure water to 110 c.c.; in the second, 5 c.c. of extra acid were mixed with the diluting water; in the others, 10, 15, and 20 c.c. of extra acid respectively were similarly introduced. The mean polarimeter readings were as follows: — − 33·0, − 33·9, − 34·65, − 35·6, and − 36·4 respectively, for the various series, beginning with the least acid; showing that each additional 5 c.c. of acid produced a mean increase in rotation of 0·85. Next, another 500 c.c. of invert solution was prepared as above; three series of experiments were made: in the first, the 55 c.c. were diluted as before; in the second, the free acid was exactly neutralised with 3·3 grms. of normal sodium carbonate; and in the third, an addition of 3·3 grms. of carbonate was made in excess of this, the mean polarimeter numbers for the three series being − 33·1, − 33·75, and − 36·17. Hence, whilst mere neutralisation caused an increased rotation of 0·65, the further addition of free alkaline carbonate gave an additional increase of 2·42. But in neutralisation, 3·65 grms. of sodium chloride are formed, and experiments similar to the last show that this amount of pure NaCl gives an increased rotation of 2·0 beyond that of the original solution. Since, then, the sodium chloride in the unneutralised solution alters the reading by 2·0, whilst in the neutralised liquid the alteration of reading is only 0·6, the difference (or 1·4) may be attributed to the action of the acid present. This is higher than the result obtained in the first series, but is probably more correct. Hence the rotatory power of the invert sugar, when hydrochloric acid is used, is probably 1·4 in excess of the correct reading, under the conditions of these experiments.

A parallel series of experiments with acetic acid showed that this acid exerts an opposite influence. Whereas the original solution (inverted by acetic acid) gave a reading of − 31·1 (against − 33·1 for hydrochloric acid), the same solution, with 10 c.c. of extra acid, gave a decreased reading of − 30·85, or a difference of 0·25 for 10 c.c. Neutralisation with 3·05 grms. of sodium carbonate gave a rotation of − 32·6 (increase of 1·5), and with a further addition of 3·05 grms. of the carbonate − 34·8 (or a further increase of 2·2). But 4·72 grms. of pure sodium acetate added to the original solution gave a reading of − 32·4 (increase of 1·3). Hence the difference between 1·3 and 1·5, or 0·2, represents the action of the acetic acid. So that the apparent rotatory power of the invert sugar, produced by acetic acid, is probably 0·2 lower than the correct reading. Determinations by Fehling's solution show, however, that inversion is as complete when acetic acid is used as it is with hydrochloric acid, the numbers given by the two inverted solutions being identical.—W. G. M.

*Sugar Acetates.* C. Tanret. Comptes rend. 1895, **120**, 194—195.

When forming the acetates of the sugars by the action on them of acetic acid in the presence of sodium acetate or of zinc chloride, the results were as follows:—

1. The stable carbohydrates, like the inosites, can be etherified either with acetate of soda or chloride of zinc.

2. The saccharoses and poly-saccharoses (cane sugar, raffinose, inulin, &c.) are transformed into the acetates with acetate of soda, but when zinc chloride (even in very small quantity) is used, the ethers of the glucoses produced by hydration are formed. The molecular weights of the acetate, as determined cryoscopically, agreed with theory.

3. With the glucoses the reaction is more complex. From dextrose, with zinc chloride, three pentacetates were obtained:—$\alpha$ (m.p. 130° C., and $[\alpha]_D = +4^\circ$); $\beta$ (m.p. 82° C., and $[\alpha]_D = +59^\circ$); and $\gamma$ (m.p. 111° C., and $[\alpha]_D = +101 \cdot 75^\circ$).—L. T. T.

*Method of Control of Lime Sludge from the Defecation of Beet Juice.* Levy. Sucr. indig. 1895, **45**, 263, and Chem. Zeit. Rep. **19**, 90.

The author refers to the importance of this method of control, and commends its operation and carrying out by the decomposition with magnesium sulphate in a 20 per cent. solution.—J. L. B.

*Determination of Cane Sugar in the Presence of Commercial Glucose.* H. A. Weber and W. McPherson. J. Amer. Chem. Soc. 1895, **17**, 312.

*See under* XXIII., *page* 515.

*Volumetric Determination of Sugars by an Ammoniacal Cupric Solution.* Zdenek Peske. Proc. Chem. Soc. 1895 [150], 43.

*See under* XXIII., *page* 524.

*Process for Purifying Alcohols, Sugars, and other Organic Matters.* E. Maumené. Comptes rend. 1894, **119**, 1014.

*See under* XVII., *page* 499.

*Rapid Estimation of Starch.* P. L. Hibbard. J. Amer. Chem. Soc. 1895, **17**, 64.

*See under* XXIII., *page* 515.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Colouring Matter in the California Red Wines.* W. D. Bigelow. J. Amer. Chem. Soc. **17**, 213—218.

The paper contains a record of the reactions given by a number of Californian red wines with various reagents, which for convenience were divided into three classes. The reagents in class 1 were:—Lead acetate, sodium carbonate and bicarbonate, ammonia, ammonium sulphide, alum and potassium carbonate, alum and lead acetate, borax, copper sulphate, and tartar emetic. These reagents give a red, blue, or violet colour with wines containing foreign colouring matters, and a green or greyish-green coloration when the wines are pure. In most of the samples examined, the latter tints were obtained. Class 2 comprises certain metallic oxides, such as mercuric oxide, manganese dioxide, and lead peroxide, which decolorised most of the samples under investigation. Sodium peroxide does not entirely destroy the colour of Californian wines, even when acidified and used in much larger quantity than that usually employed. In class 3 small rectangular pieces of chalk are used having one face carefully smoothed. After soaking for two hours in a 10 per cent. solution of egg-albumen they are dried at 45° C. and divided into five pieces, one of which is untreated, and each of the other four is soaked for 40 minutes in a 1 per cent. solution of tartar emetic, lead acetate, copper acetate, and zinc acetate, and dried at 50° C. Three drops of each wine are dropped on to the five blocks, dried at 100° C. for one hour, or at the temperature of the laboratory for 24 hours, and the colour noted. The colours obtained were brown, greyish-brown, and slate, no violet, blue, or green being produced in any case. The author concludes that the colouring matter of Californian wines appears to be much more uniform than that of European wines. The colours produced frequently differ from those said to be obtained with French wines, but none of the reagents gave reactions said to be characteristic of wines coloured with vegetable pigments.—T. A. L.

*Process for Purifying Alcohols, Sugars, and other Organic Matters.* E. Maumené. Comptes rend. 1894, **119**, 1014—1016.

The author finds that potassium permanganate will completely remove the bad taste from impure alcohol, by oxidation; in this way the alcohol can be rapidly purified, for the deposited oxides of manganese are easily separated by filtration, and any trace of acid produced by the oxidation can be neutralised with chalk. Both white and red wines can be similarly treated without loss of colour or bouquet. Should any manganese be left by accident in the liquor it would be quite innocuous.

Sugar solution is also capable of purification by potassium permanganate, and the application of this oxidant for rendering water fit to drink is likely to be of military service.—A. G. B.

*Composition and Analysis of Brandies.* X. Rocques. Comptes rend. 1895, **120**, 372.

*See under* XXIII., *page* 514.

*The Hydrolysis of Maltose by Yeast.* G. Harris Morris. Proc. Chem. Soc. 1895 [150], 46.

Having in view the important nature of the subject, and the bearing it has upon the determination of cane sugar in the presence of maltose by inversion with yeast, the author has repeated Fischer's experiments (this Journal, 1895, 377). He has obtained results confirming Fischer's statements as to the action of air-dried yeast and its extract, and also of ruptured moist yeast, but was quite unable to obtain any evidence of hydrolysis when moist and well-drained yeast was employed, although both pure cultures of Frohberg yeast and ordinary London brewery yeast were used.

In order to obtain some explanation of the remarkable difference in the behaviour of well-drained but moist yeast, and of air-dried yeast, a quantity of the former was digested with chloroform water for 20 hours, in order to kill the cells, and then air-dried; any decomposition during drying, due to vital changes, was thus prevented. The dried yeast thus obtained possessed the same power as that dried in the ordinary way, and the yeast liquor, obtained as described in the paper of O'Sullivan and Tompson on invertase (this Journal, 1890, 816 and 1049), which is manifestly a product of the decomposition of the yeast, and which possesses the power of inverting cane sugar to a most marked extent, appears to be without action on maltose. That the action of dry yeast is not due to the cells being ruptured during powdering was shown by the fact that the horny mass remaining when yeast is dried on a porous tile, was just as active when used in that form as when finely powdered before addition to the maltose solution.

The dry yeast has also the power of liquefying starch paste, and of producing dextrose from a starch-conversion from which all the soluble portions have been removed by repeated treatment with 80 per cent. alcohol.

The author is making further experiments to ascertain the cause of the hydrolysing action of dry yeast.

### PATENTS.

*Improved Means or Method of Treating Barley and other Grain for its Conversion to Malt for Brewing, Distilling, or other Purpose, and in the Construction of Apparatus connected therewith.* F. W. M. Karsten, Wood Green. From E. Kasten, Mannheim, Germany. Eng. Pat. 8212, April 25, 1894.

The grain is steeped in a series of six vats, which are filled at successive intervals of 12 hours, so as to secure a constant supply of steeped grain to the germinating chambers, each of which has two floors provided with perforations or openwork. Moist air, obtained by passing air through a tower, down which descends a finely-divided spray of water, passes into the top of the germinating chamber through the layer of grain, and out through the perforated floor, into a general outlet, carrying with it the carbonic gas produced during germination. At the edge of each floor is a travelling elevator which carries the germinating grain on to the next floor, thus taking the place of turning by hand. In case the grain should require to be moistened to a greater extent than the moist air will effect, a series of spray-producers are fixed to the inlets of the air-supply in the roofs of the germinating chambers. The withering chamber is constructed much after the same style as the germinating chamber, the warm air for drying being obtained from the kilns. The current of air during germination and withering is produced by exhausting from beneath the floors.—J. G. W.

*An Improved Method and Apparatus for Saturating Liquids with Gases, and for Bottling Liquids so Saturated.* J. F. Beins, Rotterdam. Eng. Pat. 10,523, May 30, 1894.

*See under* I., *page* 469.

*An Improved Process and Apparatus for rendering Soluble the Albuminoids in Mash and Wort.* L. Prochazka, Turnau, Bohemia. Eng. Pat. 14,918, August 3, 1894.

This process consists in blowing a hot-air current, at a temperature not lower than 125° C., in a finely-divided state, through the mash and wort, whereby it is claimed that the albuminoids are changed into soluble compounds, amides and peptones. For the production of this current of hot air, the patentee has devised the following apparatus:—A blowing engine of known capacity, delivers air into a main furnished with a meter, then passing into a ribbed heater or gilled pipe inserted within the flues of the copper, from which it is conducted into the copper or mash tun, a finely perforated distribution-pipe within which, serves to bring the air in intimate contact with the mash or wort. In order to regulate the pressure and temperature of the air-supply, a small pipe is led out of the air-supply main just before the meter. This pipe is furnished with a cock, the opening of which allows air to escape into the open, and so reduces the quantity passing into the brewing vessels, the temperature of which smaller quantity is, as a consequence, increased.—J. G. W.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

*Estimation of Iron and Alumina in Phosphate Baking Powders.* K. P. McElroy. J. Amer. Chem. Soc. 1895, **17**, 260.

*See under* XXIII., *page* 510.

### PATENTS.

*An Improved Method of and Device for Sterilising Victuals, Beverages, Remedies, and the like.* J. Bassfreund, Hildesheim, Germany. Eng. Pat. 5301, March 14, 1894.

The invention consists of a method for sterilising food, &c., by means of a current of steam led through and around the substance contained in a specially-constructed vessel, the sterilisation being complete when the substance attains the temperature of the fresh steam. Of the containing vessel, five modifications are given, their peculiarity being that they have an outlet and inlet for steam connected with the lid, so that by rotation of the lid one or both openings may be closed, and the contents, after sterilization, preserved from reinfection.

The apparatus is arranged to admit of portions of the contents being withdrawn without reinfecting the remainder, and it includes a suitable apparatus for producing the necessary supply of steam.—L. de K.

*Improvements in the Production of a Peptonised Alcoholic Beverage.* A. Bernstein, Berlin, Germany. Eng. Pat. 10,105, May 24, 1894.

Milk is first sterilised and peptonised as directed in Eng. Pat. 10,106, May 24, 1894 (this volume, p. 56).

The product thus obtained, called galacton, can now be used for making an alcoholic beverage by fermenting it with Duclaux or Weigmann's yeast. As the fermented product is, however, very poor in alcohol, it may be made more powerful by adding sugar or malt, which will also undergo fermentation.

The inventor's claim is the production of a nourishing alcoholic beverage.—L. de K.

*The Preparation of a New Product from Blood.* O. Finsen, Thorshavn, Faröe Islands. Eng. Pat. 24,735, December 19, 1894.

Fresh blood of oxen or other animals is defibrinated by whipping, and then mixed with six times its bulk of water, to which is added citric acid, 5 grms. for every litre of blood. The mixture is then heated to 90°, and so kept for a quarter of an hour. The coagulated albumin is strained and very carefully washed with water. After removing the superfluous moisture, the remaining mass is dried at 45° *in vacuô*, when it constitutes a brittle chocolate-coloured substance, which must then be reduced to a very fine powder.

The inventor claims that this preparation, designated hæmo-albumin, possesses valuable nutritious properties, and has no objectionable taste.—L. de K.

*Manufacture of a New or Improved Milk Product.* J. Wetter, London. Communicated by L. Hentzschell, Altenburg, Germany. Eng. Pat. 146, January 2, 1895.

Fresh and thick cream is brought into a frothy condition by suitable appliances, and the froth is then placed upon inclined plates which are of rectangular shape, and have a flange or rim about an inch high. Each plate has in its corner, an outlet or drainage opening. A hot current of dry air is passed over the froth, which causes it to become a dry and kneadish mixture, whilst the inclosed liquid drains off. The new product is not unlike butter, but it contains all the other valuable constituents of the cream, and smells and tastes more like milk. It has a sp. gr. of 1·013, and does not readily melt.—L. de K.

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*Improvements in and relating to the Preservation of Fruit, Fish, Game, and the like.* A. Beveridge, Glasgow. Eng. Pat. 3325, February 15, 1895.

Fruit is first kept under shade in a cool, dry place for a few days, so as slightly to dry the outer skin. It is then immersed for a few minutes in melted paraffin; or it may be sprayed with a hot blast of paraffin wax until the surface is sufficiently coated. Fish, game, and the like may be treated in the same manner. The inventor states that the articles thus preserved may be shipped as ordinary cargo for long distances.—L. de K.

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*A Sterilising and Preserving Apparatus for Milk and other Liquids.* F. Zweiböhmer, Recklinghausen, Germany. Eng. Pat. 3767, February 21, 1895.

The apparatus consists of a vessel having at its bottom end a suitable cock or valve, and at its top an annular trough, the interior side of which is higher than the exterior one. Into this trough, which is filled with dilute glycerin, enters the rim of a cover so as to leave it about half uncovered. The rim is perforated to admit the air when the milk is being drawn off, the air being deprived of germs and microbes by its passage through the glycerin. The milk is sterilised by placing the vessel containing it for 45 minutes inside a larger vessel containing boiling water.

When treating liquids which are liable to form a deposit, and which require stirring before drawing off, a disc-like agitator may be used. It can be combined with the cover by means of a rod and a handle. To stir the deposits the agitator may be turned bodily with the cover, or a stuffing box may be formed so that the knob can be turned without moving the cover.—L. de K.

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## (*B.*)—SANITARY CHEMISTRY.

*The Products formed by the Action of Ozone on Ammonia.* L. Ilosvay von Nagy-Ilosva. Ber. 1894, **27**, 3500.

In 1874 Carius studied the action of ozone on dilute ammonia solutions. He found that ammonium nitrate and nitrite and hydrogen peroxide are formed, and suggested that the presence of these bodies in the air might be due to the action of ozone on atmospheric ammonia.

The author has repeated the experiments of Carius, and has found that ozone acts very slowly on ammonia, even when the latter is present in excess. No $H_2O_2$ is formed in any case. The action takes place much more quickly with strong than with dilute ammonia. When ozonised oxygen is passed through 0·06 per cent. ammonia, the nitrite reaction is at first well developed; later, when the solution is scarcely alkaline, there is much nitric and very little nitrous acid present.

20 per cent. ammonia solution absorbs ozone very quickly. Dry ozone does not act on dry ammoniacal gas at the ordinary temperature. It seems thus improbable that the nitrates and nitrites found in the atmosphere are due to the action of ozone on ammonia, and the hydrogen peroxide has certainly no connection with the ozone in the air.
—T. E.

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*Systems of Smoke Prevention.* Henry J. Williams. Tech. Quarterly, **7**, 1894, 122—132.

After discussing the cause of smoke, and pointing out the imperfections in the ordinary methods of hand-firing boilers, the author lays down the following conditions which a wholly successful smoke-preventing device must fulfil:—

1. *Efficiency.*—The development of a high temperature, combined with oxidising action, so as to insure combustion of the separated carbon; regularity of action under varying conditions, such as charging fresh coal, cleaning fires, inattention of firemen, &c.; non-liability to get out of order under ordinary conditions of use; little or no increase in cost of working.

2. *Capacity.*—Efficient action, not only under ordinary conditions, but when forced in order to meet extraordinary demands.

3. *General Applicability.*—Ready adjustability to all forms of boilers and boiler settings; moderate first cost; repairs few, easily made, and at small cost; applicability where space is limited; no injury to be caused to boilers or accessories.

Amongst the numerous devices which have been proposed for the purpose, not one is capable, in its present form and mode of application, of fully satisfying all the above requirements. Smoke-preventing devices generally reduce the capacity of the boilers. But although the problem of complete smoke prevention where raw fuel is used still remains unsolved, much has been done to mitigate the smoke evil, the more important systems being as follows:—

1. *Steam Jets.*—Where the temperature is high, and firing carefully performed, these yield fairly good results; but with careless firing, and especially where the temperature is lowered by throwing on too much coal at once, combustion is retarded rather than promoted by the jets. Ordinary firemen scarcely ever regulate the jets to meet varying requirements of steam, and there is apt to be damage done by blowpipe action on the boiler shell.

2. *Firebrick Arches and Checker-Work.*—With careful firing, both these appliances may be made to yield good results, but only to a limited extent, and the necessity for frequent repairs, with their cost and interference with working, is a serious drawback.

3. *Hollow Walls for Preheating Air.*—These generally fail through lack of capacity and tendency to become clogged.

4. *Coking Arches or Chambers.*—These lack durability, owing to the fluxing action of the ash, combined with exposure to very high temperatures.

5. *Double Combustion.*—These furnaces, which have two fireplaces, alternately fed, the hot gases of one passing over or through the other, have the disadvantage that large volumes of useless gases pass through the fires, and carry away much heat.

6. *Downward-draught Furnaces.*—These are more promising. The air and gases are made to pass downwards through the glowing bed of coals, thereby becoming heated, and bringing about more perfect combustion. The grate-bars are generally hollow tubes filled with water, forming part of the boiler system. In the recently-improved form of this furnace there is an under-grate also formed of a set of water-tubes, which are connected by elbows with upright tubes screwed directly into a water-leg under the boiler. The hot gases are made to pass between these vertical tubes, which materially add to the heating surface, and improve the circulation of the water. This type of furnace is well adapted to reduce smoke, and can be readily attached to a variety of boilers, but it is liable to defects of construction which cause leakage at the joints of the tubes.

7. *Automatic Stokers.*—Numerous mechanical devices for supplying coal continuously to the fire-bed are in use, and among them are to be found many of the most efficient smoke-reducing appliances. But they have serious drawbacks. The coal must be properly sized, and caking coals cannot be used, since clinkers choke and impede the working of the firebars, besides being very difficult to remove. Another serious objection is, that mechanical stokers do not respond quickly to increased demands made upon them.

Among the good stokers which the author has seen, he specially mentions, as one of the most efficient, the Standard smokeless furnace of St. Louis, which combines the action of a mechanical stoker with an arrangement for coking the coal on a sort of coking plate before delivering it on to the step grate. This arrangement increases the efficiency of the furnace from 10 to 20 per cent., maintains a good smoke record, and is capable of developing the full boiler capacity, but requires about half an hour to do so. Another stoker which the author mentions is the Jones under-feed mechanical stoker. The fresh coal is fed from below by means of a ram, and the combustible gases have to pass through about 20 inches of glowing coal, whilst the draught is maintained by means of a set of tuyère holes placed some distance below the surface of the glowing coals, the supply of air from which can be regulated. One advantage of this stoker seems to be that the full steaming-power of the boilers can be quickly developed.

In conclusion, the author shows that the solution of the smoke problem by burning gas instead of coal would not pay. Coal-gas and water-gas are out of the question, owing to their great cost; but fuel-gas has been made from Illinois coal at a cost of only 8 cents per 1,000 cub. ft. Nevertheless, after adding cost of distribution, and making several other allowances, the conclusion is arrived at that the gas equivalent of coal would probably cost in the end more nearly 8 or 10 times as much as the coal. We must therefore continue to burn coal, and by taking full advantage of our knowledge up to the present time, only a moderate amount of smoke need be produced in so doing.—L. A.

*Artificial Ice.* A. C. Christomanos. Ber. 1894, **27**, 3431.

It is well known that ice prepared either naturally or artificially from impure water is considerably purer than the water from which it was obtained, both with regard to micro organisms and to dissolved impurities. In consequence of a difference of opinion as to the purity of some artificial ice prepared in Athens, the author made the following experiments:—

The freezing cells were filled with water from the Athens water supply, and then frozen quickly. The blocks of ice consisted of a clear transparent outer layer and a white opaque core. A block was cut up and yielded 18 kilos. of the transparent ice and 6 kilos. opaque. They were analysed separately, and also the original water, with the following results. (The numbers are milligrames per litre.)

| —— | Original Water. | Clear Ice. | Opaque Ice. |
|---|---|---|---|
| Total residue (dried at 160°) | 362·2 | 31·0 | 1355·8 |
| Ammonia | .. | .. | .. |
| Nitrous acid | .. | .. | .. |
| Nitric acid | 4·0 | 2·2 | 10·0 |
| Chlorine | 55·6 | .. | 222·6 |
| $SO_3$ | 15·9 | .. | 63·6 |
| Lime | 118·3 | 9·0 | 419·3 |
| Magnesia | 23·1 | 1·5 | 92·4 |
| Albuminoid ammonia | .. | .. | .. |
| Organic matter (oxidisable) | 30·0 | 2·8 | 105·5 |
| Total hardness | 15·0° | 1·5° | 57·0° |
| Sodium chloride | 75·0 | .. | 355·5 |

A second experiment, in which spring water was used, gave a precisely similar result, except that some of the water in the interior of the block was left unfrozen. This water was very much richer in impurities than even the opaque ice.—T. E.

*Water Purification.* R. Hering. J. Franklin Inst. **139**, 135.

After a careful general review of the various systems of continuous purification of drinking water, the author concludes his paper with a fuller notice of the results of investigations of the Massachusetts State Board of Health, quoting from papers by H. F. Mills—"Purification of Sewage and of Water by Filtration," and by G. W. Fuller—"Removal of Pathogenic Bacteria by Sand Filtration." The most efficient filter is said to be one made of sand of even grain, of about 0·2 mm. diameter: through such a filter sewage may be run permanently, though intermittently, at the rate of 100,000 gallons per acre per day. Such a filter is said to reduce sewage to the condition of a bright drinking water, the organic matter of the sewage being almost completely oxidised, and bacterial life being reduced to 1/10,000.—C. F. C.

*Process for Purifying Alcohols, Sugars, and other Organic Matters.* E Maumené. Comptes rend. 1894, **119**, 1014.

*See under* XVII., *page* 499.

## PATENTS.

*Improvements in Water Purifying and Softening Apparatus.* G. G. Hooper and F. H. Tyacke, London. Eng. Pat. 9814, May 19, 1894.

Cream of lime contained in a hopper provided with an overflow pipe and a steam pipe or agitator, is caused to overflow either by condensation of the steam used for agitation, or by admitted water if mechanical agitation is employed, into a tank or vessel divided into compartments into which clean water also flows. In the first compartment the water and the cream of lime are mixed, and the lime-water thus produced, after flowing through the other compartments of the vessel and depositing the surplus lime, overflows into a vertical tube where it is mixed with the hard water which it is required to soften. The vertical mixing tube contains an internal worm or similar mechanical device, which, besides causing a thorough mingling of the liquids flowing down the tube, also imparts to the mixture a rotary motion, which tends to effect rapid settling of the suspended precipitate in the vessel into the lower part of which the liquid flows. The more or less clear softened water then rises through a filter contained in the upper part of the same vessel and is drawn off for use.—L. A.

*An Apparatus for the Destruction by Burning of the Germs of Disease contained in Sewer Gas.* A. Hanlon, London. Eng. Pat. 370, January 7, 1895.

The drawing represents a kind of Bunsen burner having a second and rather longer tube surrounding the burner tube. The sewer gas is led into the annular space between the two tubes, and emerges at the top into the flame, which is enclosed in a cylindrical retort.—L. A.

*Process of Making Sterilised Filters and Filtering Surfaces.* O. W. Brandenburg and F. H. Pott, Berlin. Eng. Pat. 2200, January 31, 1895.

Carbon, sand, fossil meal, asbestos, or other suitable material, in a finely-divided state, is made into a sludge or pulp with hot water and distributed over any suitable filtering surface by the aid of suction or pressure. The filtering surface is thus made "more compact or condensed," and by means of the hot water the filtering material is sterilised.—L. A.

*Process of Manufacturing Carbon for Filtering and other Purposes.* O. W. Brandenburg and F. H. Pott, Berlin. Eng. Pat. 2203, January 31, 1895.

Coagulum or gore, flesh, or other organic substance, is heated to 1,270° F. in the absence of air, preferably by means of superheated steam, and in the presence of an alkali or alkaline earth. When the mass has cooled to 230° F., it is reduced to small fragments and treated with strong sulphuric acid, to complete the carbonisation. It is then mixed with water, and the carbon is separated by decantation or filtration; it may be further purified by boiling with hydrochloric acid. After crushing to a fine powder, the carbon is exceedingly loose and open in texture, is pure, and especially adapted to the filtration of water.—W. G. M.

*Improvements in Apparatus for Purifying Smoke.* A. Gérardin and M. Ringelmann, both of Paris. Eng. Pat. 2487, February 5, 1895.

The purification is effected by two distinct operations, namely, cooling the smoke as it leaves the furnace to below 100° C., and moistening the suspended particles by introducing a small quantity of steam.

The products of combustion are caused to pass first through a cooler and then through the precipitating chamber. The former may be of any suitable form, whilst the latter consists of a suitably-shaped chamber, in which the cooled smoke has steam mixed with it, which damps the solid particles of soot, and, by increasing their weight, causes them to descend into a receptacle at the bottom.
—R. B. P.

*An Improved Process and Means for the Treatment and Utilisation of Sewage.* M. F. Purcell, Dublin. Eng. Pat. 3272, February 14, 1895.

Pressed sewage sludge, preferably air-dried, is charged alternately with fuel, into a closed furnace, shaped like a blast furnace, having a cup and cone arrangement at the top, and tuyères for air and steam-blast near the bottom. There is a pipe at the upper end of the furnace to convey away steam, ammonia, and hydrocarbons, which are condensed into water and oil in an arrangement something like a gas-making plant, a gasometer being provided for the collection of the permanent gas. The ashes left in the furnace are withdrawn at intervals and used for making cement.—L. A.

## (*C.*)—DISINFECTANTS.

### PATENTS.

*Improvements in Apparatus for Electrolysing Chloride Solutions employed for Disinfecting.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 6497, March 31, 1894.

*See under* XI., *page* 492.

*An Improved Disinfectant or Antiseptic Preparation.* J. T. A. Walker, Blackburn, Lancashire. Eng. Pat. 9726, May 18, 1894.

Thymol is dissolved in a 5 to 10 per cent. aqueous solution of glycerin, in which it is three or more times more soluble than in pure water; or thymol may be liquefied by mixing it with 5 or 10 per cent. of pure glycerol without any water. Both these liquids are powerful germicides. They may either be used alone, or mixed with a solid base such as carbonate or sulphate of lime.—L. A.

*A Method of Utilising certain By-products of Iron and Copper Sulphides, and other Iron and Copper Ores, for the Production of Persulphate of Iron, to be used as a Disinfectant for the Purification of Sewage, and for other Purposes.* G. Dalton, Leeds, and T. B. Provis, Highbury, Middlesex. Eng. Pat. 12,708, June 30, 1894.

The oxides left on the roasting of iron and copper pyrites are peroxidised by exposure to air, effected either by frequent turning over by the shovel, or by blowing air through, and are then mixed with sufficient sulphuric acid of 168° Tw. to form a paste. If sulphur dioxide is evolved, the mixture is effected by a mechanical stirrer in a close vessel, admitting of collection of the gas, which may be utilised in the manufacture of a sulphite. The iron persulphate formed is dried, either by heating the mixing vessel, or in ovens or kilns so constructed that smoke may not reach the charge. The persulphate may be fully dried, and packed in casks for use in precipitating sewage, &c., or it may be compressed before it is fully dry into briquettes, which are afterwards further dried.

When it is desired to obtain a superior quality of the persulphate, the refuse of the roasting furnaces may be washed or re-smelted; and the persulphate obtained from the purified refuse may be dissolved in water and crystallised. If a product suitable for medical application be desired, arsenic and other impurities are dissolved out of the oxidised refuse by an acid, and the persulphate is then manufactured from the purified oxides as described.—E. S.

*Manufacture of Saponaceous Products from Petroleum.* C. Weygang, West Willow, Romsey, Hants, and the Petroleum Products Syndicate, Limited, London. Eng. Pat. 23,995, December 10, 1894.

The various saponaceous products now described by the patentee, are the subjects of eight claims. (See Eng. Pat. 3025 of 1894, page 493.)

The following appear to be the principal fresh points of chemical interest:—

1. A "*ferruginous oil*," formed by agitating his "inodorous oil" (see XII., page 494) with a solution of sulphate or nitrate of iron, settling and decanting.

If the manufacture be conducted, not with finished "inodorous oil," but with this substance, just prior to the final addition to it of alkali matter, it is stated that "a deep brown oil, rich in iron," may be obtained.

2. The use of the patentee's soap, and of his "soluble oil," as *insecticide* applications to plants, is suggested.

3. In the manufacture of his soap, the inventor now proposes an additional alternative method, which consists in replacing the caustic soda first applied, by strong liquor ammoniæ, which is added to the melt of rosin, petroleum, and fat soap, when nearly cold, the ammonia being, in a subsequent operation, driven off by evaporation, and further caustic soda added. In another soap mixture, carbonate of soda and borax are added to the melt of rosin, petroleum, and fat soap.—E. R. B.

# XIX.—PAPER, PASTEBOARD, Etc.

*Sulphite Liquor of Cellulose Pulp Mills.* Felix B. Ahrens. Zeits. angew. Chem. 1895, 41—44.

There are few mills that experience more trouble through their waste liquor than those manufacturing sulphite wood-pulp, many having been stopped through inability to sufficiently purify it to meet the demands of the pollution authorities. For this reason, as well as for the purpose of recovering the large amount of organic compounds, a thorough investigation of this liquor is desirable; and although many proposals for dealing with the liquor have appeared in technical journals and patent specifications, no successful method has as yet been discovered. The author, in conjunction with E. Klingenstein, had occasion to examine this waste liquor at the Agricultural Technological Institute of the University of Breslau, the following being the results:—Sulphite waste liquor is a reddish-brown cloudy liquor, with strong acid reaction, a peculiar smell, and a sp. gr. 1·0465 = 6·5° B. at 15·8°. When evaporated, a tough, sticky, gummy substance remains ("Solid Matter"), amounting to 9·4 per cent., of which 1·11 per cent. is ash and 8·29 per cent. organic matter. A slight error occurs in all the results herein recorded, which the authors point out. It is due to the fact that the "Ash" consists of sulphate and sulphite of lime, which in calcining is partly reduced to calcium sulphide and thence to sulphuretted hydrogen, which burns off as $SO_2$. This slight loss was thus credited as "Organic Matter."

*Purifying the Liquor with Lime.*—The liquor as it leaves the boilers is strongly acid, containing a considerable quantity of recoverable sulphurous acid, which may be obtained as sulphite of lime by the addition of sufficient lime to nearly neutralise the solution. To complete the neutralisation, the liquor may be run over limestone. The precipitate obtained by the addition of lime, contains a certain quantity of organic matter, varying according to the temperature and amount of lime added.

1. *Results of Experiments.*—The hot liquor was treated with a measured quantity of fresh milk of lime, boiled and filtered, the filtrate being then neutralised by carbonic acid.

| No. | CaO | Solid Matter. | Ash. | Organic Substance. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 2 | 8·75 | 1·89 | 6·95 |
| 2 | 3 | 7·48 | 1·59 | 5·89 |
| 3 | 4 | 7·36 | 1·71 | 5·65 |
| 4 | 5 | 7·13 | 1·56 | 5·57 |
| 5 | 6 | 6·86 | 1·52 | 5·34 |
| 6 | 7 | 6·74 | 1·58 | 5·16 |
| 7 | 8 | 6·65 | 1·54 | 5·11 |
| 8 | 9 | 6·61 | 1·57 | 5·04 |
| 9 | 10 | 6·79 | 1·51 | 5·28* |
| 10 | 11 | 6·54 | 1·55 | 4·99 |
| 11 | 12 | 6·52 | 1·49 | 5·03* |
| 12 | 15 | 6·31 | 1·49 | 4·82 |
| 13 | 20 | 7·00 | 1·60 | 5·40* |
| 14 | 30 | 4·99 | 1·01 | 3·98 |

By a further addition of lime, the organic matter precipitated increases, and by longer boiling with lime the organic compounds are again brought into solution, which fact explains the results marked * in the above table.

II.—*Results of Experiments.*—Measured quantities of fresh milk of lime were added to the liquor when cold, the precipitate filtered off, and the filtrate neutralised with carbonic acid and examined, the results being as follows:

| No. | CaO | Solid Matter. | Ash. | Organic Substance. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 2 | 6·21 | 1·11 | 5·10 |
| 2 | 3 | 6·19 | 1·33 | 4·96 |
| 3 | 4 | 5·26 | 1·00 | 4·26 |
| 4 | 6 | 5·08 | 1·04 | 4·04 |
| 5 | 8 | 4·96 | 1·10 | 3·86 |
| 6 | 10 | 5·67 | 1·22 | 4·45 |
| 7 | 12 | 5·76 | 1·23 | 4·53 |
| 8 | 14 | 6·26 | 1·29 | 4·97 |

It is seen that the minimum of organic substance is left in the liquor (3·86 per cent.) by treating with 8 per cent. of lime, a regular increase taking place with an increase in the lime used. Upon adding the lime, the liquor turns from yellow to red and brown.

*Treatment of the Liquor with Alumina.*—A number of tests were made to ascertain the quantity of organic matter that could be mechanically carried down by means of gelatinous alumina, prepared by decomposing aluminate of soda with carbonic acid gas. The liquor was treated with known quantities of aluminate of soda and then saturated with $CO_2$ at the ordinary temperature. The following table gives the results of the tests of the liquor after treatment:—

| No. | $Al_2O_3$ | Solid Matter. | Ash. | Organic Substance. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| 1 | 1 | 9·58 | 2·06 | 7·53 |
| 2 | 2 | 9·22 | 2·18 | 7·04 |
| | | 9·38 | 2·11 | 7·27 |
| 3 | 4 | 8·53 | 2·13 | 6·40 |
| 4 | 5 | 8·2 | 3·10 | 5·10 |
| | | 8·02 | 3·15 | 4·87 |
| 5 | 6 | 10·84 | 3·96 | 6·88 |
| | | 10·89 | 3·87 | 7·02 |

*Dry Distillation of the Residue.*—As already pointed out, the residue obtained by simply evaporating the liquor to dryness is a dark, gummy, tough substance, whereas the residue obtained after treatment with lime is a firm friable material. The ash and total sulphur contained in this were estimated. Ten litres of liquor were boiled with 138 grms. of CaO and filtered; the residue amounted to 835 grms. and gave by an analysis the following: 22·37 per cent. of ash and 6·45 per cent. of total sulphur; of the ash, 14·4 per cent. consisted of sulphur, of which 13·4 per cent. existed as $SO_3$ and 58·5 per cent. as CaO. By the dry distillation of this residue, a considerable quantity of gas was evolved, mostly $H_2S$, the formation of which is probably due to the reduction of the sulphites and sulphates by the organic matter. The distillate is a liquid of penetrating odour, from which sulphur separates on standing, and the residue consists of a black pitch. The distillate was acid, and contained acetic acid, acetone, mercaptan, and an oil containing sulphur, with an unpleasant smell. The two latter are produced by the secondary reaction between the sulphuretted hydrogen and the methyl-alcohol and a smaller number of nitrogenous bases. The pitch contained 33·6 per cent. of ash and 4·37 per cent. of total sulphur; the ash contained 71·6 per cent. CaO and 13·7 per cent. sulphur, of which 12·5 per cent. existed as $SO_3$. Similar results were obtained by the dry distillation of the lime precipitate.

*By Osmosis.*—The following diffusion tests were conducted in the ordinary way. In the cell there were 10 litres of liquor and 10 litres of water. At first, every hour a test was taken, but this was found to be unnecessary. The surrounding water increased in colour and became somewhat acid, and had no action on polarised light. P. Schubert obtained the following results:—

| Days. | Solid Matter. | Ash. | Organic Matter. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| 1 | 1·95 | 0·33 | 1·62 |
| 2 | 2·46 | 0·49 | 1·97 |
| 3 | 2·98 | 0·52 | 2·46 |
| 5 | 3·95 | 0·63 | 3·32 |
| 7 | 4·10 | 0·67 | 3·43 |
| 8 | 4·38 | 0·70 | 3·68 |
| 10 | 4·44 | 0·71 | 3·71 |

The diffused liquor after 10 days had a sp. gr. 1·020.

*Electrolytic Experiments.*—In one of these experiments a liquor was employed that had been treated with lime and neutralised with $CO_2$, lead plates being the electrodes. After about two hours' action of a current from three large Bunsen elements, a slimy precipitate separated, the liquor turning a light yellow colour, and the lead was dissolved in considerable quantities. A quantitative test gave the under-mentioned results. By electrolysis a liquor was obtained, which was treated cold with 3 per cent. of lime, and by neutralising with $CO_2$ became somewhat heated. It was of a dark red or brown colour, and contained 6·9 per cent. of dry substance, 1·33 per cent. ash, and 4·86 organic matter. The lead plates had 159 cm. of acting surface and were separated 0·3 cm. from each other. The current was of 5 ampères. The length of time during which the current passed was 110 minutes. After separating the lead by sulphuretted hydrogen and calculating upon the original volume, there were found 4·42 per cent. dry substance, 1·07 per cent. ash, and 3·35 per cent. organic matter. The experiment showed without doubt a great diminution of organic substance. Another trial was made with a platinum electrode, the size of the plates, strength of current, &c., being as before. The liquor employed, which had been treated with 5 per cent. of lime whilst hot, and neutralised with $CO_2$, contained 7·13 per cent. of dry substance, of which 1·56 per cent. was ash and 5·57 organic compounds. The experiment lasted 120 minutes. Only a small precipitate was produced, but the liquor became nearly black. By analysis, 6·35 per cent. of dry substance was obtained, of which 1·5 per cent. consisted of ash and 4·85 organic matter. The above experiments clearly indicate that with lead electrodes, the purifying effect is partly due to the lead; the electric current also has the effect of reducing the organic matter. It appeared desirable to ascertain the effect of a stronger and a higher tension current. By means of a dynamo, a current was employed of 70 volts and 10 ampères and of 106 volts and 19 ampères. As electrodes, lead and zinc plates were used. The liquor employed was treated with 3 per cent. of lime whilst cold, filtered and neutralised with carbonic acid gas and showed by analysis 4·96 per cent. organic substance. The precipitate formed was very small and the liquor became strongly heated. The analysis in the one case showed 6·5 per cent. of dry substance, 0·23 lead, 1·27 ash, and 5·0 organic compound, and in the other, 6·51 of dry substance, 0·15 zinc, 1·48 ash, and 4·98 organic compounds. No further effect was produced by the use of currents of higher tension. It is a well known fact that in the manufacture of sulphite wood pulp, the boiling operation occasionally requires a much longer time than usual, and the reason being unknown, a number of experiments were conducted as follows:—The liquor was treated with 3 per cent. of lime, and the precipitate was pressed and stirred in water. Into the solution, sulphurous acid gas was then passed until it smelt strongly of the latter. For several hours it was heated from 125° to 130°. In every case considerable quantities of sulphuric acid compounds were obtained, the quantities varying according to the degree of saturation with sulphurous acid and the heating. From 100 grms. of dry precipitate the minimum increase of $H_2SO_4$ was 2·6 grms. and the maximum 5·9 grms.—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

### *Concentration and Distillation of Hydrogen Peroxide.*

R. Wolffenstein. Ber. **27**, 3307—3312.

Hydrogen peroxide, which is free from alkaline substances, all traces of compounds of the heavy metals, and solid matter of every description, is much more stable than has hitherto been supposed. An aqueous (3 per cent.) solution of hydrogen peroxide, which satisfies these conditions, may be evaporated on the water-bath at a temperature not exceeding 75° C., until the concentration reaches about 50 per cent., without great loss of hydrogen peroxide by decomposition. A considerable loss, however, does take place, and if an attempt be made to push the concentration much further the loss rapidly increases. This is due, not to the decomposition of the hydrogen peroxide, but to its evaporation along with the water. If the concentration be carried out under a pressure of 68 mm. instead of at atmospheric pressure, 3 per cent. hydrogen peroxide may be concentrated to about 50 per cent. hydrogen peroxide with a loss of only about a quarter of a per cent. In order to obtain a still stronger solution, or, in fact, pure hydrogen peroxide, the concentrated solution is extracted with ether, whereby it is separated from any suspended alumina, and most of the substances, *e.g.*, phosphoric acid, soluble in water. On evaporating the ethereal extract the author obtained the following results:—

*a.* 73·8 per cent. $H_2O_2$ from 48 per cent. $H_2O_2$
*b.* 73·5 ,, ,, 45 ,,

The hydrogen peroxide obtained in this way gave, on distilling *in vacuo* (65 mm.), two fractions boiling between 71°—81° C. and 81°—85° C. respectively. The first of these contained 44·4 per cent. and the second 90·5 per cent. $H_2O_2$. On re-distilling the latter, the fraction boiling between 84°—85° C. contained 99·1 per cent. of pure hydrogen peroxide. Hydrogen peroxide is a transparent syrupy liquid with an acid reaction. It evaporates in the air, and does not wet substances so readily as water. If brought into contact with the skin it causes a prickly sensation and produces white spots, which, however, disappear after a few hours.

Small quantities of pure hydrogen peroxide solution may conveniently be obtained by distilling the 3 per cent. solution *in vacuo*. On the large scale the 3 per cent. commercial hydrogen peroxide (free from the impurities already mentioned) is evaporated on the water-bath till the concentration reaches 20 per cent. It is then concentrated to 50—55 per cent. *in vacuo*, extracted with ether, and the ethereal extract distilled *in vacuo*.—J. S.

### *Employment of the Critical Temperature of Liquids to Test their Purity.*

R. Pictet. Comptes rend. 1895, **120**, 43—45.

The author finds that the presence of traces of foreign substances causes a far greater effect on the critical point of liquids than on their boiling points. Thus the critical point of chloroform (258·8° C.) is lowered 3·8° C. by a trace of alcohol, raised 6° C. by a trace of ethyl-chloride, whilst the effect on the boiling-point is only to lower it 0·1°—0·2° C., or raise it 0·6°. The effect does not seem to follow a general law, as a trace of more volatile impurity sometimes raises and sometimes lowers the critical point.

L. T. T.

### *Bismuth Sulphide.*

A. Ditte. Comptes rend. 1895, **120**, 186—188.

Amorphous bismuth sulphide is dissolved to a red solution with formation of a double salt, by a solution of potassium sulphide, the quantity being greater the more concentrated the alkaline sulphide solution. From a boiling concentrated solution, orange rhomboidal crystals $Bi_2S_3, 4K_2S, 4H_2O$ separate out on cooling. These crystals effloresce in dry air, and are immediately decomposed by the action of moisture or moist air. This salt may be utilised for preparing the crystallised bismuth sulphide. When excess of amorphous bismuth sulphide is introduced into a weak solution of potassium sulphide in a flask, and the whole digested on a sand bath, the amorphous sulphide is dissolved in the cooler portions of the liquid, but the double salt formed is decomposed by the excess of water, and the bismuth sulphide is deposited in the warmer portions in the crystalline state. Heating in sealed tubes does not give the same result, probably because the distribution of heat is too uniform.

—L. T. T.

### *Thio-Derivatives of β-Naphthol.*

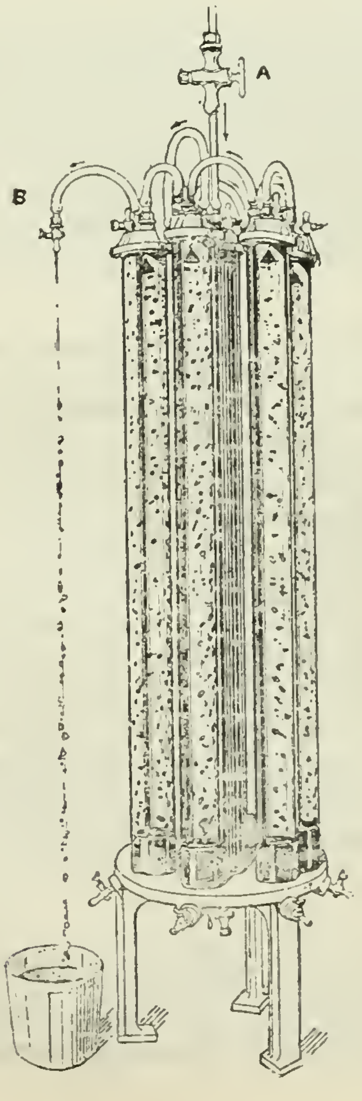
M. Schiller-Wechsler. Ber. 1894, **27**, 3418.

The author points out that two substances described by R. Henriques (Ber. 1894, **27**, 2993), under the names dioxydinaphthyl sulphide, and dehydrodioxydinaphthyl sulphide, are probably identical with a substance patented by him in 1892 (Ger. Pat. No. 64,816, 1892).—T. E.

### *Industrial Preparation and Physiological Action of Nicotine Oxalate.* H. Parenty and E. Grasset. Comptes rend. 1894, **119**, 1273—1276.

Nicotine and its known salts are so unstable and uncertain that its therapeutic use is dangerous and uncertain. The authors find that the quadroxalate $C_{10}H_{14}N_2(C_2O_4H_2)_2$ yields definite and well-formed rhombohedral crystals, which effloresce in the air to a white powder. It is very soluble in water and alcohol, melts at 110° C., evolves gas freely at 113·5° C., forming at 160° the neutral oxalate, and at 250° the pure base. The quadroxalate can be applied to all the uses of the pure base. Trials on rabbits proved that the physiological action of this salt is identical in kind, though less violent than that of the free base. The fatal dose of the free base is about 20—21 mgrms. per kilogrm. weight of the animal, whilst with the quadroxalate it is about 150 mgrms. This salt, therefore, forms a most valuable therapeutic agent.

For the preparation of nicotine, the residual ribs and cuttings of the tobacco leaf are extracted with cold water by displacement. Treated in this way, 100 kilos. of material yield 50 litres of an extract of 21° Beaumé, containing about 20 grms. of nicotine per litre. This liquid is treated with alkali and the free alkaloid extracted with light petroleum. This is best effected in the special apparatus shown in the sketch. It consists of a battery of six similar tubes filled with light petroleum. The aqueous solution entering the first tube by A passes over a cone, which breaks it up and causes it to fall in a fine rain through the petroleum. It collects at the bottom of the tube, and passes away through a small internal tube opening just above the bottom and passing out through the top to the second tube. In this way the aqueous liquid is efficiently extracted without admixture of the two liquids. This mode of washing one liquid by another is applicable to the extraction of most of the vegetable alkaloids. The petroleum solution is then agitated in a suitable vessel with the proper quantity of powdered oxalic acid, when the quadroxalate separates out, is collected, and dried, and the light petroleum re-used in another operation.—L. T. T.



### *Improvement in the Manufacture of Acetone.* E. R. Squibb. J. Amer. Chem. Soc. **17**, 187—201.

This investigation has been carried out for the purpose of obtaining acetone by decomposing the vapour of acetic acid. In the earlier experiments, the vapour was passed through a plain tube heated directly by gas burners, the tube in subsequent experiments being filled with a mixture of pumice and barium carbonate. The products of the reaction were passed first through a flask in which most of the water and unchanged acid condensed, and afterwards through a well-cooled receiver in which the acetone accumulated. The gas finally passed through three wash bottles, the middle one of which contained caustic potash, and the others water. By means of a water-pump a minus pressure of 1—6 cms. of mercury was maintained in the apparatus. The best results were obtained by the use of a heated horizontal tube, provided with longitudinal projecting pieces, the whole tube being slowly rotated by means of a water motor. The tube was first charged with barium acetate, and this was heated so long as a distillate was obtained. The vapour from a 60 per cent. acetic acid was then passed through the tube, and successive operations gave yields of 60, 72, and 80 per cent. of the theoretical quantity of acetone. The amount of acetone produced was estimated by the iodoform reaction, and the residue in the tube consisted of barium carbonate. The temperature at which the decomposition takes place is an important feature in the process, but no exact determinations appear to have been made. If it be too low, much undecomposed acid passes over, whilst if too high, inflammable gases are produced, owing to decomposition of the acetone. The paper concludes with a table giving the specific gravities of solutions of acetone at 4°, 15°, and 20° C., containing 20—100 per cent. of acetone. The physical constants given by the author for acetone are as follows:—It boils at 56·3° C. and its specific gravity at $\frac{4^\circ}{4^\circ}$ C. is 0·808157, at $\frac{15^\circ}{15^\circ}$ C., 0·79662, and at $\frac{25^\circ}{25^\circ}$ C. 0·786988. It is a transparent, colourless, mobile, light, inflammable liquid; some specimens had a slight odour of mint, possibly due to an impurity. It is miscible in all proportions with water and alcohol.—T. A. L.

## PATENTS.

### *Process for the Manufacture of Vanilline from Iso-eugenol.* C. D. Abel, London. From Haarman and Reimer, Holzminden, a/d Weser, Germany. Eng. Pat. 11,952, June 20, 1894.

Iso-eugenol is added to a solution of sodium peroxide in water, prepared in the cold way, and the mixture cautiously heated until the reaction is complete. From the alkaline solution, vanillin is disengaged by means of acids, and is purified in the usual manner.

In place of the sodium peroxide, other peroxides may be used, with the addition of an alkaline hydrate solution.
—J. G. W.

### *Improvements in Vessels for containing Volatile Liquids.* P. P. Monnet, Lyons. Eng. Pat. 3265, February 14, 1895.

Hitherto vessels used for storing and distributing volatile liquids, such as ethyl chloride, have only been provided with one aperture, and could not be re-filled. The object of the present invention is to remedy this, as also to facilitate charging and discharging, and is accomplished by making the vessels with at least two openings, through one or more of which the air can escape when the vessel is being filled. The openings may be closed in several ways, as for instance, by a metal cap fitting by a bayonet catch on to a metallic collar; an annular band of rubber passing round the vessel; a tap; or by fusion. To assist in delivering the substance, a number of delivery tubes are provided of suitable shapes for various purposes (spraying, &c.), and fitted with connections corresponding to those on the necks of the vessel.—C. S.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### PATENTS.

*A New or Improved Method of Preparing Drawings and Photographs for Reproduction.* I. J. Rubie and J. E. MacManus, Middlesex. Eng. Pat. 6687, April 3, 1894.

Drawings and photographs are prepared on plates with roughened or serrated surfaces, for reproduction by lithography, photo-lithography, zincography, &c. The serrations of the surfaces referred to are described as being of "tapering sections, or provided with inclined, bevelled, or curved upper surfaces." In the preparation of the drawings and photographs for reproduction as stated, paper, such as French tracing paper, is used, having a backing of metal or equivalent non-elastic material or composition.—W. S.

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*Manufacture of Cellulose Acetate.* C. F. Cross and E. J. Bevan, London. Eng. Pat. 9676, May 17, 1894.

*See under* XIII. *B., page* 496.

## XXII.—EXPLOSIVES, MATCHES, Etc.

*Some Practical Points in the Manufacture of Nitroglycerin.* J. E. Blomén. J. Amer. Chem. Soc. 1895, **17**, 263—277.

To obtain a good yield of nitroglycerin, the materials used must be carefully selected, and should be bought under specifications drawn up and enforced by competent chemists. It is most economical for works to make their own nitric acid, as the mixed acids supplied by contractors are apt to be very irregular in composition, owing to the tendency of the liquid to separate by gravitation, while the iron drums in which they are delivered may be weakened by corrosion. In an experiment with a mixture of 65 per cent. of sulphuric, with 35 per cent. of nitric acid, allowed to stand undisturbed in jars 4 ft. high and 4 ins. in diameter, the sulphuric acid gradually accumulated at the bottom, until after 12 days the lowest layers were found to contain 70 instead of 65 per cent. of $H_2SO_4$. Hence if the manufacturer allow the acids to stand for long before filling the drums, there will be a marked want of uniformity in the supply. To stir the mixed acids with the glycerin, the use of compressed air has been generally recommended. But the author prefers a stirrer or serpentine screw, actuated by an engine under the control of the operator; for he has found that the moisture of the air employed causes a rise of temperature in the vat, and at the same time slightly dilutes the acids at the very moment when they should have the maximum concentration; whilst condensation in, or temporary stoppage of, the air-conveying pipes may cause the sudden introduction of considerable volumes of water. Air at a temperature of 82°, blown through the usual mixture of acids ($3H_2SO_4 : 2HNO_3$) at 86° gradually raised the temperature of the latter to $95\frac{3}{4}$°, after a lapse of five hours. As to the bulk of the charge operated upon, the author prefers to treat the contents of one drum of acids in the proportion above named, or 1,500 lb., at a time, so that the apparatus used should hold this volume of acid with 210 lb. of glycerin, and should have sufficient space above to prevent an accumulation of pressure, but not enough to cause needless attack upon the apparatus by waste acid fumes. Too large a charge is objectionable; it is less under control, it tends to become unduly diluted, repairs are more costly, and the loss entailed by the drowning of a charge is heavy; whilst the use of too small a charge necessitates too much time and labour in cooling the acid mixture and rearranging the operation. Continuous apparatus does not commend itself, because of the difficulty in ensuring uniformity in the acid mixture, and because of the fluctuations in temperature, which increase the danger in manipulation. Moreover, a small jet (such as is used) is easily stopped up, and then in a moment the point of safety may be passed.

*Separators.*—A sufficient number of separators must be used to allow of the first one being emptied whilst the last is being filled; and they should therefore each hold one charge of the converter. An ordinary wooden tub, lined with lead of 10 lb. to the square foot, and drawn to funnel shape, or with an inclination of 6 in. at the bottom, is most convenient; it is best circular in shape, so that only one lead joint is necessary. The faucets of the separators should be of earthenware, well ground, and well smeared with vaseline. Their position is determined with difficulty, because of the variations in yield and the acid used. If the upper funnel be placed too high, much nitroglycerin may have to be dipped out, but if too low, an amount of acid may be drawn off that would be dangerous to the wash house. Dipping, however, with enamelled iron casseroles, is soon accomplished, and moreover helps the separation (by agitation); it requires great care if loss is to be avoided.

If the separation require more than $1\frac{1}{2}$ hours, either the glycerin is inferior or the conversion faulty. The presence of calcium or alkaline salts, or fatty acids in the glycerin, gives rise to worm-like particles, which oscillate between the acid and nitroglycerin, and so far hinder separation, that it is better to drown the whole charge. The last 2 ins. in the separator always contain enough acid to heat the wash-water unduly, and should therefore be drowned. The temperature of each separator should be registered by the attendant every 15 minutes, on pain of instant dismissal, although, as a matter of fact, the temperature rarely rises seriously, if the charge is run down from the converters at 17° to 19° C. Before leaving the separator house the charge should be immersed in, and stirred for a few minutes with cold water, to remove some of the free acid, and thus to avoid danger of explosion through friction, or through the presence of water, in the pipes.

*Wash House.*—A conical wash tub of knot-free wood (preferably cedar), of a size sufficient to treat only a half converter charge is recommended; for the treatment in the separator requires far more time than the washing. The wash-water should be introduced gradually, and caused to bubble through the nitroglycerin; if the charge has been properly separated and submitted to a preliminary washing, one treatment with at most twice its volume of water will suffice at this stage. Wooden stirrers may be used, but compressed air is preferred. The faucets may be made of cedar. To remove last traces of acid two pails full of weak alkali, containing 5 lb. of soda ash in 50 galls. of water, for every 460 lb. of nitroglycerin, are run in from a tub standing a little higher than the wash-tub. After removing the soda solution, one washing with water should suffice to finish the product, which must then be tested by means of litmus paper, two papers being used, one dipped in the nitro compound and one in distilled water, for comparison. This is found to be the safest test to entrust to workmen. All wash-waters should be run into a large settling tank before discharge, to deposit the nitroglycerin which they always carry over. In cleaning up the washing tank, the grey sediment of salts and fatty acids is allowed to stand in felt filters, for the recovery of entrapped nitroglycerin.

The drowning tank must not be too large, not only because repairs are more often required and paralyse work more seriously, but because a great pressure of water is apt to spring the boards, and leave crevices, into which acidulated nitroglycerin may enter, and by attacking the wood generate sufficient heat to fire the charge. Yet it must be large enough to drown a charge with safety. It is best to have two medium sized tanks, which may be connected with each other, or with the apparatus, separators, or wash house, individually, at will. But each should then be sufficient to meet an emergency, whilst the other is under repair.

The storage tank should be placed on a platform scale, so that the work may be checked by weighing at any time. The nitroglycerin is best drawn off through a rubber hose, attached to a faucet, and long enough to reach to the top of the tank outside, where it is clamped when not in use; to fill a bucket, the end of the hose is bent sharply over with both hands to close it until it is lowered to the level of the bucket, it may then be released gently; afterwards the mouth of the hose is wiped and returned to its original position. In this way the danger of constantly turning faucets is obviated.

It is of the utmost importance that no direct pipe connection should exist between any two departments, unless between the drowning-tank and the converter, and this should on no account pass through the separator house. All other connections should be made by lead pipes or rubber hose, with a gap of at least 12 ft. between the houses, which may be temporarily bridged by means of rubber hose and short glass tubes. Disconnection must be insisted upon directly a charge has been passed, a lead-lined tray being suspended beneath the upper broken end to receive drippings. Only thus is there a chance that fire or explosion in one house may be isolated. From the storage tank to the dynamite mixing-houses the nitroglycerin must be conveyed by buckets, never by pipe-lines. Indurated fibre may be used for buckets, if such buckets be tared weekly. Messrs. Roebling and Sons, on the advice of Munroe, have found it expedient to use a trolley system for carrying the material from the storage tanks. The safe distance between houses depends upon local conditions: if the ground is marshy, or if banks may be raised between them, they may be brought closer together than would otherwise be safe. They should be of the lightest construction, yet well roofed to ensure equable temperature. The drowning-tank should be at a low level and in close proximity to both converting and separating houses. In the latter, and in the wash-house, the floor should be lined with lead and kept scrupulously clean.

The spent acids are sometimes used for the manufacture of fertilisers from insoluble phosphates; but in America they are usually "regained" by passing them through coke or brick-filled towers, where they meet a current of steam. The nitric acid, however, which leaves the top, and the sulphuric acid running from the bottom, are thus much diluted. It is best to add the mixture to a charge of sodium nitrate and strong sulphuric acid, and thus recover the whole of the nitric acid at the strength required for subsequent work. It is sometimes urged that the presence of nitroglycerin in the acids would render this process dangerous, but if the separation has been well performed, and the acids have stood for long before use, there should be practically no nitroglycerin present, and any trace that there might be, could be decomposed by exploding a strong cap in the waste-acid storage vessel, whilst if there were a little present at the end it would be broken up in the retort by the sulphides formed. (Sulphides, it is stated, are the best decomposers of nitroglycerin known.) By treating the waste acids *in vacuô* in a small iron still heated by an iron coil, until they had lost about one-sixth of their volume, the author found that they had lost 24 per cent. of the original acid, but were of such strength that an addition of nitric acid sufficed to render them serviceable for a fresh conversion. He thinks that this may be developed into a recovery-process for works which have no nitric acid plant. The still and coil lost nothing in weight, because it is found that iron is only acted upon by the waste acid in the presence of air. Waste wash-waters may be dealt with by running them into a clean, porous-bottomed ravine far removed from all sources of water supply; or it is best (if limestone be available) to form a large excavation by blasting, fill it with limestone, and run the water into this.—W. G. M.

*Examination of Glycerin for Use in the Nitroglycerin Manufacture.* G. E. Barton. J. Amer. Chem. Soc. 1895, **17**, 277.

*See under* XXIII., *page* 516.

## XXIII.—ANALYTICAL CHEMISTRY.

### *APPARATUS, ETC.*

*A Dephlegmator for Fractional Distillation in the Laboratory.* S. Young and G. L. Thomas. Chem. News, 1895, **71**, 177.

The authors have for some time made use of a dephlegmator (Fig. 1) consisting of a glass tube, about 18 mm. in internal diameter, sharply constricted at intervals of about 8 cm. (The constrictions may be formed by heating the tube, kept in regular and rather rapid rotation, with a small blowpipe flame, then producing a partial vacuum in the tube by drawing in with the breath.) On the constricted portions of the tube rest discs of platinum-gauze, through the centre of which pass glass tubes of the form and dimensions shown in Fig. 2.

FIG I

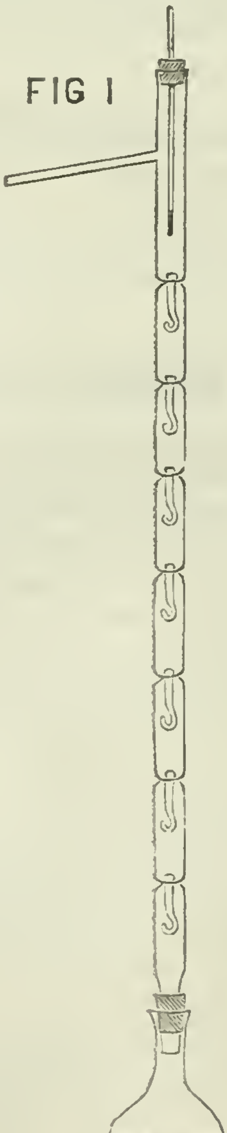
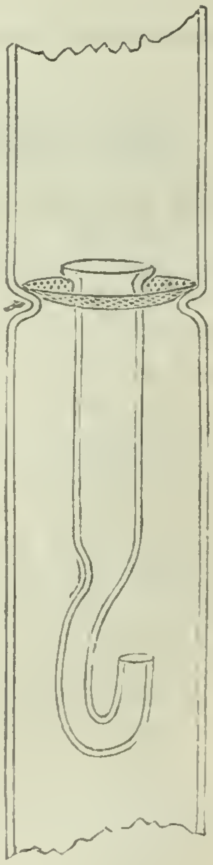


FIG 2



The vapour passes through the condensed liquid resting on the platinum discs, and the excess of liquid flows down the tubes, resting on the discs.

While the distillation is proceeding, the pressure of the vapour forces the liquid up into the wider part of the dropping tubes; if the tubes are too narrow above the head of liquid, there is danger of bubbles of vapour being caught and carried down, so as to empty the tubes, when the ascending vapour might find an easier passage through the tubes than the gauze. With the tubes constructed as shown in the diagram, this has never been found to occur.

As soon as the distillation is stopped, the level of the liquid falls to that at the lower end of the dropping-tubes, and this small quantity of liquid is easily recovered by removing the dephlegmator from the flask, and sending a small, but sharp, blast of air through the side tube.

In order to test the efficiency of the dephlegmator a mixture of 200 grms. of pure benzene and 200 grms. of pure toluene was distilled—(1), from an ordinary distillation-bulb with a still-head 30 cm. long (from the bulb to the side tube); (2), from a flask with a plain still-head, 110 cm. in length; (3) from a flask with a dephlegmator of the same length with seven constrictions.

The results are given in the table below:—

| Temperature Corrected to 760 Mm. | Weight of Fraction in Grms. | | |
|---|---|---|---|
| | Short Still-Head. | Long Still-Head. | Dephlegmator. |
| 80·2 to 83·2 | 0 | 0 | 36·5 |
| 83·2 „ 86·3 | 0 | 1·2 | 99·6 |
| 86·3 „ 89·4 | 9·0 | 48·4 | 22·3 |
| 89·4 „ 92·5 | 99·4 | 94·4 | 20·3 |
| 92·5 „ 95·6 | 86·9 | 51·8 | 18·8 |
| 95·6 „ 98·7 | 54·8 | 36·3 | 19·5 |
| 98·7 „ 101·8 | 35·8 | 30·6 | 15·1 |
| 101·8 „ 104·8 | 30·0 | 26·4 | 5·3 |
| 104·8 „ 107·9 | 30·9 | 22·0 | 18·9 |
| 107·9 „ 110·3 | 53·0 | 51·9 | 36·5 |
| 110·3 „ 110·9 | | | 40·1 |
| Pure toluene 110·9° | .. | 36·2 | 66·1 |
| | 399·8 | 399·2 | 399·0 |

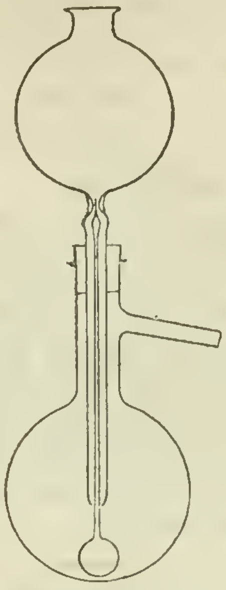
It will be seen that the separation with the long still-head is considerably better than with the short one, but that neither of the plain still-heads can compare at all in efficiency with the dephlegmator.

After three additional fractionations with the dephlegmator, 175 grms. of pure toluene and 60·8 grms. of pure benzene were recovered; two further fractionations of the partially purified benzene brought up the weight of the pure substance to 174·4 grms. The weight of each pure substance recovered amounted, therefore, to over 87 per cent.

The authors are at present using a dephlegmator 125 cm. long with 12 constrictions, the flask being supported by a retort-stand and clamp on the floor, the condenser standing upon the working table.

### *Constant-Level Apparatus.* J. C. Chorley. Analyst, 20, 1895, 16.

This apparatus was designed for use in distillations where it is advisable to maintain a constant level in the distillation flask. The small bulb at the end of the long thin tube floats on the surface of the liquid. Its upper end, which is ground, fits into the thickened part of the larger tube, and prevents the water contained in the large bulb from flowing into the flask. When the level of the liquid falls, the upper end of the long thin tube drops away, and releases a small quantity of water. In this way the level is automatically obtained.—L. A.



## *INORGANIC CHEMISTRY.—QUALITATIVE.*

### *Thio-Acetic Acid as a Substitute for Sulphuretted Hydrogen in Qualitative Analysis.* R. Schiff and N. Tarugi. Ber. 1894, 27, 3437.

The authors propose to replace the disagreeable sulphuretted hydrogen by thio-acetic acid, which is easily prepared by the action of glacial acetic acid on phosphorus pentasulphide. It has a boiling point of 95° C., an unpleasant smell, and is but little soluble in water. A solution of ammonium thio-acetate added to an acid solution of the metals of the second group, precipitates them instantaneously and completely if the liquid be warmed nearly to boiling, only a slight smell of sulphuretted hydrogen being evolved. Even arsenic acid is precipitated without difficulty. If $\frac{1}{2}$ to 1 grm. of substance have been taken for analysis, 1·5 to 2 c.c. of a 30 per cent. solution of the ammonium thio-acetate will be sufficient for complete precipitation. In presence of hydrochloric acid, thio-acetic acid decomposes into "nascent" $H_2S$, acetic acid, and ammonium chloride; it consequently introduces no harmful ingredients into the solution. As the ammonium thio-acetate solution becomes turbid on standing, it is advisable to make it up fresh (from the acid) pretty frequently. The paper concludes with a description of the reactions of different metals with thio-acetic acid. In most cases they are the same as the reactions with sulphuretted hydrogen.

Notable exceptions are the following:—In hydrochloric acid solution, arseniates (on warming the solution) are instantaneously precipitated as $As_2S_3$. Silver chloride, bromide, and iodide warmed with the thio-acetate, are completely converted into silver sulphide.—T. E.

### *Qualitative Separation of Nickel and Cobalt.* A. Villiers. Comptes rend. 1895, 120, 46—47.

This method is based on the solubility of nickel sulphide in sodium sulphide (see page 521). Tartaric acid, and then a large excess of soda, is added to the solution containing the two metals, but which must be free from other metals precipitable as sulphides, and from ammonia and potash. The tartaric acid prevents the precipitation of the nickel and cobalt by the soda, and sulphuretted hydrogen is then passed in to *complete saturation* of the liquid. If cobalt be present, it is precipitated as sulphide, whilst the presence of nickel is shown by the black or, with traces only, brown colour of the filtrate. The reaction is a very useful and reliable qualitative test, but cannot be used for quantitative purposes, as the cobalt carries down traces of the nickel with it, and the nickel retains in solution traces of the cobalt. If the cobalt solution be excessively weak, no precipitation, but a brown coloration may occur unless care is taken to use a large excess of soda.—L. T. T.

### *Separation of Arsenic, Tin, or Antimony from Lead, Copper, Silver, Cadmium, Cobalt, Nickel, &c.* P. Jaunasch. Ber. 1894, 27, 3335.

The author (together with Mr. F. Schmitt) is occupied with further experiments on the method described by him for the quantitative separation of arsenic from other metals. (This Journal, 1894, 905.) The substance is placed in the glass apparatus formerly described, dissolved in nitric acid or aqua regia, dried, and distilled in a current of hydrochloric acid gas. The whole glass apparatus is transferred to an air-bath, in which it can be heated to any temperature up to 450°. The arsenic chloride which distils over is collected, and the arsenic determined. The method is also applicable to stannic chloride, and experiments are in progress on this point.—T. E.

## *INORGANIC CHEMISTRY.— QUANTITATIVE.*

### *Estimation of Iron and Alumina in Phosphate Baking Powders.* K. P. McElroy. J. Amer. Chem. Soc. 1895, 17, 260—263.

In the author's modification of Ogilvie's method for the estimation of iron and alumina in phosphate baking-powders, the filtrate from the phospho-molybdate precipitate was treated with ammonia, the resulting precipitate was redissolved in nitric acid, and again thrown down with ammonia; it was then dried, ignited, and weighed. The author now finds that, although the process very often gives good results, it is under some circumstances unsatisfactory. Trial experiments with weighed quantities of ferrous sulphate, peroxidised by means of bromine, mixed with sodium phosphate, and treated as usual, give a slight *plus* error. But when calcium nitrate was also added, there was a mean increase of 5·4 mgrms. on 57 mgrms. taken, which was due to calcium molybdate, co-deposited even in the second precipitation. With 35·6 mgrms. of $Al_2O_3$ as ammonia alum, and 100 mgrms. of $P_2O_5$ as sodium phosphate, the weight of alumina recovered was only 28·9 to 29·3 mgrms.; whilst in a parallel experiment, in which 400 mgrms. of CaO, as calcium nitrate, were also added, the precipitation of calcium molybdate again occurred, and the actual alumina found varied from 19·8 to 20·6 mgrms., showing a mean loss of 43 per cent.—W. G. M.

### *Determining Chromium in Chrome Ore.* E. Clark. J. Amer. Chem. Soc. 1895, 17, 327—330.

Half a grm. of the finely-crushed ore is placed in a 50 c.c. (or larger) platinum crucible, and covered with 25 grms. of potassium bisulphate. The mixture is heated to fusion, at first very gently, and over a low Bunsen flame provided with a sheet-iron chimney; when fused, the contents are caused to flow around the crucible walls, and the temperature is gradually raised to fair redness, the flowing operation being repeated at intervals of 10 minutes for 40 minutes, by which time the action should be complete. The fusion is now rapidly poured in a thin layer upon the bottom of a 4 or 5 in. platinum dish, which is then covered with a watch glass, and cooled as quickly as possible by part immersion in cold water. The crucible and lid are transferred to a 12-oz. beaker. 35 c.c. of hydrochloric acid (sp. gr. 1·2) and 25 c.c. of water are next poured into the dish, and the mixture is boiled until solution is complete (15 mins.). The liquid is now poured into the beaker containing the crucible, where it is heated until the latter can be washed free from the bisulphate fusion. After settling, the clear liquid is poured into a second 12 oz. beaker, and the residue is heated on the steam-bath with 15 c.c. more hydrochloric acid, until only silica is left undissolved. The two solutions are filtered and the residue is weighed as $SiO_2$. The united filtrates are made alkaline with ammonia, and the precipitate of chromium, iron, and aluminium hydroxides is heated in the liquid, until most of the free ammonia is expelled. It is then filtered and re-dissolved (without washing) in the same beaker, reprecipitated, and washed, the mixed filtrates serving for the estimation of lime and magnesia. The precipitate is attacked (with the filter paper) with 50 c.c. of nitric acid (sp. gr. 1·42) in a 4½ in. covered porcelain dish, with the aid of a Bunsen flame. Little by little finely-powdered potassium chlorate is introduced, care being taken that no loss is occasioned by the slight explosions which occur. The change of colour indicates the progress of oxidation; when complete, a slight excess of chlorate is added, the solution is transferred to a 12 oz. beaker, made up to 150 c.c. with water, and treated with ammonia in excess. It is then filtered into a 16 oz. beaker, the precipitate of iron and alumina is redissolved and reprecipitated, and the two metals are determined in the usual way. The yellow filtrates, containing the chromium, as chromate, may either be reduced with sulphurous acid, and precipitated with ammonia, after boiling off the excess of sulphur dioxide, or they may be acidified at once with excess of acetic acid, and the chromic acid precipitated by an excess of lead acetate. The chromium hydroxide or lead chromate is weighed in the usual way.—W. G. M.

### *Superiority of Barium Hydroxide Solution as an Absorbent in Carbon Determinations in Steel.* J. O. Handy. J. Amer. Chem. Soc. 1895, 17, 247—251.

The error introduced by varying atmospheric conditions when the ordinary potash absorption bulbs are weighed, is sometimes great as compared with the amount of carbon dioxide absorbed, unless special precautions are used. To obviate this error, McKenna has used barium hydroxide as absorbent in a special apparatus to which the precipitated carbonate should not adhere, but from which it is finally filtered, and then washed, ignited, and weighed. The author prefers to titrate the excess of unaltered barium hydroxide at the end of the operation. For titration, oxalic acid may be used directly, or sulphuric acid after filtration, in either case with phenolphthalein as indicator, but with oxalic acid the end reaction is not sharp. The combustion tube, containing the carbon residue from the steel, is connected, first with a U-tube with calcium chloride in the first limb and copper sulphate in the other, and through this with two absorption tubes, each containing 50 c.c. of standard barium hydroxide solution (20 grms. to the litre). The absorption apparatus consists of a $\frac{5}{8}$-in. glass tube, 15 in. long, inclined at an angle of 20° to the horizon, and connected, immediately at the upper end, by a bend, with a vertically-axed bulb 2 ins. in diameter with a tubulure above; and at the lower end by an inch of $\frac{3}{16}$-in. vertical tube leading to a similar bulb, terminated above in a 3-in. length of upright $\frac{3}{16}$th tube, bent over horizontally at the top. In filling the tubes and storage bottles, laboratory air must not be allowed to come in contact with the baryta water. By attaching a potash bottle and calcium chloride tube to a blast pipe, an ample supply of purified air can be had. In filtering off and washing the barium carbonate precipitate, it suffices to direct a jet of such air upon the surface of the liquid as it filters. Pure water, free from carbon dioxide, must be employed, an ordinary wash bottle not being available. Decinormal sulphuric acid is used, 1 c.c. corresponding to 0·0006 grm. C. Ten grms. of steel with 0·06 per cent. C.; 5 grms. of one with 0·2 per cent. C. or 1 to 2 grms. of one with a higher percentage of carbon, are suitable weights to take, as it is not desirable that the volume of barium carbonate be excessive. —W. G. M.

### *Determination of Zinc.* P. W. Shimer. J. Amer. Chem. Soc. 1895, 17, 310—312.

To avoid the troublesome separation of manganese from zinc in zinc ore determinations by the ordinary process, 0·8 grm. of the ore is dissolved in hydrochloric acid (if manganese or zinc spinels be present, a fusion must be made), and the solution is evaporated to dryness, re-dissolved, and filtered from silica. When silica is not to be determined, it need not be filtered. The residue is re-dissolved in nitric acid (sp. gr. 1·2) and evaporated to moist dryness, 100 c.c. of strong nitric acid are added, and the manganese is precipitated as dioxide by means of potassium chlorate, as in Ford's method for steel analysis. The dioxide is filtered, with the aid of the pump, through purified asbestos, and washed first with strong nitric acid, and then with cold water. The manganese precipitate is dissolved in standard ferrous sulphate solution, and the excess of the latter is titrated back with standard permanganate. The manganese being thus determined, the filtrate from the dioxide is evaporated to dryness, hydrochloric acid is added, and the solution is once more evaporated to moist dryness, and diluted. From this the iron is separated by double precipitation as basic acetate, and the filtrates, after evaporation to 300 c.c., are boiled, and then treated with hydrogen sulphide gas for half-an-hour. The zinc sulphide, after filtration, is re-dissolved and re-precipitated as zinc-ammonium phosphate, which must be ignited cautiously at a low red heat to prevent fusion of the pyrophosphate and a probable cracking of the crucible at the moment of solidification. If lime is to be determined in the filtrate from the zinc sulphide, the oxalate must be twice precipitated, as the first precipitate will contain alkaline chlorides.—W. G. M.

### *The Addition of Calcium Chloride to the Solution of a Manure in the Determination of Potash.* R. de Roode. J. Amer. Chem. Soc. 1895, **17**, 46.

H. A. Huston proposed adding calcium chloride solution to the dissolved manure in determining potash, in order to form tricalcium phosphate with all the phosphoric acid present, so as to be able to use platinum dishes in the Lindo-Gladding method. When ammonia is added to a solution so treated, the filtered solution is found to be free from phosphoric acid, but if ammonium oxalate or carbonate be added as well as calcium chloride and ammonia, a filtered portion of the solution will be found to contain phosphoric acid, owing to the interaction of the calcium phosphate with the ammonium salt. To make the calcium chloride effective, it is necessary to filter after adding the calcium chloride and ammonia, and to add the ammonium oxalate or carbonate to the filtrate. There is then nothing gained by the method.—N. H. J. M.

### *Determination of Potash in Manures.* W. E. Garrigues. J. Amer. Chem. Soc. 1895, **17**, 47—51.

The manure (10 grms.) is made into a paste with sulphuric acid and ignited in a platinum dish, raising the heat gradually, and finishing with a blast until the residue is white, or if there is much iron, red. The residue is then ground to a fine powder, a little hot water added, and the mass triturated for a few minutes. It is then boiled with water (250 c.c.) for half-an-hour, and precipitated with 10 per cent. barium chloride solution, adding 5 c.c. at a time and boiling after each addition. A drop of phenolphthalein solution is next added and sodium carbonate, drop by drop until a permanent rose colour is obtained. It is boiled for a minute, allowed to cool and made up to 500 c.c. The solution is filtered, 50 c.c. of it (corresponding with 1 grm. of substance) made slightly acid with hydrochloric acid, and evaporated with platinum chloride. The precipitate is washed with alcohol (sp. gr. 0·848) dried and weighed.

Manures containing chlorides or nitrates have to be carefully treated with sulphuric acid to avoid loss. The ignited mass must be very finely powdered to prevent the enclosure of the potassium sulphate in calcium sulphate. It is important to avoid adding an excess of sodium carbonate. A Gooch's crucible is recommended for filtration and weighing.

Analyses of samples of known composition are given and compared with results obtained by Gladding's and the Stassfurt methods. The method, like the other methods in use, does not return all the potash, but it seems to be as accurate as any, and certainly gives better results than the Lindo-Gladding method, besides being quicker. The only disadvantage is the necessity of using a greater amount of platinum chloride.—N. H. J. M.

### *Estimation of Ferric Oxide and Alumina in Mineral Phosphates.* W. Hess. Zeits. angew. chem. 1894, 701—708.

The precipitates obtained by the Glaser-Jones method and by the acetate process seldom have a uniform composition, and in no case corresponded exactly with the formula—

$$Al_2(PO_4)_2 + Fe_2(PO_4)_2,$$

owing to the partial decomposition of the normal phosphates originally formed during the washing with hot water, and the resulting production of basic phosphates. For this reason the phosphoric acid must be determined in the precipitate by the citric acid or molybdate methods.

Glaser's statement that precipitates free from lime can be directly obtained from solutions of mineral phosphates by the acetate process was not confirmed; such precipitates can, however, be obtained by repeated precipitation with acid ammonium acetate at 70°, and with addition of phosphoric acid. There is no appreciable loss of alumina. The results are as good as, or better than those obtained by the alcohol method, and the process is, moreover, a quicker and simpler one.—N. H. J. M.

### *Determination of Phosphoric Acid.* H. Pemberton, jun. J. Amer. Chem. Soc. **17**, 178—181.

The author calls attention to one or two points in reference to the method for determining phosphoric acid by the alkalimetric titration of the yellow precipitate, which has been the subject of a report by the Association of Official Agricultural Chemists (Washington, 1894). In standardising the alkali against acid, phenolphthaleïn must be used as an indicator and not methyl orange. As regards the precipitation of the phosphoric acid by the molybdate solution, it is only necessary to heat the solution to boiling at the commencement of the operation, the lamp afterwards being withdrawn. The molybdate solution is then run in slowly, so as to obtain the precipitate in as granular a form as possible. It is filtered by means of a suction pump and thoroughly washed. Some modifications of the precipitation process are alluded to, details of which are given in the report above mentioned. This volumetric method is said to give results quite as trustworthy as those obtained by gravimetric methods (cf. this Journal, 1894, 667).—T. A. L.

### *Improved Methods of Water Analysis.* S. A. Bachman. J. Amer. Chem. Soc. 1895, **17**, 296—303.

In the Wanklyn process many errors are said to be liable to creep in owing to imperfect condensation and to contamination of the distillate by impurities from the air. Mallet's proposal to prolong the action of the permanganate by the addition of so-called ammonia-free water is also risky. The author therefore employs the apparatus shown in Fig. 1, in which the litre flask A, containing the water to be tested, is immersed in a saline bath, heated by two burners, and is fitted with an accurately ground bulb stopper; through this are sealed two tubes, one reaching to within half an inch of the bottom of the flask, and connected outside with the 250 c.c. burette C; the other, joined to a 50 c.c. burette B, and passing to within three inches of the bottom; whilst a side tube is prolonged and coiled to form the condenser worm D, which delivers through one of two perforations in the rubber cork of the receiver E, a Will and Varrentrapp bulb F, being connected with the other perforation. The apparatus is used under greatly reduced pressure, and all joints and stopcocks must be ground so as to remain tight without a lubricant. The whole may be raised, lowered, and fixed in position with the aid of the thumb-screw shown in the sketch. In use, after rinsing the apparatus with ammonia-free distilled water, 500 c.c. of the water under examination are placed in the flask, and, after making the connections, the flask is lowered into the heating bath; the receiver is then attached, and the Will and Varrentrapp bulbs, filled with Nessler solution, are placed in position, and connected with the pump. The partial vacuum is gradually established, the sodium carbonate solution is added through the smaller burette, and distillation is continued until 200 c.c. have passed over, which is then Nesslerised for free ammonia. The exhaust tube is now disengaged, and about 250 c.c. of the residual water in A are drawn up into the larger burette; after re-connecting A, 50 c.c. of alkaline permanganate solution are run into the residual 50 c.c. of water in A, and distillation is continued slowly until 30 to 40 c.c. have come over; the stopcock of the burette C is now partly opened, so that the water drops in at the same rate that distillation proceeds, which must not exceed 50 c.c. in 15 minutes (50 c.c. in 10 minutes entails loss by imperfect condensation). When 250 to 300 c.c. have distilled over, the distillate is Nesslerised. The author uses the same apparatus for a modified Kjeldahl process as follows:—300 c.c. of the water are placed in A, and the connections are made as usual; 10 c.c. of specially prepared strong sulphuric acid are added, drop by drop, from the burette B; then, after digestion at 85° C. for an hour under reduced pressure, the solution is boiled until colourless. It is then rendered strongly alkaline by the addition, through B, of 50 c.c. of a strong (ammonia-free) sodium hydroxide solution. 250 c.c. of the contents are then drawn up into C; 50 c.c. of permanganate solution are added through B, and distillation and Nesslerising are carried on as above described. By this process, rosaniline hydrochloride gave 96·9 per cent. of the theoretical

Fig. 1.

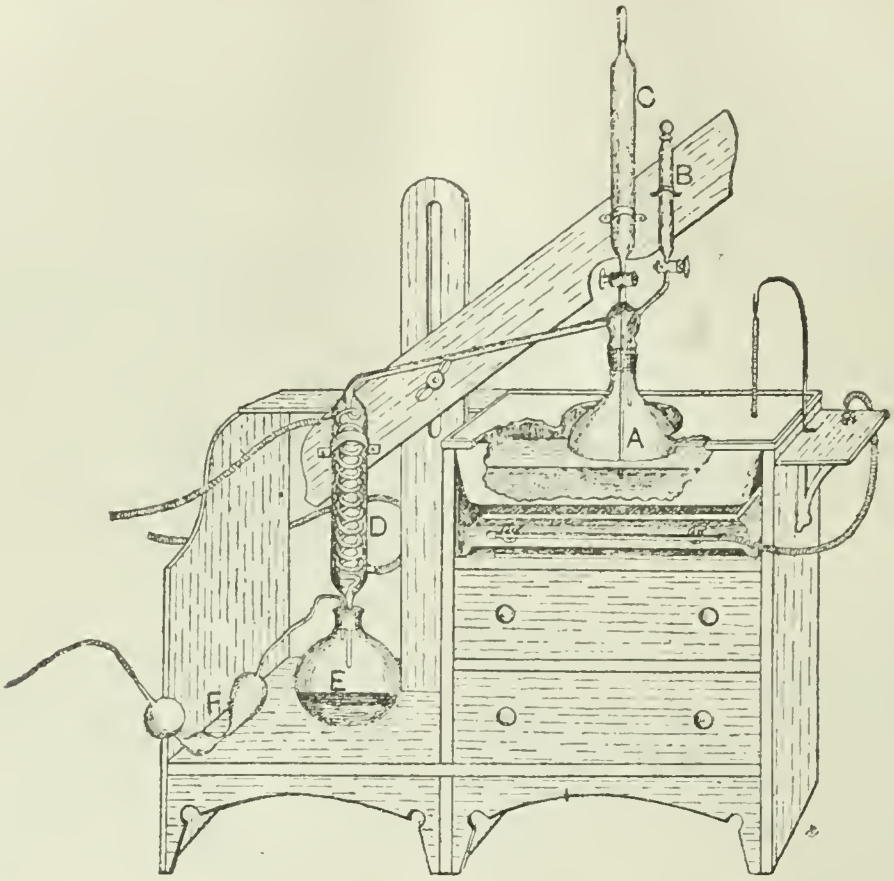


Fig. 2.

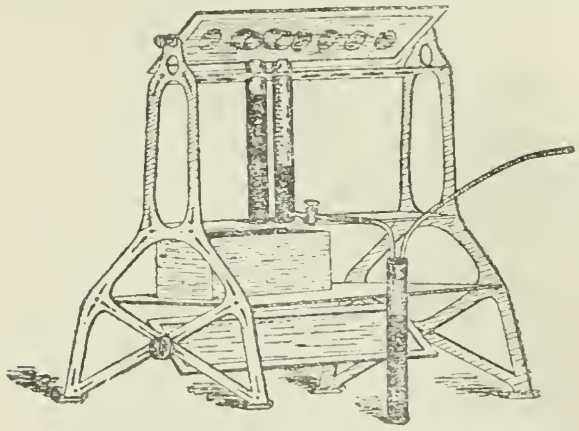
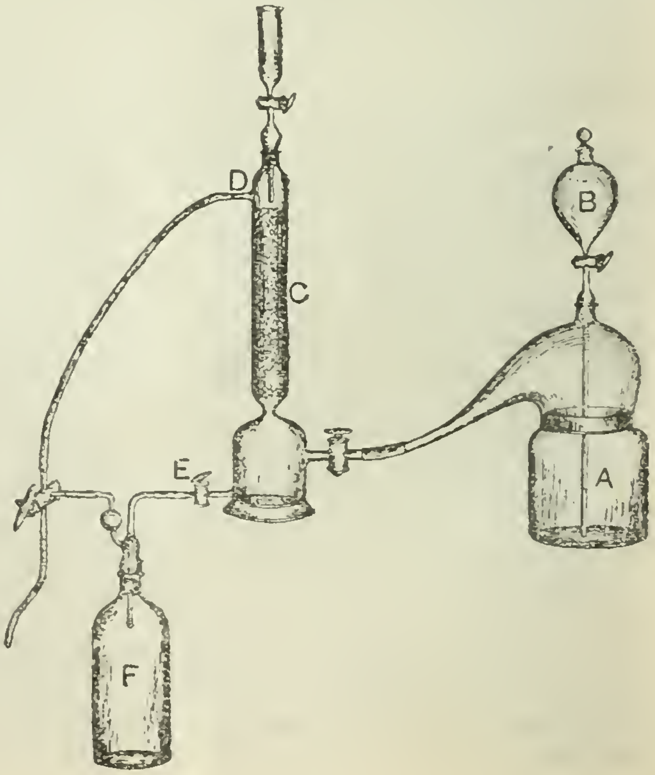


Fig. 3



amount, cyanuric acid (4 hour distillation) gave 91·2; urea, from urine 100·3, and from ammonium cyanate 99·0; and potassium ferrocyanide 59·8 per cent. In Nesslerising, the Leeds comparator, modified by the addition of a stopcock and subsidiary tube, as shown in Fig. 2, is used. The Frankland combustion process may also be arranged with great advantage so as to dispense with evaporation in the open air. Evaporation is conducted in the vessel A (Fig. 3), communicating with the tube C, the upper part of which is filled with broken glass tubing, over which a gentle stream of strong sulphuric acid is kept flowing. A jet-pump connected with a three-way cock maintains a vacuum of 15 mm. in the whole apparatus; this arrangement of cock permits the exhaust to be connected with D normally, but with E momentarily, when it is necessary to discharge sulphuric acid into the bottle F. In use, 200 c.c. of water are introduced into B, and the stopper is closed; A being immersed to a depth of two inches in a water-bath, the water is allowed to trickle through an almost capillary prolongation of B, at the exact rate of evaporation. The vacuum must be very gradually established, and at no time must the water boil.—W. G. M.

### *Analysis of Sodium Peroxide.* L. Archbutt. Analyst, 20, 1895, 3.

If solid sodium peroxide be brought into contact with an acidified solution of potassium permanganate in Lunge's nitrometer, the volume of gas evolved varies, and is very much less than corresponds with the equation—

$$5Na_2O_2 + 2KMnO_4 + 8H_2SO_4 =$$
$$5Na_2SO_4 + K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2.$$

If the peroxide be dissolved in a large volume of cold acidified water, there is always a slight and variable loss of oxygen at the moment of contact; therefore titration with decinormal permanganate gives lew and varying results.

The method recommended by the author is to place a weighed quantity of the sample (about 0·25 grm.) in the dry tube of the nitrometer flask, and in the flask itself about 5 c.c. of pure water containing in suspension a few milligrammes of precipitated cobalt sesquioxide, decomposition by water alone being much too slow and incomplete. The cobalt oxide brings about rapid and complete decomposition of the sodium peroxide as soon as it is brought into contact with the water, and the volume of oxygen evolved is the available oxygen contained in the weight of peroxide taken.

A sample of commercial sodium peroxide taken from a full 14 lb. canister fresh from the maker's works, tested by the above method (except that a small drop of cobalt nitrate solution was used instead of cobaltic oxide precipitate) gave, in three experiments, 18·54, 18·46, and 18·57 per cent. of available oxygen. The same sample contained 78·66 per cent. of sodium oxide, and 0·49 per cent. of alumina and iron oxide. Hence the calculated composition was: Sodium peroxide ($Na_2O_2$) 90·41; caustic soda (NaOH) 8·73; alumina and iron oxide 0·49; total 99·63.

This analysis does not take into account a very little carbonate, a trace of chloride, a minute trace of sulphate, and a few particles of unoxidised sodium which the sample contained. No other impurity was detected.—L. A.

### *Estimation of Tellurium in Copper Bullion.* C. Whitehead. J. Amer. Chem. Soc. 1895, 17, 280—281.

Dissolve 25—50 grms. of the bullion in nitric acid (32° B.), and boil off the excess of acid. Add ferric nitrate solution equivalent to 250 mgrms. of metallic iron. Precipitate hot, with excess of ammonia; filter, and wash completely with ammonia: if necessary, dissolving and re-precipitating. Dissolve the precipitate which contains all the selenium and tellurium as ferric selenite and tellurite, in hydrochloric acid; add excess of tartaric acid; render alkaline with potassium hydroxide, and pass hydrogen sulphide. Filter, and acidify the filtrate, which contains both these elements in solution as sulphides; filter. Dissolve the precipitated sulphides in aqua regia; evaporate dry; take up with hydrochloric acid; and pass sulphur dioxide through the liquid to saturation. Place the covered beaker aside for 12 hours in a warm place; and collect the mixed precipitate of selenium and tellurium on a tared filter; dry at 100°, and weigh. Boil the precipitate in strong potassium cyanide solution, filter, and add hydrochloric acid to the filtrate; the selenium, which then comes down alone as a brick-red precipitate, may be dried at 100° and weighed. The tellurium is determined by difference, or by saturating with sulphur dioxide the cyanide filtrate from the final selenium precipitate, and collecting the tellurium, together with the original residue from the treatment of the mixed precipitate by cyanide, and weighing after drying at 100°.—W. G. M.

### *Action of Hydrogen Sulphide on Antimonic Acid Solutions.* Otto Bošek. Proc. Chem. Soc. 1895 [150], 44.

The complete conversion of antimonious into antimonic compounds by the action of oxidising agents is difficult. Such agents as fuming nitric acid, potassium chlorate and hydrochloric acid, and even bromine in alkaline solution do not produce complete oxidation unless they act for a long time and are used in very large excess.

An excess of an aqueous solution of hydrogen sulphide acting on antimonic acid solution at ordinary temperatures forms antimony pentasulphide, thus showing that exact results are obtained when Bunsen's directions are strictly followed.

When hydrogen sulphide acts on antimonic acid solutions, the quantity of antimony pentasulphide increases (*a*) the lower the temperature, (*b*) the more rapid the stream of hydrogen sulphide; whilst the quantity of antimony trisulphide mixed with sulphur increases (*a*) the higher the temperature, (*b*) the slower the action of the hydrogen sulphide. The quantity of the pentasulphide formed increases up to a certain limit (10 to 20 per cent.) with the amount of hydrochloric acid present, after which it diminishes. Antimonic solutions are more easily and completely reduced by hydrogen sulphide in presence of a chromic salt.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *Delicate and Typical Colour Reaction for p-Amidophenol.* A. Michaelis and P. Luxembourg. Ber. 27, 3005—3009.

According to Hantzsch and Freese *p*-amidophenol after treatment with acetone does not give the typical calcium hypochlorite reaction, but the authors point out that with proper precautions, the test is a very delicate one, one part in 10,000 being readily detected. Para-amidophenol acetate gives the test more readily than the hydrochloride; dilute bleaching powder solution should be used and added gradually, as the violet colour is destroyed by an excess of the reagent. (See also this Journal, 1895, 390.)
—T. A. L.

### *The Phosphomolybdic Acid Test as applied to Lard Analysis.* G. F. Tennille. J. Amer. Chem. Soc. 1895, 17, 33—41.

The phosphomolybdic acid test for the detection of cotton-seed oil in lard was first proposed by Welmans (this Journal, 1892, 548). Schweitzer and Lungwitz (*ibid.*, 1894, 614) found the method of great use, whilst according to Wallenstein (*ibid.*, 1893, 54) tallow gives a green coloration with the phosphomolybdic solution. The author, however, in no case obtained a green colour with tallow and other kinds of beef fat. According to Lewkowitsch (this Journal, 1894, 617) Welmans' reaction can only be employed as a preliminary test. Samelson (*ibid.*, 760) concludes that the test is of no value and that the iodine-absorption figure alone is trustworthy. As regards the iodine figures, they may vary very considerably. American lards frequently do not represent the whole fat of the hog, but only a portion, and fats from different parts of the hog give very variable iodine figures.

A number of lards were examined, and the results are tabulated. They are arranged under the following headings:—The Hübl figures; the Titre; Rise of temperature with sulphuric acid; Bechi and Milliau's silver nitrate tests; Welmans' test; Microscopic test; Free fatty acid and Specific gravity. The Hübl figures varied from 47·7 to 58·6, the increase corresponding approximately with a decrease in the titre. The Hübl figures owe their differences to variations in the composition of the fat; the softer the fat, the greater is the amount of oleic glyceride, and the lower the titre.

It is concluded that the Welmans test is not trustworthy when less than 10 or 15 per cent. of cotton-seed oil is present. When a slight green colour is produced, the presence of cotton-seed oil is not proved, but a deep emerald-green colour indicates almost certainly a considerable addition of vegetable oil.—N. H. J. M.

### *Analyses of Cotton Dyed with Alizarin.* C. Liebermann and P. Michaelis. Ber. **27**, 3009—3019.

This investigation was undertaken in order to work out Liebermann's theory of dyeing (Ber **26**, 1574, this Journal, 1894, 28), since no trustworthy numbers have yet been published as to the relative proportions in which mordant and dye are present on the fibre. The theory derives no support from the present experiments. The method of analysis consists in extracting the dyed material first with ether, which after evaporation gives the "uncombined oil." The pattern is next extracted with hydrochloric acid of sp. gr. 1·125, then with alcohol, and finally with dilute hydrochloric acid. All these extracts are evaporated separately, the residues mixed, with the exception of the oils, and after moistening with hydrochloric acid are extracted with cold water, which leaves the colouring matter and oleic acid undissolved. After drying, the residue is extracted with carbon bisulphide when the colouring matter remains undissolved, and the oleic acid is also weighed after evaporating off the carbon bisulphide. The dilute hydrochloric acid extract obtained above, is again evaporated to dryness, fused with sodium nitrate and carbonate, in order to destroy any traces of organic matter, and the analysis of the mineral constituents (tin, aluminium, calcium), is carried out in the usual manner. Samples of cotton cloth dyed for the market with Turkey-red, Bordeaux, and dark madder violet, were analysed according to the method described, and the results are tabulated. It would appear that shades which are practically indistinguishable as regards strength, shade, and brightness, can nevertheless be produced apparently by very different compounds. A noticeable feature is the large percentage of calcium, which is not entirely due to the presence of the oleic acid, since experiments made without the use of ricinoleic acid also show the same high percentage, and it would appear that the lime is in some way combined with the cotton itself. The analyses made by previous observers have in general consisted of ash determinations, but these, the authors point out, are very untrustworthy, and they lay stress upon the fact that the presence of uncombined mordant on the fibre, a method frequently resorted to, necessarily vitiates an analysis, and for the purpose of analysis, samples should always be dyed to the heaviest possible shade, although technically this may not be always practicable.—T. A. L.

### *Composition and Analysis of Brandies.* X. Rocques. Comptes rend. 1895, **120**, 372—374.

The constituents mentioned in the subjoined table were determined as follows:—*Total acids;* titration with N/10 caustic soda, with phenolphthalein as indicator; acidity expressed as *acetic acid. Ethereal salts;* hydrolysis by ebullition with excess of caustic soda and titration of the residual alkali; results expressed as *ethyl acetate. Aldehydes;* comparison of the colour produced in rosaniline bisulphite solution with that produced by standard ethyl aldehyde solutions; results expressed as *ethyl aldehyde. Furfural;* comparison of the colour produced in aniline acetate solution with that produced by standard furfural solution. *Higher Alcohols;* method of the Paris municipal laboratory. *Ammonia, amides and bases;* evaporation in presence of sulphuric acid and estimation by Kjeldahl's method.

The samples analysed were undoubtedly genuine.

"Eaux-de-Vie de Vins ou Trois-six Genre Montpellier" (14 Analyses).

| —— | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| 1 hectolitre of alcohol at 100° contains:— | Grms. | Grms. | Grms. |
| Total acids.............. | 118·28 | 7·34 | 45·08 |
| Ethereal salts........... | 330·17 | 52·90 | 169·91 |
| Aldehydes.............. | 63·12 | 10·03 | 23·84 |
| Furfural................ | 2·30 | Trace | 0·23 |
| Higher alcohols......... | 384·59 | 78·20 | 192·04 |
| Ammonia............... | 0·33 | 0·08 | 0·18 |
| Ratio: $\frac{\text{higher alcohols}}{\text{ethereal salts}}$ | 2·32 | 0·43 | 1·13 |

"Eaux-de Vie de Marcs de Vins" (10 Analyses).

| —— | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| 1 hectolitre of alcohol at 100° contains:— | Grms. | Grms. | Grms. |
| Total acids.............. | 169·35 | 12·40 | 82·15 |
| Ethereal salts........... | 437·31 | 78·80 | 195·92 |
| Aldehydes.............. | 518·95 | 73·11 | 251·46 |
| Furfural................ | 1·50 | Trace | 0·45 |
| Higher alcohols......... | 333·46 | 46·82 | 217·73 |
| Ammonia............... | 1·41 | 0·32 | 0·50 |
| Ratio: $\frac{\text{higher alcohols}}{\text{ethereal salts}}$ | 2·54 | 0·26 | 1·21 |

Cognacs (11 Analyses).

| —— | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| 1 hectolitre of alcohol at 100° contains:— | Grms. | Grms. | Grms. |
| Total acids.............. | 138·30 | 8·94 | 77·65 |
| Ethereal salts........... | 198·34 | 86·80 | 137·18 |
| Aldehydes.............. | 40·05 | 7·38 | 22·80 |
| Furfural................ | 25·25 | 1·01 | 3·94 |
| Higher alcohols......... | 304·59 | 162·05 | 212·64 |
| Ammonia............... | 8·05 | 0·36 | 1·18 |
| Ratio: $\frac{\text{higher alcohols}}{\text{ethereal salts}}$ | 2·50 | 0·90 | 1·54 |

Rums (9 Analyses).

| —— | Maximum. | Minimum. | Mean. |
|---|---|---|---|
| 1 hectolitre of alcohol at 100° contains:— | Grms. | Grms. | Grms. |
| Total acids | 295·55 | 189·60 | 240·31 |
| Ethereal salts | 381·86 | 152·77 | 275·01 |
| Aldehydes | 30·77 | 17·33 | 23·61 |
| Furfural | 6·94 | 0·90 | 4·23 |
| Higher alcohols | 86·00 | 44·94 | 62·60 |
| Ammonia | 3·70 | 1·87 | 2·85 |
| Ratio: $\frac{\text{higher alcohols}}{\text{ethereal salts}}$ | 0·57 | 0·11 | 0·22 |

The author concludes that the most important constituents to be determined in a brandy for the purpose of ascertaining the origin of the sample are the total volatile substances other than ethyl alcohol, the contents of ethereal salts and higher alcohols, and the ratio of these to each other.—A. G. B.

### *Determination of Cane Sugar in the Presence of Commercial Glucose.* H. A. Weber and W. McPherson. J. Amer. Chem. Soc. 1895, **17**, 312—320.

In the determination of sucrose in glucose, all the official methods necessitate inversion by acids; but as dextrin is frequently present, which is readily hydrolysed to dextrose, and has then only one-fourth of its original rotatory power; and as there may be other similarly alterable bodies also present, very serious errors may be introduced. Of the published processes, the shorter take no cognisance of the so-called unfermentable carbohydrates, and even the longer cannot be deemed satisfactory in this respect, since so little is known about these substances. Working by the method in Thorpe's Dictionary of Applied Chemistry (Vol. III., pp. 661–62), the author analysed nine samples of glucose, and found, approximately, maltose, 22·3 to 55·9 (mean = 43·5); dextrose, 5·8 to 27·5 (mean = 17·0); dextrin, 12·8 to 32·8 (mean = 21·7); and ash, 0·17 to 0·37 per cent. In all these cases excepting one, the maltose exceeded the dextrose in quantity, the highest divergence being seen in a sample marked "Brewers' Extract," in which the percentages were, maltose 47·7 and dextrose 5·8. Three processes were then tried on these samples, such as would be used to invert the sucrose if any were present: namely, the present official method, in which the sample, mixed with the proper amount of acid, is so gradually heated that it only reaches 68° C. after 10 minutes, when the action is considered to be complete; secondly, the older official method, whereby the mixture was heated to 68° for 10 minutes; and, thirdly, the German method, in which it is heated to 67°—70° C. for 15 minutes. These three methods gave differences between the readings, made before and after inversion, of from 0·4 to 0·7 divisions, 1·3 to 1·9 divisions, and 1·8 to 2·4 divisions, respectively. By substituting acetic for hydrochloric acid (see next abstract) no advantage was gained over the first of the above three systems, the differences still ranging from 0·35 to 0·60 divisions on the cane-sugar scale. This error would be equivalent to from 0·1 to 2·0 per cent. of sucrose in an actual determination with a glucose containing cane sugar. Slight though it is, it is so constant that a correction may be advantageously made, which can be found as follows: The reading due to glucose is determined approximately, by subtracting from the direct reading three-fourths of the difference between (or sum of) the direct and invert readings, the temperature being about 20°. Then, if R be the reading due to glucose, the required correction will be $\frac{R - 15}{130}$, which must be subtracted from the numerator $(a \pm b)$ in Clerget's formulæ. Tested with mixtures of glucose and sucrose, ranging from 80.20 to 10:90, the percentage of sucrose found, without applying the correction, showed a *plus* error of from 0·15 to 0·82 per cent., and with the correction of only 0 to 0·18. Hence, the error always introduced through partial hydrolysis of dextrin during inversion is practically obviated. But it is necessary that chemists should adhere to one method of inversion if results are to be comparable.—W. G. M.

### *Rapid Estimation of Starch.* P. L. Hibbard. J. Amer. Chem. Soc. 1895, **17**, 64—68.

The substance is finely powdered, so that the starch may be readily extracted without long boiling, an amount containing at least 0·5 grm. put into a flask with 50 c.c. of water and 1 or 2 c.c. of malt extract. It is at once heated to boiling, being frequently shaken to avoid the formation of clots. After boiling a minute, the mixture is cooled to 50°—60°, 2 or 3 c.c. of malt extract added, and slowly heated for 10—15 minutes until boiling, again partially cooled and tested with iodine solution for starch. If the starch is all converted, the mixture is cooled, made up to a definite bulk and filtered through fine muslin. An aliquot part of the filtrate (containing 0·2 or 0·3 grm. of starch) is boiled with 5 c.c. of 30 per cent. hydrochloric acid, and water to make about 60 c.c., for half an hour on a sand-bath. When cold, the solution is neutralised with caustic soda, and the dextrose determined with Fehling's solution.

F. Salomon (J. prakt. Chem. **28**, 82) found hydrochloric acid to be the best acid for hydrolysis of starch.

Good starch leaves a slight residue, some of which is soluble in dilute acid; it seems to be largely due to other substances than starch.

The method is quick, less than two hours being required, and accurate. The precautions to be observed are prevention of clotting, and rapid heating to avoid lactic fermentation. The method is particularly recommended for cattle foods and starch-factory residues.—N. H. J. M.

### *Estimation of Tannins.* A. Girard. Comptes rend. 1895, **120**, 358—360.

The author originally suggested the use of the middle coat of the sheep's intestine, employed for making violin strings, as a suitable form of animal membrane by which to absorb the tannin from a liquid in which this constituent is to be estimated (Comptes rend. 1882, **95**, 185). Since, in the hands of diverse chemists, the proposed method has given results of widely different degree of accuracy, attention has been turned to the quality of the material as it is to be obtained in the market. It was found that the commercial article contains from 5 to 10 per cent. of soluble salts and some 2 per cent. of fat—constituents which will sufficiently account for the variations in the results obtained when using such a material for the estimation of tannin.

The membrane should be purchased, if possible, before it has been twisted into violin strings and otherwise treated; it should be dried and soaked in sulphurous acid to preserve it. If obtained in this condition it may be cut up and extracted in the cold with absolute benzene until free from fat. After an exposure to air, to allow the benzene to evaporate, the pieces are washed three or four times with cold water and dried at the ordinary temperature, care being taken that they do not adhere to each other. Such prepared material will give reliable results in tannin determinations.—A. G. B.

### *Separation of Solid and Liquid Fatty Acids.* E. Twitchell. J. Amer. Chem. Soc. 1895, **17**, 289—295.

The fatty acids from natural fat insoluble in water are nearly always mixtures of acids of the acetic, acrylic, or of lower, series. Usually solid stearic and palmitic acid alone represent the first group, while the liquid oleic and linoleic acids belong to the other series. Many methods are given for the separation of the solid and liquid acids, but none have proved satisfactory. A comparison of the best is given. In Muter's process (*Analyst*, April 1889) as modified by Lane, and applied chiefly to lard, the neutral potash soaps are precipitated by lead acetate from boiling water; the lead soaps which cling to the sides of the beaker are well washed with boiling water, dried quickly, and boiled with re-distilled ether. The soaps of the liquid acids dissolve, and, after filtration and washing, are decomposed with hydrochloric acid and water. Part of the ethereal solution of the fatty acids which floats on the water, is titrated with sodium hydroxide, and part with v. Hübl's reagent (after evaporation and drying in carbon dioxide). The author finds the iodine absorption of lard to be 56·27, of the fatty acids of lard 58·49 and 59·26, and of the liquid acid obtained by the above process 94·06 (Muter found 94) per cent. But even when stearic and palmitic acids are purified by crystallisation until the iodine number is zero, it is found that 100 c.c. of ether at 25° C. dissolve 0·015 grm. of their lead soaps, which quantity remains dissolved at 0° C. This would cause an error of 1 per cent. in Muter's process, which would probably be increased in the presence of lead oleate. But a more serious objection is that the lead soaps of the unsaturated fatty acids oxidise, even more readily than the free acids themselves, on exposure to air; and such oxidation is necessarily considerable in this process. In Jean's process (modified), 4 grms. of the lard fatty acids in 50 c.c. of 95 per cent. alcohol were mixed with 2·5 grms. of lead acetate in 20 c.c. of the same spirit, both hot; after standing for an hour at the room temperature, and for another hour at 15° C., part of the solution was filtered from the precipitate and treated in a separator with ether and dilute hydrochloric acid; after washing and drying in carbon dioxide, the percentage of liquid fatty acids was found to be 51·82, and their iodine number 103·37. The solid fatty acids obtained from the lead precipitate absorbed 4·90 per cent. of iodine. Clearly part of the liquid acids must have precipitated with the solid acids, as would be expected from the known low solubility of lead oleate even in absolute alcohol. The higher iodine number for the unsaturated acids obtained by this method, show that those found by Muter's process contained either saturated or oxidised fatty acids. Jean also obtained a low figure, but then he did not dry the acids in carbon dioxide. The only solution of the problem at present appears to be presented by a modification of Jean's process, tried and calculated as follows:—4 grms. of lard acids were dissolved and precipitated with lead acetate as described, cooled for one hour to 15° and filtered. 10 c.c. of the filtrate were drawn off, and the fatty acids after separation by hydrochloric acid were dried in carbon dioxide and treated with v. Hübl's solution. The remainder of the solution was cooled to 0° C. for one hour; a further precipitate was thus obtained, which was filtered and washed with 95 per cent. alcohol, the washings being thrown away. The iodine number of the acids in the filtrate from this was also taken; results were as follows:—

| —— | Weight in Grms. | Iodine Number. |
|---|---|---|
| Lard fatty acids............. | .. | 62·57 |
| Fatty acids from filtrate at 15° | 0·2675 (= 46·81 per cent.) | 109·35 per cent. |
| " " precipitate at 0° | 0·1020 | .. |
| " " filtrate at 0° | 0·1915 | 118·02 |

The fatty acid in the precipitate at 0° appeared to be pure oleic acid. The action of lead acetate is therefore rather one of fractional precipitation than of quantitative separation. But the percentages can be calculated from the above numbers. The percentage of liquid acids in the alcoholic filtrate is found from the fraction drawn off, and this is multiplied by their iodine number thus—46·81 × 109·35 per cent. = 51·19. The result is deducted from the iodine number of the original acids, the difference represents oleic acid; 62·57—51·19 = 11·38, which multiplied by 0·9 gives the percentage (12·64) of oleic acid precipitated with the solid acids. This number must be added to that of the liquid acid in the filtrate 46·81 + 12·64, which gives the total liquid acids as 59·45, and their iodine number is $\frac{62\cdot57}{59\cdot45} = 105\cdot2$. But the iodine number 109·35 corresponds to a mixture of 78·5 per cent. oleic with 21·5 per cent. linoleic acids; hence there was 21·5 × 0·4681 = 10·06 per cent. of linoleic acid in the original fatty acids. Röse's method (this Journal, 1887, **6**, 306) gave fair results when petroleum ether that was completely volatile at 80° C. was substituted for ordinary ether, lead stearate and palmitate being much less soluble in this than in the older solvent. But the method is only applicable when the original fat is perfectly fresh.—W. G. M.

### *Examination of Glycerin for Use in the Nitroglycerin Manufacture.* G. E. Barton. J. Amer. Chem. Soc. 1895, **17**, 277—280.

ALLEN'S requirements ("Commercial Organic Analysis") are considered too severe. The tests applied by the author are:—

*For Ash and Carbonaceous Residue* (indicates mineral matter and carbohydrates).—4½—5½ grms. of glycerin are heated in a tared porcelain crucible until ignition occurs; the source of heat is then removed, and the liquid is allowed to burn out. The crucible is cooled in a desiccator and weighed for carbonaceous residue and then ignited for the ash.

*Sodium Chloride.*—100 c.c. of glycerin are rinsed into a porcelain casserole, neutralised with sodium carbonate, and titrated with decinormal silver nitrate in the presence of potassium chromate as indicator; 0·2 c.c. is deducted for coloration, and the sodium chloride contents calculated as usual, the specific gravity of the glycerin being known.

*Total Acid Equivalent* (indicates fatty acids).—100 c.c. of glycerin are diluted to 300 c.c. in a beaker, a few drops of a 1 per cent. solution of phenol phthalein and 10 c.c. of normal sodium hydroxide are added; after boiling, the liquid is titrated with normal hydrochloric acid.

*Higher Fatty Acids.*—A current of nitrogen tetroxide is passed through a portion of the glycerin mixed with twice its volume of distilled water, which is then heated on the steam bath for two hours. The sample must give no precipitate either on dilution or later, as this would indicate the presence of fatty acids.

*Neutrality.*—Not more than 0·3 c.c. of normal hydrochloric acid, or normal sodium hydroxide solution, should be required to produce the change in colour of 50 c.c. of the glycerin, mixed with 100 c.c. of water and a few drops of alcoholic phenol-phthalein.

*Specific Gravity.*—This determination is made with the Sartorius balance at the room-temperature. To reduce to the value at 15° C., add $(t-15) \times 0\cdot00065$, and subtract $0\cdot0003 + (t-15) \times 0\cdot000025\,R$, when $t$ is the temperature of the glycerin, and $R$ the value read from the balance.

*Permanent Specific Gravity* (indicates lighter bodies, mainly hydrocarbons).—The glycerin is heated in a 250 c.c. flask for two hours to 225°—230° C.; the flask is closed by means of a cork with a small perforation, and cooled to the room temperature. A specific gravity determination then gives the required result. A good sample for the required purpose gave the following results:—Ash, trace; carbonaceous residue, 0·012 per cent.; sodium chloride, 0·002 per cent.; total acid equivalent, 0·05347; permanent sp. gr. 1·2653; sp. gr. 1·2634; higher fatty acids, none reaction, neutral.—W. G. M.

## *DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (*Continued from page 397.*)

A. Lehne and A. Rusterholz. Färber Zeit. 1891 *et seq.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 96.<br>Diamine Scarlet. [C.]<br>Direct Red B. [W.N.]<br>(*Animal and Vegetable fibres.*) | *Conc.*:—Fibre reddish-brown, liquid colourless.<br>*Dil.*:—Fibre brownish-red; heated—liquid faint bluish-rose. | *Conc.*:—Fibre immediately dark reddish-violet, liquid the same; on addition of water—fibre redder.<br>*Dil.*:—Fibre reddish-brown; heated—fibre decolorised, liquid orange; with excess of ammonia—lemon-yellow. | *Conc.*:—Fibre and liquid deep violet; on addition of water—both brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre reddish-brown, liquid colourless.<br>*Dil.*:—Heated—fibre bright brown, liquid brownish-yellow; acidified—bluish rose. | Heated—liquid yellowish-red; acidified—reddish-violet. | Fibre brownish red; warmed—colourless. | The colouring matter is extracted on boiling, the resulting solution being yellowish-rose; on adding concentrated hydrochloric acid to the latter, the colour changes to violet. | .. .. |
| 97.<br>Diamine Fast Red F. [C.]<br>(*Animal and Vegetable fibres.*) | *Conc.*:—Fibre immediately violet-black, liquid colourless; on addition of water—fibre dark reddish-brown.<br>*Dil.*:—Heated—fibre Bordeaux-red, liquid faint bluish-rose. | *Conc.*:—Fibre immediately dark violet, then Bordeaux-red, liquid brownish-red; on addition of water—fibre and liquid yellowish-brown.<br>*Dil.*:—Fibre violet; heated—bright brown, liquid yellowish. | *Conc.*:—Fibre violet, liquid blue; on addition of water—liquid rose.<br>*Dil.*:—Fibre darker; heated—reddish-violet. | *Conc.*:—Heated—fibre brownish-red, liquid yellowish-brown.<br>*Dil.*:—Heated—liquid brick-red; acidified—bluish-rose. | Same as dilute soda-lye. | Fibre at first darker; warmed—colourless. | No action. | .. .. |
| 98.<br>Benzopurpurin B. [By.] [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre olive-brown.<br>*Dil.*:—Heated—fibre reddish-brown, liquid colourless. | *Conc.*:—Fibre pale reddish-brown, liquid brownish; on addition of water—fibre violet-grey.<br>*Dil.*:—Fibre immediately yellowish-brown; heated—fibre almost decolorised, liquid yellowish. | *Conc.*:—Fibre dark green; on addition of water—fibre brown, liquid brownish.<br>*Dil.*:—Fibre brown, liquid colourless. | *Conc.*:—No action.<br>*Dil.*:—No action. | No action | Fibre at first brownish-red, then rose, and finally decolorised. | Very little action. | *Nitrous Acid.*—Fibre brownish-black.<br>*Picric Acid.*—Fibre brownish-red. |

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DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 99.<br>Benzopurpurin 4 B. [By.] [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre at first dark blackish-blue, then dark green, liquid colourless; on addition of water—fibre grey.<br>*Dil.*:—Fibre immediately a bluish dark grey colour. | *Conc.*:—Fibre dark brown, liquid brown; on addition of water—fibre dirty brown.<br>*Dil.*:—Fibre greyish-blue; heated—fibre almost decolorised, liquid yellowish. | *Conc.*:—Fibre dark blue, liquid faint blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—No action. | No action | Fibre at first bluish-black, then light grey, and finally decolorised. | No action | *Nitrous Acid.*—Fibre brownish-black, becoming later of a more violet shade.<br>*Picric Acid.*—Fibre dark brown. |
| 100.<br>Benzopurpurin 10 B. [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre at first dark blue, then brighter, liquid colourless.<br>*Dil.*:—Fibre immediately bright blue, liquid colourless. | *Conc.*:—Fibre at first dark blue, then greyish-olive, liquid yellowish.<br>*Dil.*:—Fibre bright blue; heated—almost decolorised. | *Conc.*:—Fibre and liquid greenish-blue; on addition of water—fibre brighter.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint rose; acidified—bluish. | Same as dilute soda-lye. | *In the cold.*—Fibre at first blue, then decolorised. | A very little colouring matter is extracted on boiling. The solution becomes a faint blue tint on addition of concentrated sulphuric acid. | All these colouring matters, which are relatively fast towards soda-lye, are readily extracted by hot soap solution. |
| 101.<br>Deltapurpurine 5 B. [By.] [A.]<br>Diamine Red B. [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately brownish-olive, liquid colourless; on addition of water—fibre brownish-red.<br>*Dil.*:—Fibre immediately brownish-red; liquid—colourless. | *Conc.*:—Fibre brownish-olive (redder than with concentrated hydrochloric acid); on addition of water—fibre reddish-brown.<br>*Dil.*:—Fibre immediately chocolate; heated—fibre brighter, liquid yellowish. | *Conc.*:—Fibre dark blue, liquid faint blue; on addition of water—both fibre and liquid brownish.<br>*Dil.*:—Fibre chocolate, liquid colourless. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint yellowish-rose. | Heated—liquid faint reddish-orange; acidified—brownish. | Fibre at first chocolate, then, in the cold, slowly decolorised. | Colouring matter hardly extracted at all. | .. .. |
| 102.<br>Rosazurin B. [By.]<br>(*Animal and Vegetable fibres.*) | *Conc.*:—Fibre at first olive-brown, liquid colourless; on addition of water—dark reddish-brown.<br>*Dil.*:—Fibre Bordeaux-red, liquid colourless. | *Conc.*:—Fibre and liquid bright brown.<br>*Dil.*:—Fibre immediately dark brown; heated—bright brown, liquid yellow. | *Conc.*:—Fibre and liquid dark blue; on addition of water—fibre reddish-brown, liquid brownish-olive; at its exterior—reddish-violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre darker.<br>*Dil.*:—Heated—liquid faint rose. | No action | Fibre at first dark purple-red, then decolorised. | On boiling—the colouring matter is extracted with the production of a fuchsine-red-coloured solution, which changes to blue on addition of concentrated sulphuric acid. | *Nitrous Acid.*—Fibre dark yellowish-grey; rinsed, and moistened with ammonia—reddish-brown. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 103.<br>Diamine Red N O. [C.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre dark green, liquid colourless; on addition of water—fibre black.<br>*Dil.*:—Fibre immediately dark grey. | *Conc.*:—Fibre dark, dirty green, liquid colourless; on addition of water—fibre dark grey.<br>*Dil.*:—Fibre immediately dark grey; heated—fibre flesh-coloured, liquid colourless. | *Conc.*:—Fibre at first violet, then blue; liquid blue; on addition of water—fibre dark grey.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint rose. | Heated—liquid yellowish-red; acidified—almost decolorised. | *In the cold*—fibre at first dark grey, then slowly decolorised. | Little action | *Acetic Acid.*—Fibre dark reddish-violet tint. |
| 104.<br>Brilliant Purpurin R. [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre greenish-black, liquid colourless; on addition of water—fibre violet-black.<br>*Dil.*:—Fibre black, liquid colourless. | *Conc.*:—Fibre black, liquid colourless; on addition of water—fibre violet-black.<br>*Dil.*:—Fibre black, liquid colourless; heated—fibre almost decolorised, liquid yellow. | *Conc.*:—Fibre blackish-blue, liquid colourless; on addition of water—liquid blackish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—Heated—liquid faint rose. | Heated—liquid bright orange. | Fibre at first dark brown, then slowly almost decolorised; warmed—completely decolorised. | Colouring matter extracted on boiling, with the formation of a yellowish-red solution. | .. .. |
| 105.<br>Azocarmine. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre Bordeaux-red, liquid colourless.<br>*Dil.*:—Heated—fibre somewhat brighter, liquid bluish-red; with excess of soda-lye—brighter. | *Conc.*:—Fibre ponceau-red, liquid bluish-red.<br>*Dil.*:—Heated—fibre orange, liquid bluish-red; with excess of ammonia—brighter. | *Conc.*:—Fibre at first dark reddish-violet, then dark green; liquid green; on addition of water—fibre bright red, liquid bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre somewhat darker, liquid colourless.<br>*Dil.*:—Heated—liquid bluish-rose; acidified—no change. | Colouring matter extracted somewhat on boiling. | Heated—fibre at first Bordeaux-red, then dark violet; liquid violet. | No action | Rosinduline [K.] shows the same reactions. |
| 106.<br>Chromotrop 2 R. [M.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid faint rose, fibre unaltered.<br>*Dil.*:—Heated—fibre brighter, liquid bluish-rose. | *Conc.*:—Fibre more yellowish, liquid rose.<br>*Dil.*:—Heated—fibre at first scarlet, then yellow; liquid faint yellowish colour. | *Conc.*:—Fibre Bordeaux-red, liquid the same; on addition of water—fibre brighter, liquid red.<br>*Dil.*:—Heated—liquid rose. | *Conc.*:—Fibre somewhat darker.<br>*Dil.*:—Warmed—fibre brick-red, liquid rose; acidified—liquid more bluish and intense. | Heated—fibre almost decolorised, liquid rose; acidified—liquid more bluish and intense. | Fibre completely decolorised on warming. | No action | Boiled with potassium bichromate and dilute sulphuric acid—fibre brown; with dark shades, black.<br>Boiled with alum solution (1 : 10)—fibre and liquid violet. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 107.<br>Rubramine. [W.N.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre bright greenish-blue, liquid colourless; on addition of water—fibre and liquid at first navy blue, then reddish-violet.<br>*Dil.*:—Fibre violet, liquid colourless; heated—liquid violet-blue, fibre almost decolorised; with excess of soda-lye—bluish-red. | *Conc.*:—Fibre at first dark blue, then brighter; on addition of water—fibre decolorised, liquid bluish-grey.<br>*Dil.*:—Fibre and liquid blue; heated—fibre decolorised, liquid rose. | *Conc.*:—Fibre green, liquid greenish; on addition of water—the original colour reappears, liquid blue.<br>*Dil.*:—Fibre violet; heated—fibre at first blue, then almost decolorised, liquid blue; with excess of soda-lye—red. | *Conc.*:—Fibre darker, liquid colourless.<br>*Dil.*:—Heated—fibre redder, liquid bluish-red; acidified—faint violet. | Same as dilute soda-lye. | *In the cold.*—Fibre at first blue, then decolorised. | Colouring matter readily extracted on boiling, forming a bluish-red solution, which becomes blue on addition of concentrated sulphuric acid. | Ammonium acetate solution extracts the colouring matter readily, and on addition of concentrated sulphuric acid to the solution a blue coloration is produced. |
| 108.<br>Primuline Red. [B.S.S.] [Cl. Co.] [D.]<br>Ingrain Red.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brownish-red; on addition of water—the original colour restored, liquid yellow.<br>*Dil.*:—Heated—fibre more yellowish, liquid faint yellow. | *Conc.*:—Fibre brownish-red, liquid red; on addition of water—fibre yellowish-red, liquid brownish.<br>*Dil.*:—Fibre more yellowish; heated—liquid yellowish. | *Conc.*:—Fibre and liquid fuchsine-red; on addition of water—both reddish-brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark brownish-red, liquid colourless.<br>*Dil.*:—Heated—fibre dirty brownish-red, liquid rose. | No action | Fibre slowly changed in colour to reddish-brown, and finally to yellow. | No action | .. .. |
| 109.<br>Titan Scarlet. [H.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre Bordeaux-red, liquid brownish-red; on addition of water—liquid brownish.<br>*Dil.*:—Heated—fibre somewhat brighter, liquid yellowish-red. | *Conc.*:—Liquid yellowish-red; heated with subsequent addition of water—fibre reddish-orange, liquid orange.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre and liquid fuchsine-red; on addition of water—both reddish-brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark red, liquid colourless.<br>*Dil.*:—Fibre brighter, liquid dirty bluish-red; acidified—yellowish-red. | Colouring matter extracted on boiling, with the formation of a yellowish-red-coloured solution. | Fibre orange; warmed—colourless, liquid yellowish. | Colouring matter extracted on boiling. | .. .. |
| 110.<br>Alizarine VI. [B.]<br>Alizarine No. 1. [M.] [N.]<br>Alizarine Ie. [By.]<br>Alizarine V. [Bi.]<br>Alizarine Ia. [L. and S.]<br>(*a.*) *On Chromic Mordant.*<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-brown; heated—fibre brighter, liquid yellowish; on addition of water—fibre redder.<br>*Dil.*:—Heated—fibre reddish-brown, liquid brownish; with excess of soda-lye—violet. | *Conc.*:—Fibre reddish-brown, liquid brownish.<br>*Dil.*:—Fibre brownish-red; heated—fibre bright brown, liquid brownish. | *Conc.*:—Fibre darker, liquid red; on addition of water—fibre brownish-red, liquid brownish.<br>*Dil.*:—Heated—fibre brownish-red, liquid reddish-brown; with excess of soda-lye—violet (redder than in the case of the hydrochloric acid reaction). | *Conc.*:—Fibre bluer; heated—fibre reddish-violet; on addition of water—liquid also reddish-violet.<br>*Dil.*:—Fibre bluer; heated—fibre reddish-violet, liquid almost colourless (very pale reddish-violet). | No action | Heated—fibre bright brown, liquid intensely yellow. | No appreciable action. | Gives no fluorescence on boiling with aluminium sulphate (distinction from madder and purpurin). |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Alizarine.<br>(*b.*) *On Alumina Mordant.*<br>(*Vegetable fibre.*) | *Conc.* :—Heated—liquid bright yellow; with excess of ammonia—faint reddish-violet.<br>*Dil.* :—Heated—fibre unaltered, liquid yellow; on protracted boiling—fibre reddish-orange; with excess of soda-lye—reddish-violet precipitate. | *Conc.* :—Fibre immediately orange, liquid yellow.<br>*Dil.* :—Heated—fibre yellowish-orange, liquid faint yellowish. | *Conc.* :—Fibre scarcely altered, liquid intensely yellowish-red; on addition of water—both yellow.<br>*Dil.* :—Heated—fibre scarcely altered, liquid intensely yellow; with excess of soda-lye—violet. | *Conc.* :—Fibre dark red, liquid colourless; heated—fibre of a more bluish shade.<br>*Dil.* :—Heated—liquid faint rose; acidified—no alteration. | No action | Heated—fibre decolorised, liquid yellow. | No action | Spectroscopy—See article by S. von Kostanecki in Post's Handbuch Chem.-Tech. Analyse, II. Aufl. |
| 111.<br>Alizarine S D G. [M.]<br>Alizarine R G and G 1. [B.]<br>Alizarine X. [By.]<br>Alizarine 5 R D. [Bi.]<br>Alizarine No. 10. [N.]<br>Alizarine F A. [L. and S.]<br>(*a.*) *On Chromic Mordant.*<br>(*Animal fibre.*) | *Conc.* :—Fibre reddish-brown; heated—fibre more yellowish, liquid faint yellowish; on addition of water—fibre redder.<br>*Dil.* :—Heated—fibre brownish-red, liquid brownish; with excess of soda-lye—reddish-violet. | *Conc.* :—Fibre reddish-brown, liquid brownish.<br>*Dil.* :—Heated—fibre bright brown, liquid brownish. | *Conc.* :—Fibre darker, liquid cherry-red; on addition of water—fibre and liquid brownish.<br>*Dil.* :—Heated—fibre reddish-brown, liquid brownish; with excess of soda-lye—carmoisin-red. | *Conc.* :—Heated—fibre dark red; on addition of water—fibre brighter, liquid cherry-red.<br>*Dil.* :—Fibre yellower, liquid brownish-yellow; heated—fibre deep red, liquid brownish-red; acidified—almost colourless. | In the cold—fibre yellower, liquid deep brownish tint. | Heated—fibre bright brown, liquid brownish-yellow. | Little action. | .. .. |
| (*b.*) *On Alumina Mordant.*<br>(*Vegetable fibre.*) | *Conc.* :—Cold—fibre reddish-orange, liquid yellowish; heated—fibre yellowish-orange; liquid treated with excess of ammonia—faint carmoisin-red.<br>*Dil.* :—Heated—fibre and liquid yellow; with excess of soda-lye—reddish-violet. | *Conc.* :—Fibre immediately orange to yellow, liquid yellow.<br>*Dil.* :—Fibre yellower, liquid yellowish; heated—fibre and liquid yellow. | *Conc.* :—Fibre bright brown, liquid faintly reddish; on addition of water—both yellow.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre dark red; heated—fibre and liquid violet; on addition of water—fibre again dark red.<br>*Dil.* :—Liquid yellowish-rose; heated—fibre dark red, liquid reddish-violet; acidified—yellowish. | Heated—liquid orange; acidified—yellow. | On warming—fibre and liquid yellow. | Very little colouring matter extracted on heating. | .. .. |
| 112.<br>Alizarine S X Extra. [By.]<br>Alizarine S X and G D. [B.]<br>Alizarine R X. [M.]<br>Alizarine 3 R F. [Bi.]<br>Alizarine S X. [N.]<br>Alizarine R F. [L. and S.]<br>(*a.*) *On Chromic Mordant.*<br>(*Animal fibre.*) | *Conc.* :—Fibre dark brown; heated—fibre brighter, liquid yellowish; on addition of water—fibre reddish-brown.<br>*Dil.* :—Heated—fibre reddish-brown, liquid brownish; with excess of soda-lye—reddish-violet. | *Conc.* :—Fibre reddish-brown, liquid brownish.<br>*Dil.* :—Fibre brighter; heated—fibre bright brown, liquid brownish. | *Conc.* :—Fibre darker, liquid bluish-red; on addition of water—fibre reddish-brown, liquid brownish.<br>*Dil.* :—Heated—fibre reddish-brown, liquid brownish-red; with excess of soda—reddish-violet. | *Conc.* :—Fibre bluer; heated—fibre and liquid reddish-violet; on addition of water—fibre redder.<br>*Dil.* :—Liquid in the cold—reddish; heated—fibre deep red, liquid intensely bluish-red; acidified—faint bluish tint. | On protracted heating—very little colouring matter extracted. | Heated—fibre brown, liquid intensely golden-yellow. | Very little colouring matter extracted, the liquid being of a bluish-rose tint. | Differentiation of the three alizarines Nos. 110, 111, and 112 (alizarin, flavopurpurin, and anthrapurpurin):—The hydrochloric acid solution treated with excess of soda-lye gives with alizarin V I a bluish-violet coloration, with S D G a reddish-violet coloration, and with S X a carmine-red coloration. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| (*b.*) *On Alumina Mordant.*<br>(*Vegetable fibre.*) | *Conc.*:—Fibre brownish-red; heated—liquid yellow; on addition of water—fibre brighter; with excess of ammonia—liquid violet-reddish colour.<br>*Dil.*:—Heated—fibre bright yellowish-red, liquid yellow; on protracted boiling—fibre almost colourless (yellowish); with excess of soda-lye—liquid reddish-violet. | *Conc.*:—Fibre at first darker, then brownish-red to brown; liquid yellow; on addition of water—fibre orange.<br>*Dil.*:—Heated—fibre orange-yellow, liquid yellow. | *Conc.*:—Fibre dark red, liquid intensely bluish-red; on addition of water—both yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dark red; heated—fibre and liquid violet; on addition of water—fibre again dark red.<br>*Dil.*:—Cold—liquid brick red; heated, fibre reddish-violet; acidified—intensely yellow. | Heated—liquid faint rose tint. | Heated—fibre decolorised, liquid yellow. | Colouring matter slightly extracted. | .. .. |
| 113.<br>Purpurine. (B.) [By.]<br>Alizarine No. 6. [M.]<br>*On Alumina Mordant.*<br>(*Vegetable fibre.*) | *Conc.*:—Fibre orange; heated—liquid faint rose.<br>*Dil.*:—Heated—fibre bright orange-yellow, liquid yellowish; with excess of soda-lye—reddish-violet. | *Conc.*:—Fibre immediately bright yellow, liquid yellowish; on addition of water—fibre decolorised.<br>*Dil.*:—Fibre bright orange, liquid rose; heated—fibre and liquid colourless. | *Conc.*:—Fibre reddish-orange, liquid bluish-red; on addition of water—fibre yellowish-orange, liquid faint orange.<br>*Dil.*:—Fibre bright reddish-orange, liquid rose; heated—fibre bright orange, liquid yellowish; with excess of ammonia—bright reddish-violet. | *Conc.*:—Fibre immediately reddish-violet; heated—liquid faint reddish-violet; on addition of water—fibre pale reddish-violet.<br>*Dil.*:—Fibre bluish-red to reddish-violet; heated—liquid reddish-violet; acidified—colourless. | Colouring matter slightly extracted on boiling. | Heated—fibre decolorised by degrees, liquid faint brownish. | No action | Boiled with alum solution and cooled—an orange fluorescent liquid. Spectroscopy—compare No. 110. |
| 114.<br>Alizarine W S. [M.]<br>Alizarine S. [B.]<br>Alizarine Powder W. [By.]<br>Alizarine W S t. [L. and S.]<br>Obsolete name—Alizarine Carmine.<br>(*a.*) *On Chromic Mordant.*<br>(*Animal fibre.*) | *Conc.*:—Fibre brighter and brown, liquid faint yellowish; heated—fibre bright brown, liquid yellow.<br>*Dil.*:—Heated—fibre bright brown, liquid brownish-yellow; with excess of soda-lye—reddish-violet. | *Conc.*:—Fibre immediately dark brown, then bright brown, and finally brownish-yellow; liquid yellow.<br>*Dil.*:—Fibre in the cold bright reddish-brown, liquid faint yellowish tint; heated—fibre and liquid yellow. | *Conc.*:—Fibre darker, liquid brownish; heated—fibre bright reddish-brown, liquid reddish-brown; on addition of water—fibre almost decolorised, liquid yellow.<br>*Dil.*:—Heated—fibre bright brown, liquid brownish; with excess of soda-lye—reddish-violet (bluer than in the case of the hydrochloric acid reaction). | *Conc.*:—Heated—fibre reddish-violet, liquid faint reddish-violet; on addition of water—liquid deeper reddish-violet.<br>*Dil.*:—Heated—fibre and liquid reddish-violet; acidified—liquid faint reddish-yellow. | No action | No appreciable action in the cold; heated—fibre bright brown, liquid faint brownish-yellow; finally—fibre decolorised, liquid faint yellow. | No action | .. .. |
| (*b.*) *On Alumina Mordant.*<br>(*Animal fibre.*) | *Conc.*:—Fibre reddish-orange, liquid faint yellowish; heated—fibre yellowish-orange, liquid lemon-yellow.<br>*Dil.*:—Heated—fibre and liquid intensely yellow; with excess of soda-lye—deep reddish-violet. | *Conc.*:—Fibre at first bright orange, then yellow; liquid yellow.<br>*Dil.*:—Fibre reddish-orange, liquid colourless; heated—fibre and liquid yellow; with excess of soda-lye—reddish-violet. | *Conc.*:—Liquid faint yellowish-rose; heated—fibre and liquid reddish-orange; on addition of water—both lemon-yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*: Heated—fibre dark violet, liquid violet; on addition of water—both reddish-violet.<br>*Dil.*:—Heated—fibre dark red, liquid intensely reddish-violet; acidified—faint but bright yellow. | Heated—liquid faint rose tint. | On heating—fibre becomes at first yellow, and is subsequently decolorised: liquid intensely yellow. | No action | Ammonium acetate solution extracts the colouring matter slightly on protracted boiling, the liquid being of a reddish colour; on addition of soda-lye it changes to faint reddish-violet. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 115.<br>Madder.<br>(*Animal fibre.*) | *Conc.*:—Heated, with subsequent addition of water—fibre brighter; liquid pale yellowish-rose.<br>*Dil.*:—Heated—fibre bright brownish, liquid brownish-yellow; with excess of soda-lye—bluish-rose. | *Conc.*:—Fibre at first brick-red, then orange; heated—fibre and liquid yellow.<br>*Dil.*:—Heated—fibre orange-yellow, liquid faint yellowish tint. | *Conc.*:—Liquid brownish-red; heated—fibre more yellowish; on addition of water—fibre brighter.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre bluish dark red, liquid bluish red.<br>*Dil.*:—Heated—fibre dark red, liquid bluish-rose; acidified—almost colourless (yellowish). | A very little of the colouring matter extracted on heating, with the formation of a faint rose-coloured solution. | Heated—fibre yellowish-brown, liquid faint brownish-yellow. | No action | Ammonium acetate solution extracts the colouring matter, forming a brownish coloured solution; on addition of soda-lye—rose tint. Alum solution behaves in the same manner as with purpurine. Spectroscopy—see No. 110. |
| 116.<br>Cochineal Scarlet.<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre yellower, liquid faint rose.<br>*Dil.*:—Heated—fibre orange, liquid bright orange; with excess of soda-lye—reddish-violet. | *Conc.*:—Fibre at first reddish-orange, then yellowish brown, liquid colourless; on addition of water—fibre yellow, liquid yellowish.<br>*Dil.*:—Fibre in the cold yellower; heated—fibre yellow, liquid colourless. | *Conc.*:—Heated—liquid bluish-rose; on addition of water—fibre yellowish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre and liquid reddish-violet; on addition of water—both fuchsine red.<br>*Dil.*:—Fibre in the cold bluish-red; acidified—faint yellowish-red. | Fibre in the cold more bluish tint, liquid faint bluish-red; heated—fibre dark red, liquid brownish. | On heating—fibre slowly decolorised, liquid bright orange. | No action | Ammonium acetate solution extracts the colouring matter on protracted boiling, forming a bluish-rose-coloured liquid. The reaction with dilute hydrochloric acid or concentrated sulphuric acid serves to distinguish the dye from a mixture of Palatin Scarlet (B) and Rhodamine. |
| 117.<br>Cochineal-Carmine.<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre ponceau-red, liquid reddish.<br>*Dil.*:—Heated—fibre at first scarlet, liquid rose, subsequently fibre bright orange to almost colourless (faint bright orange); liquid bright orange; with excess of soda-lye—carmine red. | *Conc.*:—Fibre at first darker, then brighter to yellow; liquid yellowish.<br>*Dil.*:—Fibre yellower; heated—fibre at first orange, then yellow; liquid colourless. | *Conc.*:—Fibre dark bluish-red, liquid bluish-red; heated—fibre bright red; on addition of water—fibre and liquid faint brick-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre dark reddish-violet, liquid reddish-violet; on addition of water—fibre brighter.<br>*Dil.*:—Fibre bluer, liquid colourless; heated—liquid bright reddish-violet; acidified—faint rose colour. | No appreciable action. | Heated—fibre orange, liquid bright orange. | No action | .. .. |

—A. R. L.

*The Asphalt Question.* S. F. Peckham. J. Amer. Chem. Soc. 1895, **17**, 55—63.

In 1892 Consul Pierce made a very complete report on the Trinidad asphalt. Clifford Richardson published (Jour. Analyt. and Applied Chem. 1892–93) the results of very elaborate analyses of Trinidad asphalts, and has recently published a bulky report in the "Mineral Resources of the U.S." (see this Journal, 1893, 265, and 1894, 796). D. Torrey has shown in recent numbers of "*Paving*" that a method of asphalt analysis may be based on successive solution in alcohol. (Compare also Richardson and Bowen, "*Paving*," July, 1894; Liffman and Sadtler, *ibid.*, August, 1894; and also this Journal, 1895, 315.)

With regard to the cement problem Richardson (*loc. cit.*) says that the fluxing oil should not contain large amounts of solid paraffins as they cause brittleness when the cement becomes cold, and softening under the summer sun. The more the oil resembles vaseline the better. The nature of an oil may be learned by determining specific gravity, flash-point, percentage volatile in seven hours at 400° F., susceptibility to changes in temperature as revealed in changes of viscosity, presence of crystals of paraffin scale. Before mixing the asphalt is heated to about 400° F., and to produce rapidly a smooth mixture the oil is heated as much as convenient. It is put into the still and rendered quite homogeneous by passing air through it for some hours.

The author (Amer. J. Science, Jan. 1894; "*Paving and Municip. Eng.*" Aug. 1894) showed that the residue employed for softening asphalt is not a solvent, and is therefore unsuitable; he also pointed out that the process of blowing air into melted asphalt is wrong.

Richardson does not give his analytical methods: his results include: amount of water, percentages soluble in light petroleum and in carbon bisulphide, the percentages of organic matter not bitumen, and of ash. Miss Linton (this Journal, 1895, 315) showed that carbon bisulphide does not dissolve all the bitumen, and that boiling turpentine is a much more convenient reagent.

Torrey's alcohol method does not seem to have any advantage over Miss Linton's method.—N. H. J. M.

*Volumetric Determination of Sugars by an Ammoniacal Cupric Solution.* Zdeněk Peške. Proc. Chem. Soc. 1895, [150], 43.

The author tried to find a rapid and reliable process of estimating sugar based on Pavy's method of working in an ammoniacal solution. The latter method fails on account of the rapidity with which the reduced ammoniacal cupric solution is oxidised by the air. The author avoids this by covering the solution with a layer of paraffin oil of high boiling point ("white vaseline oil"). It is necessary to keep the amount of ammonia constant. Tables are given showing the reducing power of a standard ammoniacal cupric solution (in presence of Rochelle salt) for liquids containing different amounts of (1) glucose, (2) invert sugar, (3) invert sugar in presence of cane sugar.

## PATENT.

*A New or Improved Method and Apparatus for Testing the Adhesiveness of Glue and such like.* G. Seligmann, Berlin. Eng. Pat. 615, January 10, 1895.

The patentee has found that the adhesive power of glue corresponds to the quantity of water absorbed by the ends of a piece, or stick, of the material, suspended at its centre in a vessel of water, at the moment when rupture is produced by the increase in weight of the ends, combined with the diminished cohesiveness at the centre. A simple apparatus is described, in which a weighed stick of glue may be balanced freely in a trough of water, the ends gradually drooping as they absorb water, until at length the rod breaks at the centre. The ends are then re-weighed. —W. G. M.

## *ANALYTICAL AND SCIENTIFIC NOTES.*

*Sulphides of Nickel and Cobalt.* A. Villiers. Comptes rend. 1894, **119**, 1263—1266.

If an excess of soda be added to a solution of a nickel salt containing a sufficient quantity of tartaric acid to prevent precipitation of the nickel, and then sulphuretted hydrogen be passed through the liquid to saturation, a black solution free from precipitate is formed. The solution of nickel sulphide is very stable, and may be boiled without decomposition, but nickel sulphide is precipitated therefrom if the solution be made just acid with a mineral acid. If sulphuretted hydrogen be passed into a liquid containing nickel hydrate, which has just been precipitated by excess of soda, a considerable proportion of the nickel sulphide formed is dissolved by the sodium sulphide simultaneously produced. Sodium thiohydrate has a similar solvent power. Ammonium sulphide or thiohydrate have no solvent power for nickel sulphide, unless they contain free sulphur in solution, and the solvent action of the corresponding potassium compounds is much less than that of the soda.

Neither ammonium nor sodium sulphide or thiohydrates have any solvent action on cobalt sulphide, unless they contain free sulphur in solution. (See page 509.)—L. T. T.

*Calcium Ethylate.* De Forcrand. Comptes rend. 1894, **119**, 1266—1268.

The author attempted to obtain this compound according to the equation $CaC_2 + 2C_2H_6O = Ca(C_2H_5O)_2 + C_2H_2$. Pure $CaC_2$ prepared in the electrical furnace was heated at 180° with excess of absolute alcohol. The reaction did not, however, take place in the expected manner. Two calcium compounds were formed having the formulæ $CaO, C_2H_6O$, and $(CaO)_3(C_2H_6O)_4$, and the evolved gas was a mixture of $C_2H_2$ (about 80 per cent.), an easily liquefiable olefine (about 10 per cent.), a small quantity of gas of the methane series, and apparently some more highly condensed hydrocarbons.—L. T. T.

## New Books.

Chemical Technology; or, Chemistry in its Applications to Arts and Manufactures. Edited by Chas. E. Groves, F.R.S., Editor of the Journal of the Chemical Society, and William Thorp, B.Sc. With which is incorporated Richardson and Watts' Chemical Technology. Vol. II. Lighting. Fats and Oils. By W. Y. Dent.—Stearine Industry. By J. McArthur.—Candle Manufacture. By L. Field and F. A. Field.—The Petroleum Industry, and Lamps. By Boverton Redwood.—Miners' Safety Lamps. By B. Redwood and D. A. Louis. London: J. and A. Churchill, 11, New Burlington Street. 1895. Price 20*s.*

This work is a continuation of Groves and Thorp's Chemical Technology, of which it forms Volume II. It consists of a large 8vo volume, in style resembling Volume I., on Fuel (this Journal, 1889, 824), and contains Preface, Table of Contents, Classified List of Illustrations, 358 in number, text covering 388 pages, and an Alphabetical Index. The outline plan of the work may be gathered from the following excerpt of the contents:—Fats. Saponification of Fats. Testing Oils and Fats. Vegetable Fats and Oils. Animal Fats. Stearine. Candle Manufacture. The Petroleum Industry; History; Geographical Account. Physical Character of Petroleum: Chemistry, Production, Transportation, and

Storage. Pipe Lines. Refining Petroleum. Cracking Heavy Oils. The Shale Oil Industry. Paraffin from Shale Oil. Lamps. Oil Gas. Air-Gas Machines and Carburettors. Ships' Lights and Railway Carriage Roof Lamps. Miners' Safety Lamps.

Petroleum, its Development and Uses. By R. Nelson Boyd. Memb. Inst. Civil Eng. London: Whittaker and Co., 2, White Hart Street, Paternoster Square. New York: 66, Fourth Avenue. 1895. Price 2*s*.

This little book (small 8vo) contains 79 pages of Subject-Matter, and 4 small Appendices, and may be defined, according to the author, as an effort to collect and arrange a few facts about Petroleum, likely to be of interest. Mr. A. H. Rowan has written a special chapter on "Petroleum Engines."

The work, which is very concisely written, treats of the following subjects in appropriate chapters. I. Introductory. II. Historical. III. Recent Developments. IV. Origin, &c. V. Chemical Composition. VI. Winning Petroleum. VII. Storage and Transport. VIII. Liquid Fuel. IX. Flashing-Point, and Lamp Accidents. X. Petroleum Engines. XI. Future. Appendices.—A. Tables, Molesworth and Unwin. B. Circular of London County Council on Petroleum Lamps. C. Calorific Value of Crude Oils. D. Import Duties on Crude and Refined Oils in different Countries.

The Extra Pharmacopœia. By William Martindale, late Examiner of the Pharmaceutical Society and Teacher of Pharmacy, and Demonstrator of Materia Medica at University College. Medical References and a Therapeutic Index of Diseases and Symptoms, by W. Wynn Westcott, M.B. Eighth Edition. London: H. K. Lewis, 136, Gower Street, W.C. 1895. Price 9*s*.

This is the eighth edition of the work above mentioned, the seventh edition of which was referred to in this Journal, 1892, 781. To the report there given, it may be added that in this the 8th edition very considerable additions have been made, so that whereas the pages in the 7th edition numbered 524, in the 8th edition now under notice, they number 584. Nevertheless, it is stated that about 30 pages of the 8th edition have been deleted, whilst about 110 pages of new matter have been added, thus necessitating an expansion of the Posological Index at the end of the work, by about 14 pages. Among the novelties introduced into the present edition, a few may be referred to. The internal administration of petroleum has attracted attention, and a formula for its emulsion is given. A special chapter has been introduced on Antitoxins, Serums, and Lymphs, and on Animal Glands and Tissues, and their Preparations. Various Antipyretics, several of which are compounds or derivatives of Antipyrine, and hypnotics are introduced.

"Of antiseptics, the mixed cresol preparations and their solutions have found favour, but the tendency has been, it is stated, towards using sterilised or aseptic, in place of antiseptic surgical dressings. Nevertheless, the antiseptic treatment has been extended to internal medication." Phenol, Naphthol, and Salicylic Compounds have been in request, especially in combination with Bismuth for intestinal antisepsis, whilst those of Creasote and Guaiacol have been much used for phthisis. The fuming acids for application as caustics, especially sulphuric for cancer, are noted, as also the Alcohols necessary for use in pharmacy.

The little book is of the size known as medium 24mo.

Theoretical and Practical Ammonia Refrigeration. A Work of Reference for Engineers and others employed in the Management of Ice and Refrigeration Machinery. With 25 pages of Tables. By Iltyd I. Redwood. New York: Spon and Chamberlain, 12, Cortlandt Street. London: E. and F. N. Spon, 125, Strand. 1895. Price 4*s*. 6*d*.

This is stated in the Preface to be "A book of reference that will enable engineers and others interested in refrigerating machinery to determine, with sufficient accuracy for all practical purposes, what work their machines are doing, without resorting to laborious calculations." The work is a small one, square 16mo, and bound in cloth; it contains 138 pages of matter, with which are interspersed 15 woodcuts. A series of six tables and an alphabetical index, conclude the work. The work is subdivided into 11 chapters, in which the entire subject of ammonia refrigeration is concisely dealt with.

A Treatise on Practical Chemistry and Qualitative Analysis. Adapted for Use in the Laboratories of Colleges and Schools. By Frank Clowes, D.Sc., Professor of Chemistry at the University College, Nottingham, &c. Sixth edition. London: J. and A. Churchill, 11, New Burlington Street. 1895. Price 8*s*. 6*d*.

8vo. volume, bound in black cloth, and containing 453 pages of subject-matter and an alphabetical index. The present, or sixth, edition has undergone a thorough revision, and has been re-arranged and re-paragraphed to facilitate reference. There are also several additions, the principal of which is an extension of the method of detecting organic compounds, and the addition of a few more important organic substances.

The book is illustrated with 84 wood engravings and a frontispiece. The work has been divided into seven sections. The first six sections, omitting the fifth, the author states, "contain a good practical course for senior students." Junior students can use the course by substituting in it the fifth section for the sixth, the fifth section being also specially designed for the use of medical, pharmaceutical, and engineering students. The sixth section is for advanced students, and the seventh forms a carefully elaborated set of suggestions for fitting up and furnishing a laboratory, including lists of apparatus, materials for analytical practice, &c. At the close there are Tables of Atomic Weights, Weights and Measures, &c., &c.

## Prizes.

The *Pharmaceutical Journal* of Australia says:—"The New Zealand Government has offered a prize of 1,000*l*. for the first 200 tons of crude potassium cyanide manufactured from local produce. Nitrogenous refuse suitable for this purpose ought to be abundant, but we fear that the Colonies, or indeed the entire Empire, will not supply the potash. But has sufficient search been made?"—*Chemical News.*

## Educational.

### The Schorlemmer Laboratory.

On Friday, May 3rd, in presence of a distinguished company, Mr. Ludwig Mond, F.R.S., formally opened the Schorlemmer Laboratory for Organic Chemistry at Owens College, Manchester. This laboratory has been founded as a memorial to the late professor. The appeal, which was headed by Mr. Mond, was so well responded to, both in this country and in Germany, that in a short time a sum of 2,500*l*. was subscribed. The Council of the College, at the same time, in view of the steady increase in the number of students, accepted the fund raised by the Memorial Committee, and while the Schorlemmer Laboratory was being erected they also had built a new laboratory for elementary students on a plot of land adjoining the present laboratories acquired by the College for the purpose of their extension. The Schorlemmer Laboratory, which is at the end of the main corridor in the old chemical building, measures 60 ft. by 30 ft., and has an arched roof 30 ft. high. It is designed to accommodate a professor, two demonstrators, and 36 students. It is fitted in the most complete manner with every requisite for the important work which is to be carried on within it, and in some particulars is arranged after the plan of the Munich organic laboratories. The lower laboratory is designed for 45 students. The total cost of the new building is 4,800*l*. At the meeting on Friday, Sir H. E. Roscoe, M.P., spoke of the foundation of the Manchester Chemical School under himself and the late Prof. Dittmar, to whom Schorlemmer succeeded. Thereafter Mr. Mond addressed the meeting upon the importance of chemical study in its relation to scientific discovery and the growth of industry. He also touched upon Schorlemmer's life work, and the influence which his teaching had had upon the study of organic chemistry in this country. After some other speeches the company adjourned from the chemical-lecture theatre to the laboratory, which Mr. Mond declared open.—*Chemist and Druggist.*

### THE TEACHING OF CHEMISTRY.

The London Technical Education Board has appointed a Special Sub-Committee, consisting of Dr. W. J. Russell (Chairman), Sir Philip Magnus, Mr. Ludwig Mond, Mr. W. Pearce, Mr. H. J. Powell, Professor Ramsay, and Mr. C. M. Stuart, to enquire into the teaching of chemistry as at present conducted in the day schools and evening classes throughout London and in the most important provincial centres, and to report to the Board the results of their enquiries with their recommendations for the improvement of such teaching throughout the schools and classes, but with special reference to the character of the training to be given to teachers of chemistry under the direction of the Board. The Board's secretary and Dr. Kimmins, the Board's science inspector, are acting as secretaries to the sub-committee, but as it is intended to make very extensive enquiries, the sub-committee will not be in a position to present their report for some months.—*London Technical Education Gazette.*

# Trade Report.

## *BILLS BEFORE PARLIAMENT.*

### RIVERS POLLUTION PREVENTION BILL.

*Memorandum.*

The principal object of this Bill is to improve the law for preventing the pollution of streams by extending to county councils, joint committees, and rivers boards in England the main provisions of the Mersey and Irwell Act of 1892 and the West Riding of Yorkshire Rivers Act of 1894 referred to in the marginal notes as the Mersey and Irwell Act and the West Riding Act. Many provisions are in both Acts, although one reference only is given.

New clauses and provisoes are added :—

(1.) To prevent the pollution of streams by canals (cl. 7);

(2.) To qualify justices to act, though they are members of the local authority or ratepayers (cl. 13);

(3.) To empower any local authority to contribute to the expenses of a prosecution by any other authority (cl. 18 (3));

(4.) To empower the Local Government Board to order in certain cases the rating of areas specially benefited (cl. 20, proviso).

(5.) To enable defendant to be witness in certain cases.

### PATENTS, DESIGNS, AND TRADE MARKS ACTS (1883 TO 1888) AMENDMENT BILL.

*Memorandum.*

The object of this Bill is to remedy some of the defects in our Patent Law which give rise to difficulties in its practical working. The nature of its principal provisions will be gathered from the following short summary:—

(*a.*) By the existing law an inventor loses all right to a patent if his invention has become known to any member of the public, even though it be by accident or the fraud of another person. This rule it is proposed to relax in cases where the publication has taken place without the inventor's knowledge or consent.

(*b.*) A period of some months is by statute allowed to an inventor after he has obtained provisional protection to develop and perfect his invention. During this period, however, he is liable to have his improvements patented by others, even though he is the first to arrive at them. By this Bill means are provided whereby he can secure his priority in respect of those improvements of which he is the first and true inventor.

(*c.*) Cases arise in which obscure and forgotten references in old books are cited as anticipations of meritorious inventions. Following the example of certain other countries, it is proposed that an invention shall not be held to be anticipated unless there has been publication or user in the last 50 years.

(*d.*) By our law any flaw in a patent makes it wholly invalid, and the remedy by disclaimer can only be applied by a procedure which causes great delay and often heavy expense. It is proposed to remedy this by giving a power of immediate disclaimer in the type of case which is of most frequent occurrence.

(*e.*) The Bill contains provisions for expediting the trial of cases where continuing infringement is alleged, and thus preventing delay in settling the points in controversy.

There are other provisions of minor importance directed to attain similar objects, but from their technical character they do not admit of being explained in a brief memorandum.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

### UNITED STATES.

*Customs Decisions.*

The following decisions respecting the construction to be given to Acts of Congress relating to the classification of articles in the Customs tariff and the application of the Customs laws of the United States, have recently been given by the Customs authorities in that country:—

Neutraline, a light-coloured oil obtained from crude petroleum by a process of distillation, is dutiable at 25 per cent. *ad valorem*, under paragraph 60 of the Act of August 28th, 1894, as a distilled or expressed oil.

Sulpho-tonic, an acid prepared from coal-tar, used in making coal-tar colours, is dutiable at 20 per cent. under paragraph 19 of the Tariff Act of October 1st, 1890.

Distilled oil of paraffin is to be classified for duty as distilled oil, at 25 per cent. *ad valorem*, under paragraph 76 of the Tariff Act of October 1st, 1890.

Hyposulphite of soda is dutiable at 25 per cent. *ad valorem* under the provisions of paragraph 60 of the Act of August 28th, 1894.

Articles made of collodion, paper, and gelatin are dutiable, under paragraph 21 of the Act of October 1st, 1890, at 60 cents per lb. and 25 per cent. *ad valorem.*—*Board of Trade Journal.*

## *GENERAL TRADE NOTES.*

### THE NEW STANDARD OF LIGHT.

A special committee was appointed by the Board of Trade in 1891 on the standard of light adopted in testing the illuminating power of the gas of the metropolis. The committee consisted of Mr. W. J. Dibdin (chemist to the London County Council), Dr. Edward Frankland, Mr. H. E. Jones (Commercial Gas Company), Mr. George Livesey (South Metropolitan Gas Company), Dr. Odling (chairman of the committee), Mr. C. Rose-Innes, Dr. W. J. Russell, Mr. G. C. Trewby (Gas Light and Coke Company), and the Gas Referees—Mr. A. Vernon Harcourt, Professor Rücker, and Dr. Pole. Professor V. B. Lewes was appointed secretary to the committee. The committee's report expresses the opinion that the present standard—viz." sperm candles six to the pound, burning 120 grains in the hour"—is not satisfactory from various reasons, amongst which are the uncertainty in manufacture, especially of the wicks, and also on account of the conditions under which they are burned, which are practically uncontrollable in several points. They find that Mr. Vernon Harcourt's one-candle pentane air-gas flame represents the average light of one sperm candle, but is too small for actual comparison with the statutory illuminating power of the gas. They further find that Mr. W. J. Dibdin's ten-candle pentane argand correctly represents the value of ten average candles as compared with Harcourt's one-candle standard, and recommend that Mr. Dibdin's standard be accepted as the legal standard, and that sealed specimens of the burner and carburetter be deposited with the Board of Trade.—*Chemist and Druggist.*

### NEW ALKALI WORKS.

Messrs. Brunner, Mond, and Co. (Limited) are now erecting new works at Teesside, at the mouth of the Tees river, where land is obtainable very cheaply. This new departure is on the same lines as that of the United Alkali Company (Limited), who have recently begun to build works at Fleetwood. The establishment of the Teesside factory, however, will not affect the continued existence of Messrs. Brunner, Mond, and Co.'s existing works at Northwich.—*Ibid.*

### EXPORTS OF PETROLEUM FROM U.S.A.

The Chief of the Bureau of Statistics, Washington, gives the following returns of the exports of petroleum and petroleum products for March. The total shipments were 59,798,815 galls., compared with 70,395,601 galls. in March, 1894. The total for the nine months ending March, 1895, was 671,005,804 galls., against 683,182,215 galls. during the same period in 1894. The details of the shipments are as follow:—

*Crude Petroleum.*

| | Gallons. |
|---|---|
| Total, March, 1895 | 10,160,190 |
| „ „ 1894 | 12,450,893 |

*Naphthas.*

| | |
|---|---|
| Total, March, 1895 | 1,031,416 |
| „ „ 1894 | 519,423 |

*Illuminating.*

| | |
|---|---|
| Total, March, 1895 | 44,889,370 |
| „ „ 1894 | 54,542,080 |

*Lubricating and Paraffin.*

| | |
|---|---|
| Total, March, 1895 | 3,671,051 |
| „ „ 1894 | 2,881,613 |

*Residuum.*

| | |
|---|---|
| Total, March, 1895 | 46,788 |
| „ „ 1894 | 1,592 |

—*Chemical Trade Journal.*

### UNITED STATES PRODUCTION OF PETROLEUM.

The following statistics, from a good American source, are of interest just now:—

| Year. | Highest. | Lowest. | Average. | Production. |
|---|---|---|---|---|
| | Dols. | Dols. | Dols. | |
| 1859 | 20·00 | 19·50 | 19·77 | 2,000 |
| 1860 | 20·00 | 2·00 | 9·77 | 500,000 |
| 1861 | 1·75 | 0·03 | 0·42 | 2,113,609 |
| 1862 | 2·00 | 0·10 | 1·00 | 3,056,690 |
| 1863 | 4·00 | 2·00 | 3·11 | 2,611,309 |
| 1864 | 14·00 | 3·75 | 5·85 | 2,116,109 |
| 1865 | 10·00 | 4·00 | 6·65 | 2,497,700 |
| 1866 | 5·00 | 1 65 | 3·76 | 3,597,700 |
| 1867 | 4·00 | 1·50 | 2·40 | 3,347,300 |
| 1868 | 5·50 | 1·80 | 3·75 | 3,646,117 |
| 1869 | 7·00 | 4·25 | 5·64 | 4,215,000 |
| 1870 | 4·00 | 2·75 | 3·86 | 5,260,745 |
| 1871 | 5 15 | 3·40 | 4·42 | 5,205,234 |
| 1872 | 4·10 | 3·00 | 3·68 | 6,293,194 |
| 1873 | 3·05 | 1·00 | 1·84 | 9,893,786 |
| 1874 | 1·90 | 0·45 | 1·17 | 10,926,945 |
| 1875 | 1 65 | 0·90 | 1·33 | 12,162,514 |
| 1876 | 4·23½ | 1·48¾ | 2 61 | 9,132,669 |
| 1877 | 3·70 | 1·53¾ | 2·37 | 13,350,363 |
| 1878 | 1·86⅞ | 0·78⅛ | 1·17 | 15,396,860 |
| 1879 | 1·28½ | 0·63⅛ | 0·86 | 19,914,146 |
| 1880 | 1·24⅜ | 0·70⅝ | 0·95 | 26,286,123 |
| 1881 | 1·01½ | 0·72½ | 0·85 | 27,661,238 |
| 1882 | 1·14 | 0·54⅜ | 0·78⅞ | 30,510,830 |
| 1883 | 1·16⅜ | 0·92⅜ | 1·05¾ | 23,419,633 |
| 1884 | 1·11 | 0·63½ | 0·83½ | 24,218,438 |
| 1885 | 1·05½ | 0·70⅞ | 0·88 | 21,847,205 |
| 1886 | 0·88⅜ | 0·62¼ | 0·71¼ | 28,064,841 |
| 1887 | 0·80¾ | 0·59¼ | 0·66¾ | 28,278,866 |
| 1888 | 0·93⅝ | 0·75⅞ | 0·87⅝ | 27,612,025 |
| 1889 | 1·08½ | 0·83⅛ | 0·94⅛ | 35,163,513 |
| 1890 | 1·05¾ | 0·67¼ | 0·86¾ | 45,822,672 |
| 1891 | 0·78¾ | 0·58½ | 0·67 | 54,291,980 |
| 1892 | 0·62⅜ | 0·51⅜ | 0·55⅝ | 50,509,136 |
| 1893 | 0·78¼ | 0·53½ | 0·64 | 48,412,666 |
| 1894 | 0·91½ | 0·79¼ | 0·83⅞ | 47,453,105 |

The table shows the highest and lowest prices, and the production in barrels of 42 galls. in each of the years named. —*Ironmonger.*

### THE RUSSIAN OIL PRODUCERS' AGREEMENT.

According to the *Bourse Gazette* of May 13, the Baku kerosene manufacturers have arrived at the following agreement for the establishment of a union of Russian kerosene manufacturers:—The union is formed for a period of four years. After the expiration of two years it will be open to any member of the union to propose any modification in the agreement. As regards the report that the American petroleum ring has concluded a contract with the Russian union of kerosene manufacturers, the *Grashdanin* and the *Herold* remark that a private understanding of such nature is quite possible, but that the agreement will not receive any official confirmation, because the Minister of Finance does not consider it in any way necessary.—*Chemical Trade Journal.*

### FRUITLESS OIL-DRILLING IN THE STATES.

Concerning petroleum production in the States it is advised from New York that thus far the results of drilling operations have not added materially to the production, no wells of exceptional producing capacity being reported, and with the incoming of each new well the prospects of discovering a new pool of magnitude decrease.—*Ibid.*

### MERSEY JOINT COMMITTEE *v.* SALFORD.

On Wednesday, in the Queen's Bench Division, before the Lord Chief Justice and Mr. Justice Charles, the Mersey and Irwell Joint Committee appealed from the decision of the Salford County Court judge, who dismissed a summons against the Salford Corporation under the River Pollution Act of 1876 on the ground that the plaintiffs had no jurisdiction now that the Ship Canal took the place of the Irwell and Mersey as far as Warburton. One side contended that the Irwell canalised was still within the jurisdiction of the plaintiffs; while on the other hand it was contended that the Ship Canal was not a tributary or portion of a river. Their lordships, after reserving their decision, gave judgment on Thursday in favour of the Joint Committee, thus reversing the decision of the County Court judge. Leave was given to the Corporation to appeal.—*Ibid.*

### CHROME LEAD DYEING A "DANGEROUS OCCUPATION."

Under the Factories and Workshop Act of 1891, the Home Secretary gives notice in the *London Gazette* that in his opinion processes in which yellow chromate of lead is used, or in which goods dyed with it undergo the process of bundling or noddling, winding, reeling, weaving, or any other treatment are dangerous or injurious to health.—*Ibid.*

### THE BULGARIAN DRUG-TRADE: A FIELD FOR BRITISH EXPORTERS.

The total value of the imports of chemicals into Bulgaria in 1893 was about 23,000*l.*, of which 9,000*l.* worth was furnished by Austria-Hungary, 9,000*l.* by Britain, 2,000*l.* by France, and 1,500*l.* worth by Germany. England, France, and Austria supply soda; England, potash; England and Austria, alum and carbonates; Germany, saltpetre; Austria, sulphuric and other acids; Austria, England, and France, citric acid and sulphates of copper and iron. Drugs were imported into Bulgaria to the value of 29,000*l.*, mostly from France, which supplied 2,500*l.* worth of pharmaceutical goods, 60*l.* worth of camphor, 50*l.* worth of quinine, and 150*l.* worth of mineral waters. Austria supplied 1,344*l.* worth of pharmaceutical goods, mostly bearing French labels, 500*l.* worth of quinine, and a good deal of camphor, essences, and extracts. From Germany came 4,000*l.* worth of pharmaceutical products, 1,000*l.* worth of quinine, and 1,500*l.* worth of essences and extracts. 2,000*l.* worth of perfumery came from France, 4,500*l.* worth from Austria, and 1,500*l.* worth from Germany.—*Ibid.*

### DISCOVERY OF TELLURIDES.

A discovery has been made of telluride of bismuth, which is very rare and invariably associated with gold, as in this instance. The property is under offer for London. —*Ibid.*

### MANGROVE TANNING EXTRACT.

The name "Mangrove" is given to several different plants. Thus, *Avicennia officinalis* (the white mangrove), *Ceriops Candolleana* (the black mangrove), *Ceriops Roxburghiana*, *Kandellia Rheedii*, *Bruguiera gymnorrhiza*, *Bruguiera parvifolia*, and *Rhizophora conjugata*, are all known as mangroves, as well as *Rhizophora mucronata*, which has been called the true mangrove. *Rhizophora mucronata*, *R. conjugata*, and *Bruguiera gymnorrhiza* are the three most common in Ceylon. They are abundant, usually grow intermixed, and are termed "*Kadol*" by the Sinhalese. A Glasgow firm, one of whose representatives recently visited the Ceylon Section of the Imperial Institute, in order to examine the various samples of mangrove barks, with a view to ascertain whether a tanning extract could be made from them in Ceylon, was placed by the Institute authorities in communication with the Ceylon Government, who have granted him a concession, on payment of a small royalty, for the erection of a factory and the preparation and export of mangrove extract, which will probably be in the future known as "Mangrove Cutch." There is thus a prospect of the establishment of a new industry, as it is expected that the "mangrove cutch," owing to the saving which will be effected in freight by exporting the extract instead of the bark itself, can be placed on the English market at a reasonable and remunerative price.—*Imperial Institute Journal.*

### THE KAURI GUM INDUSTRY IN NEW ZEALAND.

The following particulars respecting the deposits and industry of *kauri gum* in New Zealand are taken from the New Zealand official year book for 1894:—Although a true resin, this is usually called kauri-gum. It is the solidified turpentine of the kauri, and occurs in great abundance in a fossil condition in the northern part of the Auckland Provincial District, from the North Cape to Middle Waikato, and is dug up alike on the driest fernhills and the deepest swamps. The purest samples are found on the Cape Colville Peninsula. A large quantity is also obtained from the forks of living trees, but is considered of inferior quality, and fetches a lower price. At the present time gum-digging employs nearly, or quite, 7,000 persons, including Maoris and aliens.

In the fossil state, kauri resin occurs in larger or smaller lumps, from the size of a walnut to that of a man's head. Pieces have been found weighing upwards of 100 lb. When scraped, the best specimens are of a rich brown colour, varying greatly in depth of tint. Sometimes translucent, or even transparent, specimens are found, occasionally with leaves, seeds, or small insects enclosed. When obtained from swamps the resin is very dark coloured, or even almost black, and fetches a low price. Waikato resin is the darkest of all. Transparent or semi-transparent specimens fetch very high prices, being used as a substitute for amber in the manufacture of mouthpieces for cigar-holders, pipes, &c. The great bulk is used in the manufacture of oil varnishes, and in oil countries where much varnish is made, it holds the chief place in the market. It is exported chiefly to England and the United States of North America. In 1860 the export was only 1,046 tons, valued at 9*l.* per ton; in 1893 it amounted to 8,317 tons, valued at 61*l.* per ton. The following statement, taken from the Customs returns, shows the quantity exported in each year from 1883 to 1893, with the total value and average price per ton:—

| Year. | Quantity. | Total Value. | Average per Ton. |
|---|---|---|---|
| | Tons. | £ | £ *s.* *d.* |
| 1883 | 6,518½ | 336,606 | 51 12 10 |
| 1884 | 6,393 | 342,151 | 53 10 4 |
| 1885 | 5,875¾ | 299,762 | 51 0 3 |
| 1886 | 4,920¾ | 257,653 | 52 7 1 |
| 1887 | 6,790 | 362,434 | 53 7 6 |
| 1888 | 8,482 | 380,933 | 44 18 0 |
| 1889 | 7,519 | 329,590 | 43 16 8 |
| 1890 | 7,438 | 378,563 | 50 17 11 |
| 1891 | 8,388 | 437,056 | 52 2 1 |
| 1892 | 8,705 | 517,678 | 59 9 4 |
| 1893 | 8,317 | 510,775 | 61 8 3 |

—*Board of Trade Journal.*

### Ontario Minerals.

The *Toronto Monetary Times* for the 5th April, gives the figures for the mineral output of Ontario for 1894.

Comparing them with the previous year, it is found that while a decrease is shown in the products of the stone quarry and in the make of common brick, yet there is a considerable increase in the output of pressed brick and terra cotta. Pottery shows an enlarged product and so does gypsum, but there is a decline in salt production, as indeed there is also in petroleum, two industries which are of no small moment to considerable areas in Western Ontario. Nickel and copper mining exhibit improvement; the number of hands employed is increased from 495 to 655, and the quantity and value of the output are both much larger. Natural gas shows a lessened production.

### Valuable Iron Deposits in Quebec.

There is, according to the *Canadian Gazette* of the 18th April last, much activity among the miners in Little Lake St. Francis district, Quebec, as the iron deposits there have been proved to be valuable. Mr. Hugh Leonard, of Stornoway, who has a mine at Little Lake St. Francis, tells Canadian reporters that he has just shipped from Portland to Liverpool, 400 tons of chrome iron. The mine was only opened last autumn. The ore yields the high average of 50 per cent. of pure material.

There is, stretching for miles throughout that section of the country, in the vicinity of the Black Lake region, a vast belt of rocks containing pockets, more or less disconnected, of this rare and valuable mineral. The excitement prevailing amongst those already interested in its development is great, and all the miners have implicit faith in the existence of extensive deposits of the precious metal. Mr. Leonard says that operations are being carried on this spring in the whole region with increased activity.

### Direct Treatment of Ores by the Cyanide Process.

Hitherto the use of the cyanide process in South Africa has been confined to the treatment of tailings from the mills, but a beginning has been made in the treatment of ore direct from the crusher. The London *Statist* of recent date says: "The company making this important new departure is the George and May. This company's property extends for $2\frac{1}{2}$ miles along the outcrop of the main reef series, and, as the oxidised zone extends in depth for several hundred feet, it has enormous quantity of oxidised ore, since it owns such a large number of outcrop claims, and the main reef being wide and payable. In February Mr. Freeman, the manager, introduced the new method of treating this oxidised ore without putting it through the mill at all. The ore is broken in Gates crushers, and the lumps are sent direct to the cyanide vats. The oxidised ore being porous, that is, as far as the cement or banket containing the gold is concerned, permits the cyanide solution to permeate the matrix more freely than when crushed fine in the mill. About 85 per cent. of the gold is recovered in this way. In February, 900 tons were treated at the George and May, resulting in the recovery of 7 dwt. per ton at a cost of about $2\frac{1}{2}$ dwt. per ton. This experiment has proved so satisfactory that 4,000 tons were to be treated in March, and vats are to be erected capable of treating 16,000 tons monthly. It is estimated that there are close on 2,000,000 tons of oxidised ore on this property, and that the whole, including the rich south reef, of which there are 20,000 tons developed, will give an average yield of about 10 dwt. per ton, which will give 20s. per ton profit. This new process will be of immense benefit in treating oxidised ore, especially in those properties where the main reef is still untouched. It will permit low-grade free-milling ores, of which there are enormous quantities on the various series, such as the Kimberley, Bird, and Black Reefs, to be profitably worked at a very low cost. This process, so far as this property is concerned, may now be considered to have passed into the practical stage."—*Engineering and Mining Journal.*

### Treatment of Antimonial Ores.

Two plants are being built in South Australia for Mr. J. J. Christmas, who is tributing the Union Gold and Antimony Mine, Redcastle (Vic.). The plants are being constructed to Mr. Christmas' designs, and are intended to give a practical trial to special processes for the treatment of antimonial and auriferous ores. Mr. Christmas claims to have overcome the difficulty of using lead as an amalgamating metal and a means of obtaining gold from ores. According to the *Australian Mining Standard*, the method adopted by the patentee is to prevent the oxidation of the lead (which has always proved an obstacle to the successful application of the treatment) by passing the finely-ground ore, previously mixed with a small quantity of kerosene or similar compound of carbon and hydrogen, through a bath of the molten metal. The addition of kerosene as described effectually prevents the oxidation of the lead, which alloys with the gold and silver, while the dry, powdered ore, being much lighter than the lead, rises to the surface of that metal, and is carried away as tailings. In the antimony process the native ore, or sulphide of antimony, is melted in large crucibles, and when on the point of cooling, a quantity of molten lead is poured into the ore, stirred with an iron rod, and poured into moulds to cool. When the ingot is turned out of the mould it is found that the lead, which has a greater affinity for gold than for antimony, robs the latter metal of its contents, and, having a greater specific gravity, settles at the bottom of the mould, from which it is easily removed, and the gold recovered by cupellator or other methods. The plants, which are fitted with patent rock-breaker and rolls for preparing the ore, are equal in capacity to 15 head of stampers, and the cost of the processes is comparatively small. A smaller plant of the same design has just been sent away for the Lady Lily Gold Mining Company, Western Australia.—*Ibid.*

## *LONDON CHAMBER OF COMMERCE.*

### Extracts from Report for 1894.

### *The Chamber of Commerce Journal.*

By means of the *Journal* the Chamber is not only able to place on record the more valuable of the addresses delivered before it; but, by way of exchange, to obtain for its reference collection a regular supply of official and other publications. The edition is, at present, 5,000 copies per month, beyond which, except on special occasions, it is not possible to go, so long as the Post Office continues to apply the book-postage to monthly periodicals, even of a reasonable size and weight, whilst carrying far more bulky weekly journals at the halfpenny rate.

### *Cement Trade Section.*

The section had under consideration, towards the close of the year, the alleged admixture of cement with Kentish rag stone and other foreign substances, with the result that a firm of experts were engaged to report upon the extent to which admixtures were being used in the manufacture of Portland cement on the Thames and Medway. The investigations into this matter were not concluded at the end of the year.

### *Chemical Trades Section.*

Four meetings of this Section and its committees were held. Early in the year, the section had under consideration draft rules proposed to be issued by the Home Office for the better regulation of chemical works in the interests of workmen, which, it transpired, had been already considerably modified through the representations made by the special committee of the Section to the Home Office. It was agreed that the modifications to be suggested should also be incorporated in the proposed rules for bi-chromate works. The Section also considered the provisions of the Thames Conservancy Bill, affirming the opinion that its provisions would be extremely prejudicial to the Chemical Section, on grounds which were set out in clause 7 of the petition which was deposited in the chamber. At the annual meeting of the Section, attention was directed to the use of metric weights and measures in the trade. The county council, through its inspector, had intimated to a large firm of manufacturing chemists that it was illegal to use any weights and measures, even for export purposes, other than those conforming to the Imperial standards. In view of this it was felt absolutely necessary, in the interests of the trade, to at once introduce a Bill into Parliament with the object of amending the Weights and Measures Acts of 1878 and 1889. An amending Bill has been drafted, and it was decided to bring the views of the Section before the Select Committee of the House of Commons on Weights and Measures. In view of the sittings of the Parliamentary Committee on Adulteration, the question of the Food and Drugs Act was again under discussion, and the Section affirmed that it was desirable that drugs should be treated in a separate section of the Act, and that they should not, as at present, be associated with foods. Two members of the Section were appointed with a view to appear, if need be, before the Parliamentary Committee, for the purpose of recommending the adoption of this course. It was also urged that a board of reference for appeal in cases of disputed analysis should be constituted. Representations were made to the Home Secretary through Her Majesty's Inspector of Factories on behalf of white lead manufacturers, as to certain rules which it was proposed to issue for the better preservation of the health of employés engaged in that industry. The result of these representations was that a set of rules was ultimately issued which were considered satisfactory to the employers concerned. Other subjects discussed by this Section included bills of lading, Government contracts, and the rating of machinery.

### *Mineral Oil Sub-Section.*

Ten meetings of this sub-section and its committees were held. Early in the year the attention of the Section was called the regulations as to the storing and piling of casks and barrels contained in the London Streets and Buildings Bill, and a memorial was addressed to the London County Council pointing out the hardships which would be inflicted upon the oil trade if the provisions referred to became law, and were put in force. The result of the joint opposition with the Timber Trade Section was the withdrawal of the objectionable clauses. Immediately upon the appointment of a Select Committee of the House of Commons "to inquire into and report upon the law relating to the keeping, selling, and conveyancing of petroleum and other inflammable liquids, including the precautions to be adopted to prevent the sale of dangerous lamps for use with inflammable liquids," a meeting of the Section was convened, and a special committee of 16 members appointed to take such action as might be deemed expedient. The committee invited the co-operation of the Petroleum Defence Committee (the Trade Association), whose interests were specially affected, and a joint executive committee was subsequently formed, which had several meetings. This joint committee watched the evidence before the Select Committee, and took other action in the interests of the trade. At the close of the Parliamentary Session, the joint executive issued an interim report, showing that the main points in connection with the Parliamentary Inquiry were the raising of the standard flash-point from 73° F. to 100° F., Abel test, and the resuscitation of the harassing provisions of the Inflammable Liquids Bill of 1891, which had been successfully opposed by this Chamber when before Parliament.

### *Photographic Trade Section.*

The attention of the Section was called to the recurrence of explosions of, and accidents with, gas cylinders, and a special conference with the makers, fillers, and users of these cylinders was arranged. At this conference, considerable divergence of opinion existed as to the cause of accidents; but the experts present maintained that, generally speaking, every care was taken in manufacturing these cylinders, and the tests to which they were subjected after manufacture, and on each occasion before being refilled, were ample.

### *Provision Trade Section.*

A meeting of this Section was held to consider what steps should be taken to safeguard the interests of the trade before the Parliamentary Committee on Adulteration. In reference to the adulteration of butter, cheese, and lard, resolutions in the following terms were adopted:—1st, "That the Trade Section, whilst not wishing to in any way interfere with the honest sale of margarine, is aware that it, and particularly margarine mixed with butter, is largely sold to the public as butter, and the Section is therefore of opinion that further legislation is necessary for the purpose of checking these frauds, which cause immense injury to honest traders and to the butter industry of this and other countries." 2nd, "That legislation should be enacted which will absolutely prohibit the sale of mixed or adulterated cheese. That such legislation should be enacted as will absolutely prohibit the sale of lard compounds or mixtures, and that lard shall be defined as the product of the hog only." Certain members of the Section were appointed to appear as witnesses before the Committee, if need be, in order to support these recommendations.

## *BOARD OF TRADE RETURNS.*

### Summary of Imports.

| Articles. | Month ending 30th April. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,661,457 | 1,351,907 |
| Chemicals and dyestuffs | 569,251 | 571,941 |
| Oils | 560,942 | 664,439 |
| Raw materials for non-textile industries. | 3,597,390 | 3,005,266 |
| Total value of all imports | 35,015,781 | 34,341,358 |

### Summary of Exports.

| Articles. | Month ending 30th April. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,426,068 | 2,232,083 |
| Chemicals and medicines | 747,794 | 675,553 |
| Miscellaneous articles | 2,477,315 | 2,703,189 |
| Total value of all exports | 17,559,876 | 17,252,311 |

## IMPORTS OF METALS FOR MONTH ENDING 30TH APRIL.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper :— | | | | |
| Ore ............. Tons | 5,754 | 9,517 | 50,755 | 48,482 |
| Regulus ........ „ | 6,523 | 7,680 | 136,144 | 191,516 |
| Unwrought .... „ | 5,396 | 3,786 | 229,778 | 152,970 |
| Iron :— | | | | |
| Ore............. „ | 428,329 | 377,550 | 290,618 | 271,439 |
| Bolt, bar, &c.... „ | 2,741 | 2,194 | 24,368 | 16,187 |
| Steel, unwrought.. „ | 416 | 669 | 4,036 | 7,177 |
| Lead, pig and sheet „ | 13,582 | 11,278 | 122,961 | 110,095 |
| Pyrites ........... „ | 51,585 | 50,572 | 92,510 | 85,246 |
| Quicksilver....... Lb. | 421,200 | 90,000 | 30,313 | 7,700 |
| Silver ore....... Value £ | .. | .. | 181,013 | 137,341 |
| Tin ............... Cwt. | 80,087 | 42,383 | 277,528 | 128,653 |
| Zinc .............. Tons | 5,295 | 3,744 | 71,613 | 54,654 |
| Other articles ...Value £ | .. | .. | 149,520 | 140,447 |
| Total value of metals | .. | .. | 1,661,457 | 1,351,907 |

## IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH APRIL.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 7,074 | 10,942 | 6,136 | 8,230 |
| Bark (tanners', &c.) „ | 18,124 | 19,697 | 6,815 | 7,034 |
| Brimstone ........ „ | 43,444 | 33,453 | 8,539 | 6,882 |
| Chemicals...... Value £ | .. | .. | 124,427 | 118,122 |
| Cochineal ........ Cwt. | 278 | 244 | 1,491 | 1,586 |
| Cutch and gambier Tons | 3,554 | 2,692 | 71,625 | 61,159 |
| Dyes :— | | | | |
| Alizarin ...... Value £ | .. | .. | 16,016 | 28,483 |
| Aniline and other „ | .. | .. | 15,983 | 35,592 |
| Indigo ........... Cwt. | 5,125 | 6,267 | 84,213 | 92,524 |
| Nitrate of potash . „ | 21,851 | 22,114 | 23,592 | 20,599 |
| Valonia ........... Tons | 1,478 | 4,857 | 17,673 | 51,773 |
| Other articles... Value £ | .. | .. | 192,711 | 139,957 |
| Total value of chemicals | .. | .. | 569,251 | 571,911 |

## IMPORTS OF OILS FOR MONTH ENDING 30TH APRIL.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut......... Cwt. | 4,850 | 15,828 | 5,630 | 17,479 |
| Olive .............. Tuns | 3,234 | 1,926 | 111,631 | 64,940 |
| Palm .............. Cwt. | 108,218 | 85,020 | 116,721 | 91,161 |
| Petroleum ......... Gall. | 11,928,146 | 14,907,872 | 184,599 | 299,777 |
| Seed .............. Tons | 1,939 | 4,176 | 42,749 | 82,046 |
| Train, &c. ......... Tuns | 931 | 994 | 18,675 | 17,863 |
| Turpentine ....... Cwt. | .. | 13,758 | .. | 14,271 |
| Other articles .. Value £ | .. | .. | 80,937 | 76,902 |
| Total value of oils ... | .. | .. | 560,942 | 664,439 |

## IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH APRIL.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 4,250 | 4,277 | 7,883 | 6,360 |
| Bristles........... Lb. | 247,521 | 269,564 | 41,195 | 36,523 |
| Caoutchouc...... Cwt. | 36,580 | 25,192 | 444,529 | 261,030 |
| Gum :— | | | | |
| Arabic......... „ | 3,614 | 4,960 | 9,778 | 13,476 |
| Lac, &c. ....... „ | 19,735 | 14,970 | 99,308 | 79,548 |
| Gutta-percha .... „ | 4,853 | 3,468 | 52,012 | 24,609 |
| Hides, raw :— | | | | |
| Dry............ „ | 51,306 | 38,068 | 117,202 | 73,954 |
| Wet ........... „ | 37,231 | 57,923 | 73,996 | 108,848 |
| Ivory ............ „ | 1,063 | 900 | 44,537 | 37,651 |
| Manure :— | | | | |
| Guano ......... Tons | 6,311 | 6,384 | 26,176 | 59,203 |
| Bones.......... „ | 8,410 | 7,081 | 39,448 | 30,503 |
| Nitrate of soda... „ | 25,530 | 38,078 | 247,386 | 309,750 |
| Phosphate of lime „ | 19,553 | 30,429 | 32,264 | 56,949 |
| Paraffin.......... Cwt. | 51,416 | 70,182 | 53,862 | 70,283 |
| Linen rags....... Tons | 1,649 | 1,906 | 15,987 | 22,621 |
| Esparto.......... „ | 19,089 | 12,823 | 84,514 | 53,042 |
| Pulp of wood .... „ | 21,421 | 21,509 | 114,175 | 111,591 |
| Rosin............ Cwt. | 97,856 | 108,940 | 18,711 | 24,194 |
| Tallow and stearin „ | 224,979 | 191,097 | 291,187 | 222,911 |
| Tar ..............Barrels | 2,084 | 1,752 | 2,096 | 933 |
| Wood :— | | | | |
| Hewn ......... Loads | 220,239 | 136,281 | 354,581 | 229,281 |
| Sawn .......... „ | 246,871 | 138,590 | 578,350 | 321,421 |
| Staves ......... „ | 9,021 | 4,944 | 40,298 | 24,322 |
| Mahogany ..... Tons | 3,902 | 3,382 | 28,599 | 27,681 |
| Other articles....Value £ | .. | .. | 779,316 | 798,579 |
| Total value ....... | .. | .. | 3,597,390 | 3,005,266 |

Besides the above, drugs to the value of 69,869*l*. were imported as against 64,975*l*. in April 1894.

### Exports of Metals (other than Machinery) for Month ending 30th April.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 9,959 | 9,368 | 37,389 | 36,290 |
| Copper:— | | | | |
| Unwrought..... „ | 35,667 | 44,230 | 78,971 | 93,668 |
| Wrought......... „ | 22,528 | 29,010 | 61,506 | 72,119 |
| Mixed metal.... „ | 22,458 | 32,012 | 50,470 | 63,429 |
| Hardware..... Value £ | .. | .. | 153,117 | 149,540 |
| Implements....... „ | .. | .. | 97,628 | 107,906 |
| Iron and steel..... Tons | 240,351 | 225,459 | 1,567,053 | 1,506,329 |
| Lead............. „ | 4,158 | 2,941 | 45,347 | 36,047 |
| Plated wares... Value £ | .. | .. | 21,600 | 24,886 |
| Telegraph wires „ | .. | .. | 186,739 | 35,544 |
| Tin............... Cwt. | 13,361 | 9,337 | 49,741 | 32,911 |
| Zinc.............. „ | 10,651 | 18,878 | 8,460 | 12,222 |
| Other articles .. Value £ | .. | .. | 68,227 | 61,192 |
| Total value......... | .. | .. | 2,426,068 | 2,232,083 |

### Exports of Miscellaneous Articles for Month ending 30th April.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 567,400 | 624,800 | 11,242 | 13,927 |
| Military stores.. Value £ | .. | .. | 89,434 | 186,862 |
| Candles.......... Lb. | 1,268,100 | 1,585,400 | 22,495 | 26,880 |
| Caoutchouc..... Value £ | .. | .. | 92,512 | 107,051 |
| Cement.......... Tons | 38,831 | 36,115 | 63,327 | 57,775 |
| Products of coal Value £ | .. | .. | 117,553 | 166,105 |
| Earthenware... „ | .. | .. | 127,655 | 146,448 |
| Stoneware...... „ | .. | .. | 14,262 | 13,495 |
| Glass:— | | | | |
| Plate........... Sq. Ft. | 96,187 | 87,010 | 4,934 | 4,534 |
| Flint........... Cwt. | 6,526 | 8,165 | 15,576 | 16,140 |
| Bottles......... „ | 59,968 | 56,849 | 28,591 | 27,028 |
| Other kinds.... „ | 13,403 | 16,221 | 10,886 | 13,595 |
| Leather:— | | | | |
| Unwrought.... „ | 12,467 | 11,527 | 110,519 | 100,197 |
| Wrought..... Value £ | .. | .. | 20,507 | 25,926 |
| Seed oil.......... Tons | 6,743 | 5,821 | 139,082 | 111,514 |
| Floorcloth ..... Sq. Yds. | 1,725,400 | 1,962,500 | 64,745 | 70,713 |
| Painters' materials Val. £ | .. | .. | 119,832 | 131,274 |
| Paper........... Cwt. | 76,074 | 82,647 | 121,206 | 131,352 |
| Rags............. Tons | 4,536 | 4,024 | 26,576 | 23,874 |
| Soap............. Cwt. | 47,180 | 57,732 | 50,566 | 58,416 |
| Total value.......... | .. | .. | 2,477,315 | 2,703,189 |

### Exports of Drugs and Chemicals for Month ending 30th April.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 465,990 | 484,611 | 132,147 | 120,488 |
| Bleaching materials „ | 106,401 | 114,718 | 42,109 | 42,186 |
| Chemical manures. Tons | 26,604 | 26,187 | 192,576 | 161,131 |
| Medicines....... Value £ | .. | .. | 80,628 | 83,815 |
| Other articles... „ | .. | .. | 300,334 | 267,938 |
| Total value.......... | .. | .. | 747,794 | 675,558 |

## Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

### I.—GENERAL PLANT, APPARATUS, and MACHINERY.

#### Applications.

7608. P. Kirkup and J. Hodgson. Improvements in furnaces and kilns. April 16.

7770. C. Merington. Improvements in apparatus for heating, airing, or drying. April 18.

7947. C. Bateson and C. Bateson. Improvement in furnaces for melting glass, puddling iron, or like operations. April 22.

8343. W. Shore and G. E. Coupe. Improvements in means or apparatus for separating solid from liquid matters. April 27.

8344. J. Laidlaw. Improvements in centrifugal machines for separating fluids of different densities. April 27.

8389. J. Kent. Improvements in the manufacture of thermometers. April 27.

8640. W. A. E. Crombie. Improvements in apparatus for evaporating or drying. May 1.

9011. E. J. T. Digby. An improved method of producing crucibles or melting pots. May 7.

9258. J. M. C. Grierson. Improvements in thermometers. May 10.

9355. W. T. Ramsden. Improvements in apparatus for producing cold. May 11.

9395. C. H. Wild. Improvements in certain hydraulic presses for pressing fabrics. May 13.

9418. Caddy and Co., Lim., and L. Edwards. Improvements in or relating to furnaces. May 13.

9729. J. L. Dorian and J. A. Dorian. Improvements in steam-heating and distilling apparatus. May 13.

9772. M. R. Ruble. Improvements in and connected with drying apparatus. May 17.

### Complete Specifications Accepted.*

1894.

17,219. R. Altschul. Improvements in or connected with feeding liquid fuel, such as petroleum and other oily and inflammable substances, to steam-boiler or other furnaces, and burning same therein. May 8.

23,956. S. J. Robinson and S. Pope. Improvements in open hearth steel-melting furnaces and regenerative furnaces generally. May 15.

1895.

6059. J. J. Tong and J. R. Wood. *See* Class XII.

7265. R. Urbanitzky. An improved melting and reducing furnace. May 15.

### Patent Abandoned.

1891.

11,043. G. W. Miller. Faucets for measuring fluids. April 24.

## II.—FUEL, GAS, AND LIGHT.

### Applications.

7606. S. Wolski. *See* Class X.

7664. L. G. Harris. Improvements in the manufacture of artificial fuel. April 16.

7714. W. Crookes. Improvements in connection with incandescent mantles. April 17.

7772. A. J. Fenner. Improvements in the manufacture of coke for smelting and other uses, and in the means or apparatus employed therein. April 18.

7814. T. H. L. Bake and H. A. Leverett. Improvements in apparatus for the production of hydrogen. April 18.

7919. W. Joy. Improvements in the utilisation of shale. April 20.

8374. F. Kuhn. A new or improved process for preparing, by the aid of gaseous mixtures, liquefied gas by compression. Complete Specification. April 27.

8680. G. H. Hirst, J. Hirst, A. Hirst, and A. Beaumont. A new means or method of generating heat by the use of spent gases arising from furnaces. May 2.

8746. A. R. Newman and J. M. Somerville. Improvements in the manufacture of illuminating gas. May 2.

9054. J. Cockshutt. An improvement in the manufacture of beeswax candles and in means to be used therein. May 7.

9082. J. C. Hanauer. An improved apparatus for use in the production of mineral gas. May 7.

9538. S. Cutler. Improvements in fittings for water-gas washers. May 14.

9556. C. C. Walker. Improvements in apparatus for washing and scrubbing gas. Complete Specification. May 14.

9739. D. W. Stone and B. Chaplin. An improved method of and apparatus for the treatment of smoke. May 16.

9831. S. H. Crocker. Improvements in the production of incandescent tissue for lamps. May 18.

### Complete Specifications Accepted.

1894.

8117. J. Posno. Improvements relating to the treatment of sewage and town refuse for transforming the same into fuel. May 1.

8670. B. H. Thwaite. Improved method of utilising the waste gases from iron-smelting blast-furnaces. May 8.

9197. H. Hawkins and S. H. Hawkins. Improvements in apparatus for manufacturing and carburetting hydrogen gas and producing metal sulphates as by-products. May 15.

11,256. J. Ormerod. Improvements in and connected with gas-carburetting apparatus. May 1.

12,663. E. Hermite, C. F. Cooper, and E. J. Paterson. An improvement in the purification of gas.

15,486. E. Edwards.—From The International Gesellschaft für Torfverwaltung. Improvements in apparatus and process for manufacturing coke and charcoal, and for separating the products obtained in such manufacture. May 15.

17,219. R. Altschul. *See* Class I.

1895.

2092. F. S. Cripps. Improvements in valves for use in connection with purifiers employed in gasworks. May 15.

3089. A. C. Humphreys and A. G. Glasgow. An improved method or process of carburetting water-gas and apparatus therefor. May 1.

5036. J. West. Improvements in machinery or apparatus for charging gas retorts. May 8.

5703. G. J. Altham. Improvement in fuel and the process of making the same. May 1.

5730. H. H. Lake.—From E. N. Dickerson and J. J. Suckert. An improved process of and apparatus for producing and liquefying acetylene gas. April 24.

5732. W. P. Thompson.—From G. D. Bayaud, G. F. Perrenoud, and G. H. Harvey. Improvements in or relating to the manufacture of gas from oil and air. May 15.

6585. P. Douin and P. Kestner. Improvements in the combustion of gaseous fuel and apparatus therefor. May 8.

## IV.—COLOURING MATTERS AND DYES.

### Applications.

7665. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of colouring matters. April 16.

7969. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of direct-dyeing colouring matters. April 22.

8572. S. Pitt.—From L. Cassella and Co. Producing dis- and poly-azo dyestuffs from $\gamma$-amidonaphtholsulpho acid. April 30.

8645. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Improvements in the production of new sulphonic acids derived from naphthaline and of colouring matters therefrom. May 1.

8661. G. W. Johnson.—From F. von Heyden, Nachfolger. The manufacture and production of benzo-sulphonimides or their nitro or halogen substitutes. May 1.

8988. P. A. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of chemical compounds and dyestuffs derived from phenolic bodies. May 6.

8989. P. A. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of chemical compounds suitable for the production of colouring matters in bulk or on fibre. May 6.

9103. G. W. Johnson.—From Kulle and Co. Improvements in the manufacture of amido bases and amido sulpho acids belonging to the naphthalene series and of colouring matters therefrom. May 7.

9431. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of poly-azo colouring matters. May 13.

9451. G. W. Johnson.—From Kulle and Co., Germany. Improvements in the manufacture of fast azo colouring matters especially adapted for dyeing on wool. May 13.

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* *See* Note (*) on previous page.

9471. W. Inman. Improvements in developing colouring matter in fustic (wood) or fustic extract. May 14.

9622. Brooke, Simpson, and Spiller, Lim., and W. S. Simpson. A new substance having colouring properties, and the process for its manufacture. May 15.

9645. S. Pitt.—From L. Cassella and Co. The manufacture of new azo dyes and of materials for producing the same. May 15.

9794. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of dyestuffs and materials therefor. May 17.

### Complete Specifications Accepted.

1894.

11,216. A. Wohl. Manufacture of hydroxylamine, hydrazine, and derivatives thereof. April 24.

11,569. O. Imray.—From The Farbenfabriken vormals Meister, Lucius, and Brüning. Production of red dye from paranitro-aniline. April 24.

11,641. O. Imray.—From The Farbenfabriken vormals Meister, Lucius, and Brüning. Process for production of black azo dyes on the fibre. April 24.

11,708. O. Imray.—From The Farbenfabriken vormals Meister, Lucius, and Brüning. Improved manufacture of paramethoxy- and para-ethoxyphenyl-urea. May 1.

11,717. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. April 24.

12,742. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. May 1.

13,260. O. Imray.—From Goerlich, Wichmann, and Co. An improvement in the manufacture of yellow prussiates from the rhodanalkalis. May 15.

13,577. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Improvements relating to the manufacture of nitrosamines. May 8.

15,305. J. Y. Johnson.—From the Badische Anilin and Soda Fabrik. The production of yellow colour in or upon silk by the aid of diazo-compounds or nitrosamines. May 22.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

7637. L. Schreiner. Method of producing a silky lustre upon fabrics and webs of all kinds. Complete Specification. April 16.

8053. J. B. Rapetout. An improved process for treating textile materials in order to render them less liable to be spotted or soiled. April 23.

8642. W. P. Thompson.—From R. C. L. E. de Swarte and J. M. E. Doumer, France. Improved process and apparatus for retting and drying flax and other textile materials. May 1.

8650. C. K. Mills.—From Fresca Frères et Cie. Improvements in the manufacture of silk thread. Complete Specification. May 1.

8714. R. J. Rastrick. Improvements in the treatment of rhea and other fibrous plants. May 2.

8858. S. Simon and R. Dux. Improvements in the preparation of textile materials and fabrics. May 4.

### Complete Specifications Accepted.

1894.

943. Manby. Sizing, dressing, and finishing of textiles, and material therefor. April 24.

8038. D. E. Radclyffe. Improved apparatus or method or system for preparing China grass, or rhea fibre, or hemp, or similar fibres, for combing or spinning. May 1.

13,345. W. P. Thompson.—From P. C. D. Castle. *See* Class XIV.

15,305. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. *See* Class IV.

1895.

7637. L. Schreiner. Method of producing a silky lustre upon fabrics and webs of all kinds. April 16.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

8633. J. H. Walton, J. Walton, and J. H. Walmsley. Improvements in sizing, dyeing, bleaching, and printing cotton and woollen yarns, and apparatus therefor. May 1.

8922. A. Ingham, S. Irwin, and A. D. McLaren. Improvements in and connected with the printing of textile warps. May 6.

9624. E. Bush. Improvements in or connected with machinery for varnishing or otherwise coating paper or other flexible material. Complete Specification. May 15.

### Complete Specifications Accepted.

1894.

10,392. J. Pritchard. Improvements in apparatus for dyeing yarns and slubbings or rovings, or otherwise treating the same with liquids. April 24.

10,466. E. B. Manby. An improvement in thickening and fixing calico-printers' pigments, colours, and mordants. May 1.

11,641. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. *See* Class IV.

1895.

2614. W. J. S. Grawitz. Improvements in dyeing or printing fibres black, or shades approaching thereto, with aniline, its homologues or derivatives. April 24.

5075. G. Keighley. An improved means or method of dyeing and bleaching warp upon a warp beam. May 8.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

7834. A. A. Moffatt. A new or improved process for the treatment and utilisation of "waste iodine still liquor." April 19.

7934. C. O. Weber and S. Kleemann. Improvements in the manufacture of cyanides and ferrocyanides. April 20.

8099. H. R. Angel. Improvements in the manufacture of sulphuric acid from ores of either low or high grade in sulphur. April 24.

8314. J. Brock and J. Hawliczek. Improvements in the manufacture of bicarbonate of soda. April 26.

8330. H. Bower. Improvements in the treatment of gas liquor or like ammoniacal liquor, and in obtaining useful products therefrom. April 26.

8342. J. Todd. An improved method of and apparatus for treating brine in the manufacture of salt. April 27.

8381. H. Bower. Improvements in the manufacture of prussiates. April 27.

8425. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of chemical compounds containing sulphur. April 29.

8449. C. Hoepfner. Improvements in and relating to the manufacture of solutions of zinc chloride and other metal chlorides. April 29.

8669. H. W. Crowther, E. C. Rossiter, and G. S. Albright. Improvements in the manufacture of cyanides. May 1.

8742. P. Jensen.—From E. de Haën. A process for manufacturing hyperoxide of alkali and of alkaline earths. May 2.

8847. E. J. Mills. Improvements in the formation and preparation of soluble colloids. May 4.

9052. J. C. Butterfield. *See* Class X.

9191. J. A. Mason. Improvements in the manufacture of caustic soda (sodium hydrate). May 9.

9332. T. Twynam. Improvements in the fixation of nitrogen and the production of cyanides. May 11.

9373. W. von Baranoff. Improvements in and connected with the manufacture of alkaline carbonates. May 11.

9555. W. von Baranoff. Improvements in and connected with the manufacture of alkaline carbonates. Complete Specification. May 14.

9558. M. W. Beylikgy. Process of manufacturing alkaline bichromates. Complete Specification. May 14.

9608. W. P. Thompson.—From S. Cantu and Co. An improved process for producing concentrated solutions of hydrofluosilicic acid and of hydrofluoric acid, as well as fluosilicates and fluorides derived therefrom. May 15.

### Complete Specifications Accepted.

1894.

8652. R. H. Leaker. Improved method of and apparatus for making vinegar and maturing spirits.

8889. O. Imray.—From Goerlich and Wichmann. An improvement in the manufacture of cyanides of the alkaline metals. May 8.

9197. H. Hawkins and S. H. Hawkins. *See* Class II.

9275. H. W. Crowther, E. C. Rossiter, and G. S. Albright. Improvements in the manufacture of cyanides. May 8.

11,655. J. Greenwood. Improvements in and connected with the manufacture or production of ammonia soda. May 22.

11,966. J. Brock, V. C. Driffield, and F. W. Wright. Improvements in and apparatus for effecting the decomposition of gases by means of porous or catalytic material, more especially intended for use in the production of chlorine from hydrochloric acid gas and air. April 24.

11,967. J. Brock, V. C. Driffield, F. W. Wright, and T. Davies. Improvements in apparatus for effecting the decomposition of gases by means of porous or catalytic substance, more especially intended for use in the production of chlorine from hydrochloric acid gas and air. April 24.

11,968. J. Brock, V. C. Driffield, A. Carey, and G. Ogg. Improvements in apparatus relating to the manufacture of chlorine. April 24.

11,988. G. S Albright and J. J. Hood. Improvements in the preparation of sulphur. May 1.

12,218. H. Y. Castner. Improvements in the manufacture of cyanides. April 24.

12,219. H. Y. Castner. Improvements in the manufacture of cyanides. April 24.

13,199. C. Raspe. Improvements in the manufacture of soluble metallic phosphate compounds. May 8.

13,202. H. Wilcox. *See* Class XIII.

13,315. W. McD. Mackey and J. F. Hutcheson. Improvements in the manufacture of ammonia. May 22.

14,215. J. W. Scott. Improved process of rectifying sulphuric acid and means or apparatus therefor. May 15.

17,978. K. J. Bayer. Improvements in the manufacture of chlorine acid potash or chlorate of potash. May 15.

22,844. I. Levinstein. Improvements in the method of and apparatus for concentrating sulphuric acid. May 15.

1895.

5299. O. Alins and M. Treitel. Improved apparatus for producing carbonic acid and other gases. May 8.

5354. H. J. Dartnell. Utilising the drainage and bilge water collecting in the bilge and limbers of ships used for the transportation of nitrate of soda. April 24.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

7914. C. D. d'Enghien, A. D. d'Enghien, and S. D. d'Enghien. Improvements in kilns or ovens for firing terra cotta and other like materials. Complete Specification. April 20.

7947. C. Bateson and C. Bateson. *See* Class I.

8409. H. Emery and J. Emery. An improved construction of kiln for firing articles made of or from china, earthenware, and the like. April 29.

8558. C. H. Tondeur. An improved method of and apparatus for the manufacture of glass for skylights and the like. Complete Specification. April 30.

8795. J. Faulkner and R. Hesketh. Improvements in or relating to the decoration of earthenware and the like. May 3.

9051. H. Boris. A new process of crystallisation on glass and transparent bodies, applicable to various uses, decorative or industrial. May 7.

9714. W. L. Wise, and from T. Lefevre and L. Michau. Improvements in the manufacture of glass plates. Complete Specification. May 16.

9801. J. A. Baker, W. K. Baker, and G. S. Baker. Improvements in machines for treating plastic material. Complete Specification. May 17.

### Complete Specifications Accepted.

1894.

9554. W. W. Pilkington. Improvements in apparatus for the manufacture of sheet and plate glass with embedded metallic wire. April 24.

12,056. R. M. Wight. Improvements in machinery or apparatus for use in the manufacture of sheet glass. May 8.

12,291. W. Hassall and H. W. Sansom. Improvements relating to fireplaces for pottery and other like kilns. May 1.

1895.

3560. V. F. L. Smith. Improvements in the construction of drying chambers for bricks, pottery, or other objects to utilise waste heat. May 22.

5008. T. H. Stubbs. Improved method or methods of decorating tiles or the like. April 17.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### APPLICATIONS.

7591. W. Jones and H. Jones. Improvements in the construction of fireproof tile ceilings, partitions, and the like. April 16.

7622. R. Walker. Improvements in the construction of artificial stone slabs, bricks, tiles, and the like. April 16.

7920. W. Joy. Improvements in arrangements for drying slurry by the waste heat from cement kilns. April 20.

8402. G. R. Dawnay. Improved tiles for permanent centering, to be used in the construction of fireproof floors. April 29.

9210. S. Jörgensen. Improvements in the manufacture of slag-cements. May 9.

9283. W. H. Metcalfe and F. B. Wrightson. The manufacture of an improved and artificial stone. May 10.

9876. H. H. Leigh.—From F. A. Jumeau, France. Improvements in and connected with the manufacture of pictures in cement or analogous material. May 18.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

9455. R. Hauers. Improvements in the preservation or treatment of buildings, structures, building materials, and the like. May 22.

13,607. R. Y. Ardagh. Improvements in the manufacture of wooden blocks for paving and flooring. May 22.

14,145. J. F. Golding. Improvements in the construction of floors and ceilings. May 22.

21,735. E. Weckwarth and M. Hoeft. Improvements in and relating to the manufacture of lime mixtures and cements, or mortars suitable for use in the production of artificial stone. May 8.

### PATENT ABANDONED.

1891.

12,219. W. J. Reagan and R. R. Longley. Composition for plastering walls. May 1.

## X.—METALLURGY, MINING, ETC.

### APPLICATIONS.

7575. J. Johnson.—From N. McConnell, United States. Improvements in the manufacture of alloys of iron or steel with nickel. Complete Specification. April 16.

7606. A. Wolski. An improved process for the utilisation of blast-furnace gases. April 16.

7669. H. C. S. Dyer. Improvements in the manufacture of iron and steel by which sulphur is eliminated. April 16.

7718. H. K. Jompkins. Improvements in the treatment of iron and steel. April 17.

7847. W. P. Thompson.—From La Société Néo-Metallurgie Marbeau, Chaplet, and Co. An improved process of manufacturing improved alloys of refractory metals with more fusible metals. April 19.

7947. C. Bateson and C. Bateson. *See* Class I.

7957. H. R. Angel. Improvements in the extraction of lead with silver, gold, or other metals from ores blended with sulphide of zinc or otherwise. April 22.

8047. A. Reichwald.—From F. Krupp and Co. Method of or process for improving or perfecting steel armour plates and other steel articles. Complete Specification. April 23.

8275. A. E. Westwood. An invention for a method of allowing molten metal to flow from a crucible by means of a perforation in the lower part of the crucible. April 26.

8297. A. Reichwald.—From F. Krupp and Co. Method of or process for increasing the toughness and hardness of armour plates and other articles made of steel or of mixtures of steel capable of being hardened. Complete Specification. April 26.

8328. C. Hoepfner. Improvements in and relating to the treatment of zinc, lead, and silver, or cobalt and nickel ores or materials. April 26.

8376. A. Schmidt. Improvements in and relating to the extraction of gold and silver from their ores. April 27.

8531. J. B. Rudkin. A process for the treatment of refractory metallic ores, consisting of sulphides of lead, zinc, silver, and other metals in chemical combination. April 30.

8536. E. D. Kendall. A process for the recovery of gold and silver from solutions. Complete Specification. April 30.

8867. H. Grosvenor. Improvements in the manufacture of armour plates. May 4.

9052. J. C. Butterfield. Improvements in the treatment of blue-stone and other sulphurised ores. May 7.

9068. E. B. Parnell. Improvements in the extraction of metals from ores. May 7.

9072. E. E. Lungwitz. New or improved process and apparatus for reducing or smelting ores. Complete Specification. May 7.

9073. W. A. Thoms and J. Stephenson. An improvement in alloys. May 7.

9081. H. C. S. Dyer. Improvements in the manufacture of iron and steel by which sulphur is eliminated. May 7.

9610. W. P. Thompson.—From H. Schaaf. An improved thin liquid substance for case-hardening iron. May 15.

9635. C. Raleigh. Improved means applicable for use in precipitating metals from their solutions. May 15.

9793. F. Arnand. An improved process for converting cast iron into steel in a Siemens-Martin furnace. May 17.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

8183. W. P. Thompson.—From L. R. Bonehill and E. T. Gautier. Improved process and apparatus for extracting metals from their ores. April 3.

11,570. S. Hufty and J. K. Caldwell. Improvements in methods of partially decarbonising and converting iron and increasing carbon in wrought iron and steel. May 8.

15,225. S. Hufty and J. K. Caldwell. Certain improvements in processes of converting cast iron into malleable iron or steel. May 8.

18,569. J. Harris. Improvements in apparatus for treating ores. May 8.

20,071. L. Bangert. Process for coating metals with tin. May 8.

25,322. A. Lencauchez. Improvements relating to the production of homogeneous cast iron or steel and to apparatus therefor. April 24.

1895.

1514. J. Y. Johnson.—From L. Pelatan and F. Clerici. Process of and apparatus for treating and desulphurising ores. May 15.

5512. H. Potter.—From C. Dormoy. An improved composition for anti-friction metal. May 1.

5539. H. Potter.—From C. Dormoy. An improved composition for anti-friction metal. May 1.

6323. A. Reichwald.—From F. Krupp. Method or process of reducing metals or mixtures of metals containing oxygen. May 15.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### APPLICATIONS.

7600. W. Rowbotham, H. Levetus, and S. J. Levetus. Improvements in and relating to primary batteries. April 16.

7657. W. M. McDougall, H. B. Adams, and G. P. Smith. Improvements in secondary or storage batteries. Complete Specification. April 16.

7773. H. Tee. Improvements in or connected with the production of electricity. April 18.

7888. E. Etève. Improvements in electric cells or batteries. April 19.

8011. G. Hübener. Improvements in the electrodes or plates of electric storage batteries. Complete Specification. April 23.

8081. A. Schanschieff. Improvements in the active material for secondary and primary batteries. April 23.

8226. J. von der Poppenburg. Improvements in and relating to electric batteries. Complete Specification. April 25.

8306. C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell. Improvements in or connected with electric batteries. April 26.

8373. W. S. Rawson. Improvements in conductors for coupling cells of voltaic batteries. April 27.

8637. E. Clark. Improvements in secondary batteries, May 1.

8728. J. G. A. Rhodin. Improvements in plates for secondary voltaic batteries. May 2.

8729. L. Epstein. An improvement in secondary voltaic batteries. May 2.

8740. M. Bailey and J. Warner. Improvements in secondary batteries. May 2.

8876. C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell. Improvements in or connected with electric batteries. May 4.

8904. C. L. R. E. Menges. Improvements in primary and secondary battery plates. May 4.

8905. C. L. R. E. Menges. Improvements in primary and secondary galvanic batteries. May 4.

9050. E. Bailey, T. Cupper, A. L. Stobbs, W. A. Wilson, and J. W. Pollard. An improved process for the production of lead compounds or other metallic compounds by electrical means. May 7.

9257. J. Hargreaves. Improvements in cells and diaphragms for use in electrolysis. May 10.

9429. H. Guthrie. Improvements in apparatus for electrolytical purposes. May 13.

9515. R. D. Cassells and G. Dowie. Thermo-chemical processes for generating electricity. May 14.

9779. W. Mather. An improvement in secondary batteries. May 17.

9806. R. Comboul. Improvements in diaphragms for use in electrolytical apparatus. May 17.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

7950. H. Guthrie. Improvements in apparatus for electrolytical purposes. April 24.

8731. T. Froggatt. Improvements in electric batteries. April 24.

9368. F. Brain. Improvements in electric fuses. May 8.

10,952. C. Hoepfner. Improvements in electrodes. May 8.

12,650. B. M. Drake and J. M. Gorham. Improvements in storage battery plates. May 8.

13,363. W. A. B. Buckland. An improved plate for secondary voltaic batteries. May 15.

17,741. W. P. Thompson. From A. Lessing. Improvements in or relating to galvanic batteries. May 8.

1895.

4939. E. Andreoli. A new process of electrolysis and apparatus therefor. May 8.

6163. W. A. B. Buckland. Plate for secondary voltaic battery. May 8.

7657. W. M. McDougall, H. B. Adams, and G. P. Smith. Improvements in secondary or storage batteries. April 16.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### APPLICATIONS.

7706. C. Morfit. Improvements in the treatment of cod-liver oil. April 17.

8798. R. Gartenmeister, O. Stommel, and F. Vorberg. Improvements in composition of matter used for cleansing and removal of greasy matter, oil or paint spots from dresses and textile fabrics. Complete Specification. May 3.

8814. W. P. Thompson.—From J. B. Okie. An improved process for making tormentil soap by the cold process. May 3.

9153. G. Mitchell. A new or improved process for the treatment and refining of vegetable oils during or subsequent to their expression from nuts, beans, seeds, and the like. May 8.

9304. F. L. Bartelt. An improved compound to be used in the preparation of leather, wool, and other fibrous material for manufacturing purposes and also as a lubricant. May 10.

9503. E. Maertens. Improvements in refining and separating wool-fat into sundry constituent parts. Complete Specification. May 14.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

9200. M. Zingler and W. Chattaway. *See* Class XV.

11,324. F. B. Aspinall. Improvements in the treatment of cotton-seed oil. May 15.

11,832. J. McDonald.—From E. J. Pearson. Improvements in the manufacture of soap. May 15.

12,072. J. P. F. Field. Improvements in and relating to the manufacture of soap for laundry and other purposes. May 22.

1895.

5197. J. H. Filbert. Apparatus for deodorising fats and oils. May 8.

5226. A. J. Boult.—From G. W. Washburn. Improvements in or relating to the treatment of cotton seed. May 15.

6059. J. J. Tong and J. R. Wood. Improvements in apparatus for filtering oils and the like. May 8.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

7592. W. L. Livermore. Improvements in and connected with the methods of vulcanising india-rubber. April 16.

7962. R. V. Houssart. An improved insulating compound. April 22.

8095. J. Tennant, J. Tennant, and W. R. Tennant. Improvements in the manufacture of gold paint for interior gilding and other purposes. April 24.

8478. T. Lowe. Improvements in non-corrosive paint to resist the action of heat and atmospheric influence. April 30.

8915. H. Fleming. Improvements in the manufacture of varnish. May 4.

9790. R. T. Sutton. Improved composition of matter for indelible ink. May 17.

9891. H. R. Gregory. Improvements in the manufacture of sulphate of lead and lead pigments. May 18.

### Complete Specifications Accepted.

1894.

9655. J. S. MacArthur. Improvements in making white lead. April 17.

13,202. H. Wilcox. Improvements in or relating to the manufacture of white lead and nitrate of ammonium. May 22.

1895.

1457. J. C. Sellars. Improved, or improvements connected with, protective covering for surfaces. May 8.

7366. H. Kolker, B. Kolker, and H. Naphtali. Improvements relating to paints suitable for coating iron and other surfaces. May 15.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

8040. W. L. Wise, E. Moritz and Co. Improvements in machinery or apparatus for treating skins in the manufacture of leather. April 23.

8215. H. Schmiedel. Improvements in the manufacture of imitation or artificial leather. April 25.

8360. O. Thiele and J. Stocker. Manufacture of artificial leather. May 6.

9713. M. J. Volcker and M. W. G. Bergmann. Improved process of tanning with mineral agents. Complete Specification. May 16.

### Complete Specifications Accepted.

1894.

9090. R. Combret. Improvements in the manufacture of substances suitable for finishing, polishing, preserving, or otherwise treating leather skins, hides, and the like. May 8.

13,345. W. P. Thompson.—From P. C. D. Castle. Improvements in the manufacture of gum or size, applicable for use with cotton, wool, silk, linen, or other textile fabrics. May 15.

1895.

6692. F. Prelli and B. Demo. Improvements in or relating to the tanning of hides or skins. May 15.

## XV.—AGRICULTURE and MANURES, Etc.

### Applications.

8101. R. T. Savage and E. G. Walker. Treating animal blood for manurial purposes. April 24.

8232. A. A. Dickson. Improvement in the manufacture of fertilisers. April 25.

9817. A. D. Cohen and J. C. S. McLay. Improvements in fertilisers. May 18.

### Complete Specifications Accepted.

1894.

5517. D. Blyth. Improvements in the preparation of manures. May 22.

9200. M. Zingler and W. Chattaway. Improvement of manufacturing guano from the refuse of fish and other animal matter, and the extraction of oil or fat therefrom. May 8.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

7997. G. D. Hart and C. L. Hart. Improvements in the manufacture of ferment leavens. Complete Specification. April 23.

5518. D. Blyth. Improvements in the method of purifying and decolorising saccharine, amylaceous, and other fluid bodies. May 22.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

7813. A. J. Boult.—From G. R. Besser. Improvements in processes and apparatus for ageing fluids containing alcohol. Complete Specification. April 18.

7997. G. D. Hart and C. L. Hart. *See* Class XVI.

8123. W. P. Thompson.—From J. Effront. An improved process for the fermentation of worts which have been rendered antiseptic. April 24.

8319. E. Heinemann. A process and apparatus for infusion and extraction of hops. Complete Specification. April 26.

### Complete Specifications Accepted.

1894.

8652. R. H. Leaker. *See* Class VII.

11,310. H. H. Lake.—From P. W. Sothmann. Improvements relating to the ageing or maturing of wine, cognac, and other alcoholic beverages, and to apparatus therefor. April 24.

12,196. A. F. Spencer. Improved preparations to be used in brewing and in the treatment of finished beer. May 8.

13,492. R. Zdarek. Improvements in the manufacture of alcohol. May 8.

22,270. P. L. F. E. Vignier. Improvements in and relating to distilling apparatus, chiefly designed for the manufacture of pure grape spirit and of whiskies free from fusel oil. May 15.

1895.

3956. F. Calmant. Purifying and ageing brandies, cognac, whiskey, and gin, and in apparatus therefor.

4627. A. Fraser. Improvements in or relating to the manufacture of oat malt stout, that is to say, porter. May 1.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

### Applications.

### A.—*Chemistry of Foods.*

7695. T. R. Mason and G. V. Alsing. Improvements in and connected with the sterilisation and preservation of milk, cream, and other fluids. April 17.

7988. T. B. Percy. An improved product for use in the preparation of articles of food. Complete Specification. April 22.

8044. G. Gaertner. Process for reducing the proportion of caseine contained in milk. Complete Specification. April 23.

8779. M. Pedersen. An improved process and means for preserving milk, cream, and other liquids. May 3.

9411. E. Adair. Improvements in the process of manufacturing bread, specially relating to fermentation and the preparation of materials for same. May 13.

9639. J. Wood. Improved means of preserving milk and other liquids and semi-liquids, principally for food products, in a liquid or semi-liquid form. May 15.

9687. J. Edge. Sterile water. May 16.

### B.—*Sanitary Chemistry.*

8256. T. Royle. An improved method of purifying water. April 26.

8877. P. O'Dowd. Improvements in apparatus for the disinfection of sewage. May 4.

9071. E. Fischer, E. Klein, and F. Mahlstedt. A new or improved resistance regulator for apparatus employed in the separation of amalgam and other metallic molecules from sludge. Complete Specification. May 7.

### C.—*Disinfectants.*

7924. E. Greenfield. The preparation of an absorbent dust or fibre for disinfecting purposes. April 20.

8575. J. J. A. Trillat. Improvements in vaporising apparatus, more especially for use in producing vapours of formic aldehyde or formol for disinfecting purposes. Filed April 30. Date applied for, October 9, 1894, being date of application in France.

9535. I. S. McDougall and J. T. McDougall. Improvements in insecticides. May 14.

9672. A. D. Cohen and J. C. S. McLay. Improvements in disinfectants. May 16.

### Complete Specifications Accepted.

### A.—*Chemistry of Foods.*

1894.

6010. H. H. Lake.—From F. Delangle. Improvements relating to the preservation of alimentary and other organic substances. May 22.

9765. T. P. Hawksley. A simple and effectual apparatus whereby milk may be sterilised or rendered absolutely free from disease germs and adapted for family use. May 8.

11,393. W. F. E. Casse. Process and container for preserving milk, cream, and other liquids. May 1.

1895.

3166. W. Gaedke. Process for the extraction or rendering soluble cocoa. May 8.

### B.—*Sanitary Chemistry.*

1894.

8117. J. Posno. *See* Class II.

9338. O. Schmidt. An improved process for purifying sewage and waste water of a putrescible character. May 15.

11,188. J. E. Keirby. Improvements in apparatus for supplying, precipitating, and purifying materials employed in the treatment of sewage and other analogous purposes. April 24.

13,171. F. W. Lacey. Improvements in apparatus for the treatment of towns' refuse. May 8.

1895.

5257. S. Pitt.—From The Drainage Construction Co. Improvements in the treatment of sewage and in apparatus therefor. April 24.

6632. J. Berry. Improvements in apparatus for mixing precipitants with sewage and the like liquids. May 8.

## XIX.—PAPER, PASTEBOARD, ETC.

### Applications.

7698. W. Teggin. Improvements in the manufacture of waterproof paper and paper board. Complete Specification. April 17.

7700. W. Teggin. Improvements in the manufacture of waterproof paper bags. Complete Specification. April 17.

8847. E. J. Mills. *See* Class VII.

9303. W. Mottershall. Improvements in the preparation of paper for copying and printing purposes. May 10.

### Complete Specifications Accepted.

1894.

12,978. R. Münch. Improvements in the manufacture of albumenised paper. May 22.

1895.

6999. J. P. Cornett. Improvements in or connected with the boiling of esparto or like fibrous material in the manufacture of paper. May 15.

7698. W. Teggin. Improvements in the manufacture of waterproof paper and paper board. April 17.

7700. W. Teggin. Improvements in the manufacture of waterproof paper bags. April 17.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

### Complete Specifications Accepted.

1894.

10,112. S. Pitt.—From The Chemische Fabrik auf Actien vormals E. Schering. The production of homologues of vanillin. April 24.

11,774. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of mandelate of antipyrine. April 24.

12,980. C. D. Abel.—From The Fabriques de Produits Chimiques de Thannet Mulhouse. Improvements in the manufacture of artificial musk. May 8.

12,987. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of chemical compounds containing iodine. May 15.

1895.

2656. A. Knoll. New or improved manufacture or production of crystallised compound of antipyrine. April 24.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### Applications.

9438. F. Hrdliczka-Csiszar. Improved printing silver nitrate paper for photographic purposes and process of preparing same. May 13.

9842. T. Thomson. Improvements in waterproof cements, applicable in connection with photography and for other purposes. May 18.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

7641. A. Morley. Improvements in matches, vesuvians, and the like. April 16.

8239. H. Maxim. Improvements in detonating fuses. April 25.

8356. W. Hope and I. A. Timmis. Improvements in gunpowder. April 27.

8556. J. D. Kendall. Improvements in or connected with detonators and fuses. April 30.

9432. M. Bals, C. Noel, and G. Gerrersdorfer. Manufacture of matches and apparatus therefor. May 13.

9798. H. V. Keeson. Improvements in fuses for projectiles. May 17.

### Complete Specifications Accepted.

1894.

12,084. D. Hickie and G. F. Beutner. Improvements in explosives. May 1.

12,649. D. Hickie and G. F. Beutner. Improvements in detonators. May 8.

13,276. H. Priester. Improvements in igniting compositions for safety matches. May 15.

1895.

3867. A. Viebig. Improvements in safety matches. May 8.

5235. J. Graham. Improvements in pyrotechnic compounds. April 24.

5386. G. W. Thomas. Improvements in matches, fusees, and the like. May 1.

6327. H. R. von Dahmen. Improvement in blasting compositions. May 1.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

# THE JOURNAL

OF THE

# Society of Chemical Industry:

## A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 6.—Vol. XIV.] JUNE 29, 1895. [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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Watson Smith, 34, Upper Park Road, Haverstock Hill, N.W.

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| A. L. Stern, D.Sc. ... | XVII. |
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| C. Otto Weber, Ph.D. | IV., XIII. |
| J. G. Wells ...... | XVII., XX. |
| A. Wingham ........ | X. |

## NOTICES.

In accordance with the provisions of Rule 18 of the Bye-laws, notice is hereby given that those Members of Council whose names are placed in italics in the annexed list will retire from their respective offices at the forthcoming Annual General Meeting.

Mr. Thos. Tyrer has been nominated to the office of President; and Prof. T. E. Thorpe, F.R.S., has been nominated Vice-President under Rule 11.

Mr. T. Fairley, Mr. Boverton Redwood, and Sir H. E. Roscoe, M.P., F.R.S., have been nominated Vice-Presidents under Rule 8; and Mr. C. C. Hutchinson has been nominated an Ordinary Member of Council under Rule 17, in the place of Mr. Thos. Tyrer, nominated to the office of President.

Mr. Ivan Levinstein has been nominated an Ordinary Member of Council under Rule 24, and the Treasurer and Foreign Secretary have been nominated for re-election to their respective offices.

Mr. R. Le Neve Foster, Mr. W. Douglas Herman, Mr. J. S. MacArthur, and Sir Robt. Pullar have been nominated under Rule 18 to fill four vacancies among the Ordinary Members of Council.

A Ballot List and Member's Ticket have already been issued under separate cover.

The Annual General Meeting will be held in Leeds on the 17th, 18th, and 19th of July next, and Members are reminded that it will greatly facilitate the arrangements if they will kindly inform the Local Secretary, as soon as possible, whether they intend to be present.

### *Sketch Programme.*

Wednesday, July 17th.

10 a.m.—Council Meeting.

10.30 a.m.—Annual General Meeting and President's Address at Yorkshire College.

1 p.m.—Lunch, followed by inspection of College Buildings.

3 p.m. to 6 p.m.—Visits to works; including the Monkbridge Iron and Steel Co., Burmantofts Pottery, and Messrs. Greenwood and Batley.

8.30 p.m.—Conversazione, by invitation of the Mayor of Leeds.

Thursday, July 18th.

The excursions will be divided between the *Leeds and Bradford* districts.

The *Leeds* group will include:—

Messrs. Tetley's Brewery; The Leeds Steelworks; Messrs. Jackson's Tannery; Messrs. Flitch's Leather Works; The Clarence Ironworks; Messrs. Barran's Clothing Manufactory; Messrs. Illingworth and Ingham's Timber Works; and (provided sufficient applications are received) Messrs. Breffitt's Glassworks at Castleford, and Coal-washing Machinery.

The *Bradford* group will include:—

Sir Titus Salt, Bart., and Co., Saltaire; Messrs. E. Ripley and Sons, Bowling Dyeworks; Messrs. John Smith and Sons, Ltd., Wool Combers and Spinners; Messrs. Grandage and Co., Dyeworks; Messrs. Pickles, Smithson, and Pickles, Ltd., Chemical Works; the warehouses of Messrs. A. and S. Henry and Co., Ltd., and Messrs. Milligan, Forbes, and Co.; and Messrs. Rule, Greenlees, and McEwan's Manufactory.

7.30 p.m.—Annual Dinner.

Friday, July 19th.

Excursion to Wharfedale, including Bolton Abbey, Burnsall, Barden, and Skipton.

9 p.m.—Smoking Concert, by invitation of the Priestley Club.

The above is subject to modification.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10*s.* |
| To Subscribers | 12*s.* 6*d.* |
| To others | 15*s.* |

## LIST OF MEMBERS ELECTED 21st JUNE 1895.

Adamson, Geo. P., 233, Reeder Street, Easton, Pa., U.S.A., Manufacturing Chemist.

Baum, Henry, 145, Dickenson Road, Rusholme, Manchester, Chemist.

Carter, Stewart F., P.O. Box 221, North Adams, Mass., U.S.A., Chemist.

Johnson, Jesse F., c/o Hamilton Powder Co., Montreal, Canada, Chemical Engineer.

Lovejoy, Frank W., 58A, Chestnut Street, Cambridgeport, Mass., U.S.A., Chemical Engineer.

McMurtry, Geo. C., Wallaroo, South Australia, Metallurgist.

Moale, Philip R., c/o New York and Boston Dyewood Co., Green and West Streets, Greenpoint, Brooklyn, N.Y., U.S.A., Research Chemist.

Phillips, Samuel C., 130, Fleet Street, London, E.C., Chemical Engineer.

Reed, Dr. J. Hastings, (Journals) c/o Colonial Sugar Refinery, Fiji; and (subs.) c/o R. B. Reed, Springfield, Forest Hall, near Newcastle-on-Tyne, Sugar Manufacturer.

Seabrooke, H. Cecil, The Echoes, Grays, Essex, Chemical Research Assistant.

Sherman, Geo. W., c/o Boston Woven Hose and Rubber Co., Cambridgeport, Mass., U.S.A., Chemical Engineer.

Ungerer, Wm. G., c/o Colgate and Co., 55, John Street, New York City, U.S.A., Manufacturing Perfumer.

## BIRTHDAY HONOURS.

The following members of the Society are included in the list: — *Baronetcy:* John Tomlinson Brunner, M.P. *Knighthood:* Robt. Pullar.

## STATEMENT OF REVENUE AND EXPENDITURE FOR THE YEAR 1894.

### REVENUE.

| | £ s. d. | £ s. d. |
|---|---|---|
| Annual Subscriptions for 1894:— | | |
| 62 subscriptions received in 1893 ...... | 77 9 9 | |
| 2,553 subscriptions received in 1894 ...... | 3,191 2 11 | |
| 28 subscriptions received in 1895 ...... | 35 0 0 | |
| Sundry balances (short paid in 1893) | 0 19 0 | |
| | | 3,304 11 8 |
| 2,643 | | |
| 21 Life Composition Fees .................. | 315 0 0 | |
| Interest on Deposit Account .............. | 7 19 11 | |
| Interest on Metropolitan Consolidated Stock | 129 19 2 | |
| Interest on North British Railway Consolidated Lien Stock .................. | 31 11 0 | |
| Interest on Gas Light and Coke Company's 6 per cent. Debenture Stock ............. | 8 14 5 | |
| Interest on Midland Railway 4 per cent. Preference Stock ......................... | 17 6 11 | |
| | | 196 1 5 |
| Journal:— | | |
| Advertisements ........................ | 568 0 0 | |
| Sales ................................. | 292 10 3 | |
| | | 860 10 3 |
| | | £4,361 3 4 |

### EXPENDITURE.

| | | £ s. d. | £ s. d. |
|---|---|---|---|
| Journal Expenses:— | | | |
| Publishing ........................ | | 1,819 0 6 | |
| Insurance of Stock .................. | | 3 18 0 | |
| Editorial:— | | | |
| Editor's Salary ......... | 500 0 0 | | |
| „ Expenses ....... | 44 19 1 | | |
| Abstractors ............ | 442 4 3 | | |
| Portion of Secretary's Salary ................ | 100 0 0 | | |
| Indexing Journal ....... | 61 15 0 | | |
| Patent Lists ........... | 69 10 3 | | |
| Foreign Journals ....... | 7 4 6 | | |
| | | 1,225 13 1 | |
| | | | 3,048 11 7 |
| Sundries—Printing, &c. ........................................ | | | 59 6 6 |
| Sectional Expenses ........................................ | | | 286 7 4 |
| Secretary's Salary (Portion not included in Journal Editorial Expenses) ........................................ | | | 300 0 0 |
| Expenses in connection with Annual Meeting ......... | | | 150 0 0 |
| Hon. Treasurer's Assistant ........................................ | | | 52 10 0 |
| Office Expenses ........................................ | | | 116 2 4 |
| Library ........................................ | | | 17 17 10 |
| Stationery ........................................ | | | 62 15 7 |
| Auditors' Fee ........................................ | | | 10 10 0 |
| Solicitor's charges ........................................ | | | 2 0 8 |
| Bank Charges ........................................ | | | 3 1 9 |
| Treasurer's Petty Cash ........................................ | | | 16 13 4 |
| Secretary's Petty Cash ........................................ | | | 56 16 3 |
| Balance of Revenue over Expenditure ......... | | | 178 10 2 |
| | | | £4,361 3 4 |

## THE TREASURER—IN ACCOUNT WITH THE SOCIETY OF CHEMICAL INDUSTRY FOR THE YEAR 1894.

Dr.

| | £ s. d. | £ s. d. |
|---|---|---|
| To Balance at Bank (1st January 1894) .... | 229 18 3 | |
| Balance in Treasurer's hands (1st January 1894) ............................ | 14 17 0 | |
| Balance in Secretary's hands (1st January 1894) ............................ | 1 0 7 | |
| | | 245 15 10 |
| Annual Subscriptions:— | | |
| 1 subscription for the year 1890 . | 1 5 0 | |
| 1 subscription for the year 1891 . | 1 5 6 | |
| 1 subscription for the year 1892 . | 1 5 0 | |
| 28 subscriptions for the year 1893. | 35 0 1 | |
| 2,553 subscriptions for the year 1894 (less 2*s.* 1*d.* short paid) ........ | 3,191 2 11 | |
| 77 subscriptions for the year 1895 (less 7*s.* short paid) ........... | 95 18 3 | |
| 1 subscription for the year 1896. . | 1 5 0 | |
| 2,662 | | |
| Sundry amounts received on account of Subscriptions for 1893, 1894, 1895, and 1896.... | 3 18 0 | |
| | | 3,330 19 9 |
| Life Composition Fees ................. | .. | 315 0 0 |
| Interest on Deposit Account ........... | 7 19 11 | |
| Interest on 4,476*l.* 9*s.* 2*d.* Metropolitan 3 per cent. Consolidated Stock ........ | 129 19 2 | |
| Interest on 813*l.* 10*s.* North British Railway 4 per cent. Consolidated Lien Stock | 31 11 0 | |
| Interest on 460*l.* Midland Railway 4 per cent. Preference Stock ............... | 17 16 11 | |
| Interest on 300*l.* Gas Light and Coke Company's 6 per cent. Debenture Stock | 8 14 5 | |
| | | 196 1 5 |
| Journal:— | | |
| Advertisements ..................... | 576 0 0 | |
| Sales .............................. | 298 16 11 | |
| | | 874 16 11 |
| | | £ 4,962 13 11 |

Cr.

| | £ s. d. | £ s. d. |
|---|---|---|
| By Journal Expenses:— | | |
| Publishing ........................ | 1,776 3 5 | |
| Editorial ......................... | 1,207 15 11 | |
| Insurance of Stock ................ | 3 18 0 | |
| | | 2,987 17 4 |
| Sundries, Printing, &c. ............................ | | 56 14 6 |
| Sectional Expenses:— | | |
| Glasgow Section .................... | 56 10 1 | |
| Liverpool Section .................. | 33 16 11 | |
| London Section ..................... | 84 6 9 | |
| Manchester Section ................. | 53 16 0 | |
| Newcastle Section .................. | 10 5 0 | |
| Nottingham Section ................. | 4 18 6 | |
| Yorkshire Section .................. | 21 12 7 | |
| | | 265 5 10 |
| Secretary's Salary (balance not included in Journal Editorial Expenses) .......................... | | 300 0 0 |
| Hon. Treasurer's Assistant (for work in 1893)...... | | 52 0 0 |
| Stationery ........................................ | | 48 16 0 |
| Expenses in connection with Annual Meeting...... | | 150 0 0 |
| Office Expenses .................................... | | 116 2 4 |
| Library ............................................ | | 17 17 10 |
| Auditors' Fee ...................................... | | 10 10 0 |
| Bank Charges ....................................... | | 3 1 9 |
| Purchase of 300*l.* Gas Light and Coke Company's 6 per cent. Debenture Stock ....................... | | 541 5 3 |
| Treasurer's Petty Cash ............................. | | 16 13 4 |
| Secretary's Petty Cash ............................. | | 56 16 3 |
| Balance at Bank (31st December 1894) .. | 288 11 1 | |
| Balance in Treasurer's hands (31st December 1894) .......................... | 45 0 0 | |
| Balance in Secretary's hands (31st December 1894) .......................... | 6 2 5 | |
| | | [*]339 13 6 |
| | | £ 4,962 13 11 |

[*] In addition to this there are the following Investments:—Metropolitan 3 per cent. Consolidated Stock, 4,476*l.* 9*s.* 2*d.*; North British Railway Company, 4 per cent. Consolidated Lien Stock, 813*l.* 10*s.*; Midland Railway Company, 4 per cent. Preference Stock, 460*l.*; Gas Light and Coke Company, 6 per cent. Debenture Stock, 300*l.*

We have compared the above Statement with the Receipt Books, Counterfoils, Vouchers, and Books of the Society, and certify it to be correct. We have also verified the amount of the Metropolitan Stock, 4,476*l.* 9*s.* 2*d.*, by reference to the Books of the Bank of England, and inspected the Certificates for the North British and Midland Railway Stocks and Gas Light and Coke Company's Debenture Stock. The Balance of Cash at the Bankers and in hand is correctly stated.

(Signed) ARTHUR MIALL,
Chartered Accountant.
(Of Theobald Bros., Miall and Co.)

23, St. Swithin's Lane, London, E.C.,
March 1895.

## CHANGES OF ADDRESS.

Ambler, C. T., l/o Monghyr; Jamalpur, E. I. Ry., Bengal, India.

Bothamley, C. H., l/o Taunton; Wentworth, Weston-super-Mare.

Brown, G. E., l/o Park Lane; Great Western Railway Laboratory, Swindon.

Carpenter, H. S., Beckington (not Beckingham as in list) House, Anerley, S.E.

Connor, C. C., M.P.; l/o Notting Hill House; 4, Queen's Elms, Belfast.

Cordner-James, J. H., l/o Sherborne Lane; Finsbury House, Blomfield Street, E.C.

Coste, J. H., l/o Stoke Newington; Chemical Department, L.C.C., 40, Craven Street, W.C.; and (Journals), 206, Amhurst Road, Hackney, E.

Edwards, H. W., l/o Arizona; 514, Utah Avenue, Santa Monica, Cal., U.S.A.

Ellis, Chas. J., l/o Mysore; c/o Cassell Gold Ext. Co., 13, West Scotland Street, Kinning Park, Glasgow.

Fawcett, Jas. H., l/o London; c/o Bank of Australasia, Perth, West Australia.

Griffith, D. Agnew, l/o Birkenhead; Ballaspet, St. John's, Isle of Man.

Hart, Prof. E.; Journals (temporary) c/o Baring Brothers and Co., Lim., 8, Bishopsgate Street Within, E.C.

Hill, Frank, l/o Whitehall Street; 52, Water Street, New York, U.S.A.

Hosie, G. H., l/o Torquay; Greenbank, Lochgoilhead, Argyllshire.

Ingalls, Walter R., l/o New York; P.O. Box, 95, Cripple Creek, Colorado, U.S.A.

McKenzie, Angus, l/o Whitehall Street; 52, Water Street, New York, U.S.A.

Picard, H. K., l/o Abbey Road; 18, Sandwell Mansions, West End Lane, N.W.

Pollitt, R. B., l/o London; c/o National Explosives Co., Lim., Hayle, Cornwall.

Roberts, E. H., l/o Herndon Road; 41, Cicada Road, East Hill, Wandsworth, S.W.

Rollin, J. C., l/o St. Bede Chemical Co.; 1, St. Nicholas Buildings, Newcastle-on-Tyne.

Shimidzu, T., l/o Peoria; 6641, Woodlawn Avenue, Chicago, Ill., U.S.A.

Spiller, Arnold, l/o America; 2, St. Mary's Road, Canonbury, N.

Stevenson, Jno., l/o Limehouse; 73, St. Paul's Road, Bow Common, E.

Takamine, J., l/o Peoria; 6641, Woodlawn Avenue, Chicago, Ill., U.S.A.

Thomas, S. Percy, l/o Stratford; 105, Clova Road, Forest Gate, E.

Watt, Alex., l/o Hartington Road; 19, Brompton Avenue, Sefton Park, Liverpool.

White, J. Walwyn, l/o Widnes; Springfield, Farnworth, near Widnes.

## Deaths.

Dr. Wm. Morgan, Nelson Terrace, Swansea. June 19.

A J. Smith, Wincobank, Sheffield. May 31st.

# Manchester Section.

Rooms of the Chemical Club, Victoria Hotel.

***Chairman:*** **R. Forbes Carpenter.**
***Vice-Chairman:*** *Edw. Schunck.*
***Committee:***

| | |
|---|---|
| **G. H. Bailey.** | **J. M. Irving.** |
| *F. H. Bowman.* | *E. Knecht.* |
| **G. E. Davis.** | **I. Levinstein.** |
| **C. Dreyfus.** | **W. H. Perkin, jun.** |
| **H. Grimshaw.** | **Sir H. E. Roscoe, M.P.** |
| *P. Hart.* | **W. Thomson.** |

***Hon. Local Secretary:***
**J. Carter Bell,**
**Bank House, The Cliff, Higher Broughton, Manchester.**

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Vice-Chairman:* P. Hart. *Committee:* R. S. Dale, M. J. Langdon, and E. Schunck.

*Meeting held Friday, May 24th,* 1895.

MR. R. FORBES CARPENTER IN THE CHAIR.

## ON THE TREATMENT OF ZINC ORES AND COMPLEX ORES CONTAINING ZINC.

BY PETER HART.

The chief ore of zinc is blende, a native sulphide, and the first operation to which the smelter submits it is roasting, by which means he eliminates the sulphur and substitutes oxygen in the molecule. This roasting has mostly been effected in reverberatory furnaces, the sulphur escaping, into the open air by means of the chimney, thus becoming more or less a nuisance to the surrounding neighbourhood. The money loss can scarcely be considered a negligible quantity when over 20,000 tons of blende or thereabouts are treated during one year in Great Britain; assuming this to contain 40 per cent. of zinc as sulphide, it represents 2,640 tons of sulphur. This state of things has not passed unnoticed, as is shown by several attempts having been made within recent years to utilise this gaseous sulphurous acid for the manufacture of sulphuric acid. In some cases it has been a complete failure; and for a description of the more successful, Dr. Lunge's book "Sulphuric Acid and Alkali" may be consulted, as he states the blende is very difficult to desulphurise; in fact, it parts with its sulphur so reluctantly and slowly that during the process the sulphurous acid becomes so diluted with excess of air that it is very difficult to deal with in the sulphuric acid chamber. To minimise this evil various furnaces have been devised, which, though most elaborately and ingeniously contrived, and expensive to build, are very liable to derangement and expensive to repair, even then have not been successful, for it would appear that at their best it was only the first rich gas that could be used in the vitriol chambers. Some time ago the author, being aware that zinc salts were largely used in the arts, turned his attention to the low-priced zinc ores to see if these salts could not be produced from these ores as the cheapest source of the metal. The most obvious course was to roast the ore to the state of oxide and dissolve this in the requisite acid, but all the literature on the subject placed the difficulty of producing a gas which could be utilised in the forefront, and as the chief inspector of alkali works has in several reports deplored the existence of the zinc-smoke evil, it was hardly to be expected that he or his assistants would have looked approvingly on any attempt to increase it. Fortunately a mode of proceeding was hit upon which seems to fulfil all the conditions. If zinc sulphide—native blende—for instance, be mixed with a sufficiency of strong sulphuric acid, and heat applied, a strong reaction sets up, at 300°—400° F. a rapid evolution of gas takes place, the mixture becomes pasty, and finally dries; this mass is then heated to a low red heat and finally lixiviated with water. The filtered solution is found to contain all the zinc contained in the ore, together with such other metals, as copper and cadmium, which form soluble sulphates; this result premises that the ore is sufficiently finely ground and a sufficiency of sulphuric acid added. Several reactions evidently occur, for the dried mass, when heated red hot, shows the presence of free sulphur, the blue flame being easily seen. It would appear that the main reaction is—

$$ZnS + 4SO_3 = Zn_2SO_4 + 3SO_2.$$

The small experiments seemed so promising that a larger one was tried. To the side of an ordinary blind furnace, as used for roasting saltcake, a small pot was attached, an opening being made into the furnace—in fact, the arrangement commonly used for the large scale production of sodium sulphate, the difference in this case being that, as it was for experimental purposes only, the pot was a small one—6 ft. diameter and 9 in. deep. The gas outlet was detached from the ordinary hydrochloric acid condenser and led into the first of a series of vitriol chambers. The illustration here given must not be taken as a working drawing, but as an ideal one, with the object of making the operation more clear. Into the pot there shown the proper proportions of ore and vitriol were placed, heated, and stirred until it became thick enough to push through the opening on to bed A; here the excess of sulphuric acid was driven off, and here also, as the drying proceeded, the free sulphur was seen to burn off rapidly. When dry, this charge was pushed on to bed B, and there kept until of a low red heat all through, after which it was raked out. Of course, on removal of the charge to bed B, bed A was open to receive another charge from the pot, which, in its turn, was replaced with a fresh dose of ore and vitriol. In this manner 17 tons of low-grade blende, containing about 32 per cent. of zinc, were worked through, all the gases being conveyed into the vitriol chambers already working with pyrites, without in the slightest degree disturbing their working. The charges so obtained were now, in portions, treated with hot water in an ordinary dissolver, with a raw steam jet introduced, the small amount of iron present removed in the ordinary manner, and the muddy solution pumped into settlers to become clear. This clear liquor was run into a common lead concentrating pan, and slabs of spelter or scrap zinc introduced. This zinc removed the small amount of copper and cadmium present, and when the requisite density was reached, the liquor was run into coolers, where it deposited the zinc as a nearly pure sulphate. Although the experiment was conducted with a somewhat makeshift apparatus, we were able to account for nearly 80 per cent. of the zinc in the ore. This loss is not large, when it is taken into consideration that the proportions of vitriol and ore were repeatedly altered, to find the smallest amount of vitriol it was necessary to employ; in fact, some of the charges contained no soluble zinc—this, for a reason which will be made sufficiently clear in a later portion of this paper. The experiment, as a whole, proved the process to be a perfectly practical one for the production of zinc sulphate, or the removal of zinc from ores where its presence was detrimental. It is now necessary to become somewhat retrospective. In the year 1880 Mr. E. A. Parnell read a paper before the British Association meeting, describing a process he had invented for the metallurgic treatment of complex ores containing zinc, which I am afraid I shall have to quote so shortly as to do it scant justice. In some copper ores zinc exists in such quantity as to necessitate their rejection by the smelter, on account of their injuring the quality of the metal, or necessitating complicated operations for its removal, and similarly, lead smelters reject ores containing much zinc. Many other ores of a mixed description, some containing silver, are unavailable for use in the ordinary manner, from the presence of a comparatively small proportion of zinc. Parnell proposed to overcome this difficulty by roasting the ground ore containing the metals as sulphides in a blind furnace, conducting the evolved sulphurous acid into a vitriol chamber, and there converting it into sulphuric acid, leaving the metals as oxides in the furnace charge, grinding this charge in a lead-lined revolving pan with sulpuric acid, by which means the metals which form soluble sulphates are removed, leaving the remaining insoluble portion to be smelted in the ordinary manner. The zinc sulphate solution is concentrated and mixed with a fresh portion of blende, and heated to redness in a blind furnace, where the following reaction takes place:—

$$3ZnSO_4 + ZnS = 4ZnO + 4SO_2$$

He also proposed to treat in a similar manner the poor residues which remain after dressing the blendes, which are too poor in zinc to be worth treating in the ordinary manner, such, for instance, as contain less than 30 per cent. zinc. These would cost too much for manipulation by the smelter, and are consequently rejected.

It would seem that Parnell did not escape the great difficulty of roasting *per se*, and the consequent trouble, owing to dilution, of utilising the evolved sulphurous acid, for he himself says: "The operation is conducted in a large muffle furnace, the gas from which, *when* containing a sufficient proportion of sulphurous acid, is conveyed to leaden chambers." It would seem that the outlet from this difficulty is to employ the process already described at the commencement of this paper for the removal of the zinc from these complex ores—that is, the mixing with vitriol, at once roasting and dissolving out the zinc and soluble metals, leaving the rest to be smelted in the ordinary manner.

The combined process is equally applicable to the treatment of the low ores of zinc. Thus, if three proportionals of low-grade blende have their contents of zinc removed as described, and the resulting zinc sulphate mixed with one proportional of the same ore and roasted, the whole of the zinc is concentrated into this last fourth proportional. If we take 100 parts of blende containing 32·5 per cent. zinc as sulphide and the remainder barium sulphide as gangue, its composition will be—

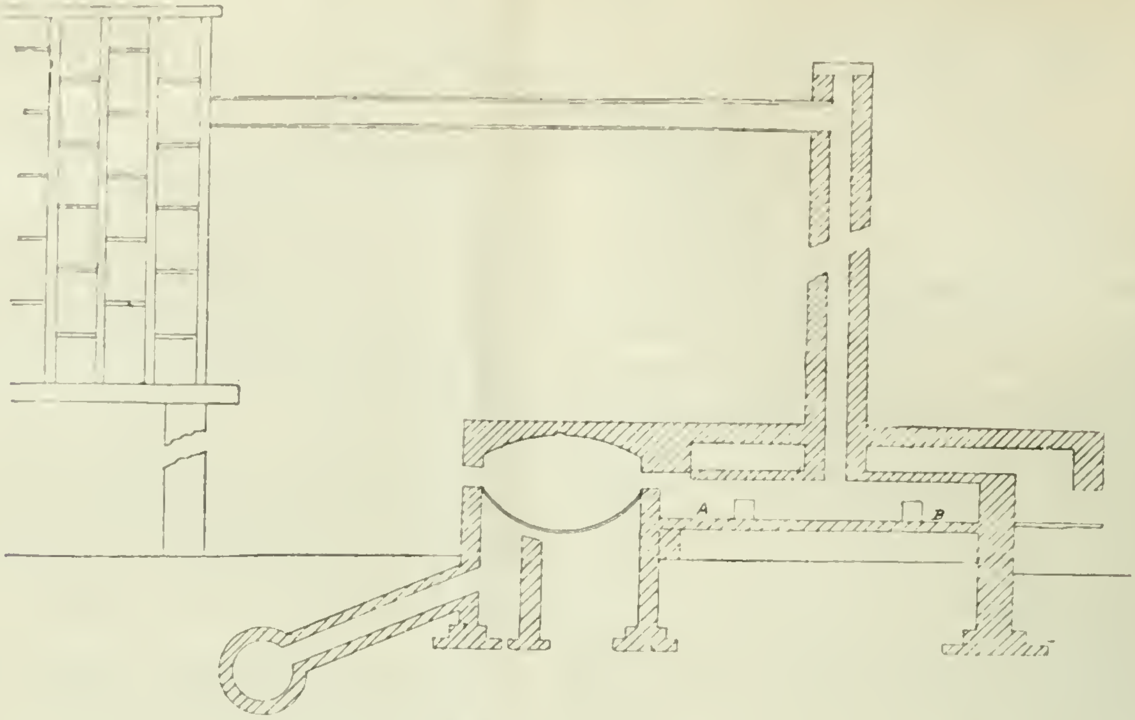
48·5 zinc sulphide.
51·5 gangue.
———
100·0

This, when roasted into zinc oxide, will have the composition—

40·5 zinc oxide.
51·5 gangue.
———
92·0 = 34·2 per cent. zinc.

But if three times 100 parts of the same blende have their zinc extracted as sulphate, and this sulphate mixed with another 100 parts of the same blende and roasted as described, we shall have 162 parts of zinc oxide plus 51·5 of gangue, making a total of 213·5 parts containing 60·9 per cent. zinc—a product which would have been obtained by roasting a blende containing initially 53·4 per cent. zinc.

It will be seen that the combined process comprises, not only the treatment of poor and complex ores, but is capable of being applied to those of a richer quality, such as are ordinarily employed. Take a rich ore, say of 60 per cent.; mix this with sufficient sulphuric acid to convert one-fourth of the zinc present into sulphate; pass this through the blind furnace in the manner described. The remaining portion of sulphide will be rapidly oxidised at the expense of the sulphuric acid contained in the sulphate, and the charge, when drawn, will have the whole of its zinc as oxide, and the whole of the sulphur—both that contained in the blende and the added sulphuric acid—will have been evolved as sulphurous acid in an almost undiluted state. The *rationale* of the method is the adding liquefied oxygen in the shape of sulphuric acid instead of diluted, diffused, atmospheric oxygen, the sulphur from both sources being found in the vitriol chamber, into which the gases have been led. It is not necessary here to say what is to be done with the sulphuric acid so produced. This problem will have to be solved hereafter. The advantages of the combined method may be summed up as follows:—That the ordinary blendes as at present used may be easily desulphurised, without emitting the fumes into the atmosphere and fouling it; that such fumes are evolved in a concentrated state capable of being utilised entirely; that the process of desulphurising is more rapidly performed; that only well-known apparatus is employed, thus dispensing with cumbrous and expensive erections, which at best are not absolutely efficient; that low-grade ores at present of no value may be utilised; that complex ores, at present useless, may be made of value.



During the writing of this paper many minor suggestions have been left out, as it would have unduly lengthened it, but one may be mentioned. It is very probable that the waste heat of the smelting furnace may be as at present used for heating the roasting furnace, and even then the products of combustion would have sufficient heat in them to concentrate the zinc sulphate solution.

* * *

# THE CHEMICAL CONSTITUTION OF GAS ENRICHERS AND ITS RELATION TO THEIR ENRICHING VALUE.

BY WILFRID IRWIN, F.C.S.

So very much has been written of late on the theory of luminous combustion, and the influence of the various components of a gas on its illuminating power, that it may seem presumptuous for a comparative stranger to enter a field where so many chemists of standing and ability are already engaged and are daily making new additions to our knowledge on the subject; for although it is now nearly 100 years since the manufacture of gas for lighting purposes was first introduced on a commercial scale, it is only very recently that any scientific knowledge of the cause of luminosity has been forthcoming.

The widespread ignorance of even the composition of illuminating gas may be gleaned from the fact that in very few of even the later text books is any mention made of its most important illuminant—benzene, a substance which is now being manufactured on an enormous scale. Its history may be found in Lunge's treatise, "Coal Tar and Ammonia," 1887, 114, and Roscoe and Schorlemmer's treatise, Org. Chem. III., 1886, 64. See also this Journal, 1883, 217.

In the year 1882 the price of 90 % Benzol having risen to 15*s.* per gallon Josiah Hardmann suggested to me the advisability of experimenting on this process. A few trials soon showed me the right course to pursue, and the results were truly startling. I found that as much as $3\frac{1}{2}$ galls. of benzene could be produced from 10,000 cub. ft. of Manchester gas; or, in other words, of all the benzene formed in process of coal carbonisation only 3 to 5 per cent. remains in the tar, the rest going forward into the gas and supplying a great part of its illuminating power.

Plant was immediately erected, and within a very short time several hundred gallons were actually extracted from the corporation gas, the residue being employed as a fuel. Large carbonising works were also soon in course of construction, and the commercial bearing of the case may be gauged from the fact that at that time 1 ton of coal, costing 6*s.*, with labour, say 4*s.*, would produce 30*s.* worth of benzene, in addition to other by-products.

There occurred to me about this time an idea to make an arrangement with gas companies for the extraction of benzene from their gas and to replace the illuminating power lost thereby with light petroleum spirit, the former being about 8 times the price of the latter. I soon found, however, that at least 3 times the amount of spirit was required to repair the loss of a certain quantity of benzene, and that there was also great difficulty in getting the required amount into the gas without condensation. These facts, combined with the rapidly-falling price of benzene, soon rendered the suggestion quite impracticable.

Mr. G. E. Davis afterwards brought out a process in which he cooled the gas before absorption, and Mr. S. Mellor one for obtaining the benzene by compression, so that Manchester and benzene are somewhat intimately associated.

In the years succeeding from the small beginning above mentioned largely owing to the increase in the number of coke-ovens of the Simon-Carvès type, especially in Germany, the supply of benzene has outstripped the demand, and the price now stands at 1*s.* a gallon, and unless some new requirement can be found for it, it appears likely to remain there. It was in connection with experiments on its efficiency as a gas enricher that I was led to take up the line of investigation I am about to describe.

*Methods employed for conducting Experiments on Gas-enriching.*—This to begin with is no easy matter, as the contact of ordinary coal gas with water was found to cause a rapid diminution in illuminating power so that known mixtures in ordinary gas holders could not be obtained.

An experiment will illustrate this. Take a large bottle half-filled with water and the remainder with Manchester gas of 19 to 20 candle power. Agitate the two together and then test the gas again. It will be found to have fallen from 19 candles to 1 candle with union jet-burner or 2 with an Argand.

This fact could only be due to the solubility in water of benzene and olefines, and as the former is described in the text books as practically insoluble in water I determined to settle the matter by experiment. The result was just what one would expect and was as follows :—

1,000 vols. of water dissolve 1·45 vols. of benzene.

As a little digression, I resolved to compare it with toluene and xylene in this respect. You may be aware of the fact that the addition of $CH_3$ in the aromatic nucleus decreases the solubility.

Thus aniline is more soluble than toluidine. Phenol is more soluble than cresol, and that again than xylenol, and it appeared interesting to discover if the base of all these bodies followed the same law. This was found to be the case. As I said before—

| | | |
|---|---|---|
| 1,000 parts of water dissolve | 1·45 | parts benzene. |
| ,, ,, ,, | 0·57 | ,, toluene. |
| ,, ,, ,, | 0·12 | ,, xylene. |

In comparison with the foregoing heptane was found to be practically insoluble in water.

The method which I adopted for the regular and gradual absorption by the gas of an enricher on a laboratory scale was the following : the gas, after being well dried with $CaCl_2$ was passed over the enricher, say pure benzene, and a by-pass was arranged for the unenriched gas to meet and mix with the enriched gas before passing to the burner for testing. By this means, only substances with constant boiling points could be tested, but it appeared the most satisfactory method that I could think of for the work I wished to perform.

The first experiments I propose to describe were made with dis-illumined coal gas, that is gas from which all illuminating power has been extracted by treatment with fuming $H_2SO_4$. Such gas, with a union jet burner tested about 0·03 candle, with an Argand burner 0·75 candle, with an Argand burner having its air supply checked, it gives a flame of about 5 candles, but difficult to determine owing to its peculiar colour and great length. The gas is practically a mixture of 2 of H to 1 of $CH_4$.

As the union jet is the commonest in practical use, all my experiments except a few specially mentioned have been made with it, No. 4 Bray being the one chosen.

Note very carefully the flame we get with this dis-illumined gas. Next to the jet is a space quite devoid of luminosity, above it a very slight luminous band, higher up still there is a perfectly dark band, and lastly, at the very top of the flame is again a fringe of slight luminosity.

To determine the meaning of this, I made the following experiments. I first introduced into the dis-illumined gas a small quantity of benzene vapour and noted the change in the flame, and found that the lower slightly luminous portion greatly increased in brilliancy, the result being a comparatively small but very bright flame. I next tried benzene with hydrogen, also water-gas respectively, and found that the combination in both cases gave a result similar but more intensified than when dis-illumined coal gas was employed.

I then tried the effect of hexane, an enricher containing a large percentage of hydrogen, and which, on decomposition in the lower part of the flame would yield a considerable amount of $CH_4$. The result of this admixture was that the lower part of the flame was not rendered anything like so brilliant as with benzene, but that the outer luminous fringe was considerably increased in size so that a large though not highly luminous flame was the result.

The union jet was now replaced by an Argand burner which doubled the illuminating power of the hexane gas, whilst the gas enriched with benzene was not greatly altered —say about 20 per cent.

Now Prof. Vivian Lewes' researches seem to point to the fact that most substances which produce luminosity in gas, do so by first decomposing into $C_2H_2$ and H, and further, that the endothermic heat of decomposition of $C_2H_2$ causes a rapid rise in the temperature of the liberated carbon resulting in the luminosity with which the flame is endowed.

When hydrocarbons of the paraffin series are passed through a red hot tube, a large amount of $C_6H_6$ and $CH_4$ is produced, the latter being further decomposed by more intense heat into $C_2H_2$ and H.

A less intense heat is required for the decomposition of benzene which, however, also produces large quantities of $C_2H_2$.

The meaning of the stratification of slightly luminous flames now became clear.

When the gas first leaves the jet, it passes through the "baking" part of the flame where bodies such as $C_6H_6$ and $C_2H_2$ are decomposed and form the lower luminous band (in the case of $H_2SO_4$ treated gas, a trace of $C_6H_6$ has evidently escaped absorption.

As we pass further up the flame, the temperature naturally rises until after passing the non-luminous layer where complete combustion of the liberated carbon has taken place, we ultimately reach a point sufficiently high in temperature to decompose $CH_4$ with the production of $C_2H_2$, the decomposition of which again yields the luminous fringe at the top of the flame.

With an Argand burner the heat of the whole flame is greatly increased. This has little effect on the benzene, as in a union jet there is still sufficient to cause its decomposition into $C_2H_2$, but with a body like hexane, which on decomposition would yield a large quantity of $CH_4$, the heat of the Argand is most beneficial, as it causes far more $CH_4$ to decompose into $C_2H_2$ and H, and very much less has therefore to be spent in merely maintaining the heat of the flame by combustion.

I have little doubt that this is the process which goes on in every gas flame, with certain exceptions, which I will refer to later on.

We now come to the figures relating to the action of different quantities of benzene on dis-illumined gas, and as an example of the details required in each case I will give the following :—

Volume of gas employed, 14 litres.
Volume of gas after addition of benzene vapour, 14·28 litres.
Weight of benzene absorbed, 1·267 grms.
Time occupied in burning, 7·5 minutes.
Candles burning at the rate of 119 grms. per hour.
Candle-power calculated to 5 cub. ft. per hour, 20·2.
Benzene contained in a litre of gas burned, 0·088 grm.
Benzene required per candle, 0·00434 grm. per litre.

Results of dis-illumined gas + benzene :—

| | | | |
|---|---|---|---|
| 0·0221 | grm. per litre gave | 1·3 | candles. |
| 0·0385 | ,, ,, | 4·1 | ,, |
| 0·0544 | ,, ,, | 7·6 | ,, |
| 0·0630 | ,, ,, | 9·6 | ,, |
| 0·0863 | ,, ,, | 21·0 | ,, |
| 0·0881 | ,, ,, | 20·2 | ,, |
| 0·1230 | ,, ,, | 30·0 | ,, |

From the above it will be seen that 0·018 grm. per litre is required before any effect is produced on the illuminating power, but that after that point is reached the illuminating power is increased at an average rate of 0·0034 grm. of benzene per candle, or about 4 candles per gallon per 10,000 cub. ft.

With the foregoing I carefully compared the action of heptane (prepared by fractionating petroleum spirit) on the dis-illumined gas :—

| | | | |
|---|---|---|---|
| 0·0528 | grm. per litre gave | 2·15 | candles. |
| 0·1010 | ,, ,, | 6·35 | ,, |
| 0·1560 | ,, ,, | 11·10 | ,, |

From the above it will be seen that 0·028 grm per litre was required before any illuminating action could be produced, but that after reaching that point the increase was at the rate of 0·0115 grm. per candle per litre, or about 1 candle per gallon per 10,000 cub. ft.

By comparing these results, I came to the conclusion that the carbon density alone had little to do with the enriching value of the hydrocarbon, but that it was the proportionate amount of C and H in the molecule that was the principal factor in determining its value. I therefore resolved to try the effect of toluol, which (if this theory be correct, and which I have since found that Knublauch was the first to put forward) should be below benzene in its illuminating value :—

| Benzene. | Toluene. | Xylene. | Naphthalene. | Heptane. |
|---|---|---|---|---|
| $C_6H_6$ | $C_7H_8$ | $C_8H_{10}$ | $C_{10}H_8$ | $C_7H_{16}$ |

With toluene I found 0·0033 grm. per litre was required per candle.

Against benzene 0·0034 „ „ „
And heptane 0·0115 „ „ „

This result did not seem encouraging, so I tried xylene, with which I found 0·0027 grm. per litre was required per candle.

This result quite upset the afore-mentioned theory, and I began to conclude that the arrangement of atoms in the molecule might have a considerable influence on the enriching power of the hydrocarbons. I therefore tried the effect of naphthalene, and found :—

0·062 grm. naphthalene per litre gave 26·9 candles.
0·059 „ „ „ 23·5 „
0·046 „ „ „ 21·0 „
Average 0·058 „ „ „ 23·8 „

After allowing 0·010 grm. for the start, the amount of naphthalene required per candle per litre was only 0·0020 grm., showing that its enriching power was more than half as great again as benzene and nearly six times that of heptane.

On comparing benzene with naphthalene, as regards structural arrangement, we find that in the case of benzene 92 per cent. consists of C combined with $H_1$, whilst in the case of naphthalene—

75 per cent. consists of C combined with H.
18 „ „ C uncombined with H.

From this we may conclude that carbon, in combination only with other carbon atoms and not linked with H, is of much greater utility as an enricher than C in combination with H. In other words far more of the latter gets destroyed, *i.e.*, burnt before the final decomposition of $C_2H_2$ takes place. As a matter of fact it is very improbable that the two C atoms uncombined with H ever form $C_2H_2$ at all, but simply separate into free C.

From the above figures we may calculate that C in combination with other C atoms only is nearly three times as efficacious as C in combination with $H_1$. In other words, only one-third of the C atoms in combination with H ever get utilized, so that even in naphthalene not more than 44 per cent. of the weight added to the gas is really utilized in emitting light, and since the addition of 0·002 grm. per litre raises the I. P. of the gas by one candle, the amount of solid carbon engaged in emitting this amount of light would be 0·00088 grm., or, in other words, a gas burning for one hour, and giving out a light equal to 20 candles does not employ more than the extraordinary small amount of 2·58 grm. = $\frac{1}{11}$ oz. of solid carbon actually engaged in emitting light. Experiments on naphthalene and hydrogen, shortly to be described, confirm this result.

From the above considerations, and bearing in mind that with a union jet $CH_4$ and $C_2H_6$ are non-luminous we may arrive at the following conclusions :—

That in an enricher a C atom combined with $H_4$ or $H_3$ is useless.

That C atom combined with $H_2$ possess enriching power.

A C atom combined with $H_1$ possesses two to three times the enriching power of the foregoing.

A C atom combined only with other C atoms again possesses two to three times the enriching power of a C atom combined with $H_1$.

These facts account easily for the position toluene and xylene hold with regard to their enriching value.

My next experiment was on the influence of a body possessing a higher percentage than naphthalene of carbon atoms combined only with other C atoms, and for this I used phenanthrene. Here again I obtained higher values than with naphthalene, but its very high boiling point (350° C.) made it difficult to work with, and my results not being constant I do not care to give them.

I then tried the effect of an oxygen atom in combination with benzene, and for this used phenol $C_6H_5OH$, the results being interesting,

0·020 grm. per litre gave 1·6 candles.
0·0841 „ „ 11·6 „

or 0·0064 grm. per candle after the start. This was nearly double the benzene figure, and illustrates the deleterious effect of combined oxygen on the illuminating value of the enricher.

So much for the action of enrichers on dis-illumined coal-gas, let us now consider their action on hydrogen itself.

*Benzene and Hydrogen.*

0·068 grm. per litre gave 0·45 candles.
0·096 „ „ 10·05 „

Hence one candle after the start required 0·0028 grm. benzene.

*Hexane and Hydrogen.*

0·121 grm. per litre gave only 0·2 candles though this amount was increased to 1·5 candles with an Argand burner.

*Naphthalene on Hydrogen.*

0·0517 grm. per litre gave 4·3 candles.
0·0872 „ „ 18·0 „
Therefore 0·0355 „ „ 13·7 after the start.
Or 0·0026 grm. per candle per litre.

Mr. Lewis T. Wright, in a paper recently published, lays great stress on the relation between the total effective carbon vapour (*i.e.*, C in combination with H) in any gas and its illuminating power.

I would beg to bring before his notice the case of this mixed gas and that of disillumined coal-gas. The latter with a carbon density of 30 per cent. has an illuminating power of at most five candles with an Argand burner (air-checked).

Naphthalene + hydrogen with a carbon density of 7·5 per cent. has an illuminating power of 18 candles.

This fact you will see quite disposes of the theory advanced by some, that a good heating gas and a good lighting gas are practically synonymous terms.

In the foregoing figures there is one point that needs some explanation.

In the case of benzene 0·065 grm., with hexane 0·12 grm., and with naphthalene 0·042 grm. per litre is required to be sacrificed before any luminosity is forthcoming. Prof. Vivian Lewes finds the same to be the case with acetylene, and explains it by the fact that the more dilute the enricher is, the higher the temperature required for decomposition, and assumes that it is the heat of combustion of a certain amount of the enricher that is required in addition to that supplied by the burning H for the decomposition of a further supply of the enricher, say $C_2H_2$.

Additional proof appears to me, however, necessary to settle this point, for only half the amount of benzene, which has the same percentage composition of C and H as $C_2H_2$, is required, and only one-third the amount of naphthalene, to produce the same result, and this in spite of the high endothermic property of acetylene.

Again, in a disillumined coal-gas flame, where the percentage of carbon is far higher than in any of the above mixtures, a certain amount of benzene is required to be added before any perceptible addition to the illuminating power is obtained.

The only attempt at an explanation that I can give is to suppose that it is merely a question of the ability of a certain amount of the enricher to resist oxidation in the lower part of the flame before it can reach that portion of it which is hot enough to cause complete decomposition with separation of solid carbon. Of course the latter action will be hastened by the heat of combustion of that portion of the hydrocarbons which is burnt in the lower part of the flame.

It may be noted that in these considerations, the solid particle theory of combustion is completely upheld, but the theory that it is always the H in a hydrocarbon that first burns, thus liberating the C to form the glow, is unsound and no longer tenable.

### *Water-Gas and Benzene.*

*Preparation of the Gas.*—Steam was passed through a tube filled with coke and kept at a bright red heat. The gas produced contained no air, but 10 per cent $CO_2$, which was removed by treatment with caustic soda.

With this gas, 0·079 grm. benzene per litre gave 0·51 candle; 0·154 grm. benzene per litre gave 12·9 candle. Hence 0·075 grm. benzene was required before any luminosity could be produced, and after that point was reached, enrichment at the rate of 0·006 grm. per candle ensued.

These figures on comparison with previous experiments with disillumined coal-gas and hydrogen, tell against the use of benzene with a gas containing a high percentage of CO in a general way, but its economic bearing, taking into consideration the rapid rate at which carburetted water-gas can be manufactured, I cannot enter into now.

Note the shape of the flame of water-gas and benzene. It is like an ordinary gas flame without a top to it. This is no doubt due to the fact that little or no $CH_4$ is present to decompose into $C_2H_2$ and C at the hottest and highest part of the flame. If, however, we add to this flame an enricher like pentane (which by itself in any reasonable quantity adds no illuminating power to the flame), but which on decomposition in the lower part of the flame would yield a large amount of $CH_4$, the flame nearly resumes its normal shape.

### *Benzene with Manchester Gas.*

For the action of benzene as an enriching agent on ordinary coal-gas, the figures given by authorities on the subject are most widely divergent. The following is a list:—

Knublauch, 1 gall. in 10,000 cub. ft. gives 3·7 candles enrichment.

Bunte, 1 gall. in 10,000 cub. ft. gives 3·6 candles enrichment.

Frankland, 1 gall. in 10,000 cub. ft. gives 2·9 candles enrichment.

Stenhouse, 1 gall. in 10,000 cub. ft. gives 1·3 candles enrichment.

Hunt, 1 gall. in 10,000 cub. ft. gives 0·9 candle enrichment.

Lewis T. Wright, 1 gall. in 10,000 cub. ft. gives 0·8 candle enrichment.

The following experiment will suffice to show the effect of benzene on Manchester gas:—

| — | Union Jet. | Argand Burner, arranged to give the most light. |
|---|---|---|
| Manchester gas before enrichment ...... | 12·6 | 21·0 (approx.) |
| Benzol added or rather contained in the enriched gas per 10,000 cub. ft. | 0·075 grm. per litre. | 0·079 grm. per litre. |
| Candle power after enrichment ......... | 28·6 | 23·5 |
| Gain in luminosity by enrichment ...... | 16·0 | 2·5 |
| Gain in candle power per gallon per 10,000 cub. ft. (average of three tests). | 2·7 candles | ½ candle |

Notice the extraordinary effect the burner has upon the results. But further these results do not appear to tally even in the case of the union jet with those wherein disillumined gas was experimented on, and I can only account for the difference by assuming that a sort of overlapping takes place in the illuminants contained in an ordinary coal-gas flame, in other words that you cannot get the full value of the light giving power of both the olefines and the benzene when burnt in any proportion together. If this be so, a cubic foot of gas enriched to 20 candles with olefines mixed with an equal amount of gas enriched to 20 candles with benzene would not necessarily give 2 cub. ft. of 20 candles, but the mixture would probably have a lower illuminating power.

The above supposition, if it be correct, must be of the greatest importance to the gas manufacturer. And I hope before long to be able to settle it by experiment, but it is the only explanation I can offer to explain my own results and to account the discrepancies recorded by other observers, the influence of the class of burner used, great as it is being insufficient. Data recorded then relating to enriching values are absolutely useless unless both the composition of the gas to be enriched and the kind of burner employed are given at the same time.

### *Manchester Gas with Hexane.*

| | Union Jet. |
|---|---|
| Candle power before enrichment............... | 13·2 |
| Hexane contained in the enriched gas per 10,000 cub. ft. ......................................... | 0·092 grm. per litre. |
| Candle power after enrichment ............... | 17·3 |
| Gain in candle power by enrichment .......... | 4·1 |

Equal to 0·62 candle per gallon per 10,000 cub. ft.

The foregoing experiments open up a very wide question. They show that when the common union-jet burner is employed—and I suppose 80 per cent. of the burners used in this country are of that type—gas enriched to a high candle power, when tested in the ordinary manner, is of very little avail when that enrichment is due to the presence of olefines or other hydrocarbons with a high percentage of H.

Argand burners are not popular, and slit-burners are said to be smoky, so the union jet still holds the field.

The lights of Paris, with its 14-candle gas, are often compared with and said to be equal in illuminating power to those of the north with gas of 20 to 23 candles. Why is this so? Some say because the atmosphere of Paris is clearer than that of our northern towns, that therefore the lights shine clearer, whilst others try to find a difference between illuminating power and illuminating effect, a distinction which I am unable to understand. My own opinion in the matter, however, and one which I have formed from the experiments here described, is that Paris gas, as Berthelot states, owes its 14-candle illuminating power almost entirely to benzene, so that the consumers really get what they are supposed to do, probably quite as much as we in Manchester get from our 20-candle gas made from cannel, and owing its illuminating power therefore largely to olifines as well as benzene, and which the majority of us consume in burners ill adapted to its use.

Gas enriched to 17 or 18 candles with benzene would be far better appreciated than 20-candle gas owing its illuminating power largely to olifines, *i.e.*, by the average consumer. The same considerations also hold good for petroleum enrichment as for olefines.

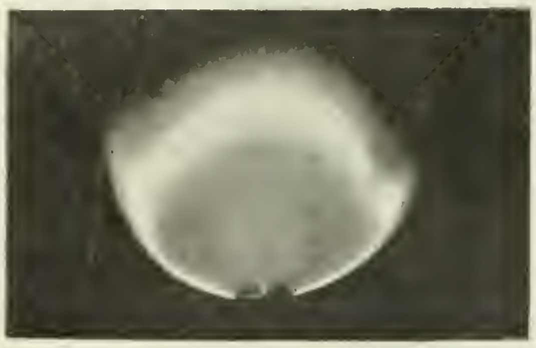
As regards price, benzene at 1*s.* a gallon is by far the most economical enricher with a union jet, and its production from coke ovens is continually on the increase. Should a great increase in its employment cause a rise in price, the gasworks might themselves manufacture it in summer time for winter's use when the market for coke and other by-products would allow of this being done; but, anyhow, whilst the price remains at the present figure it certainly ought to be used for the enrichment of gas.

### *General Conclusions.*

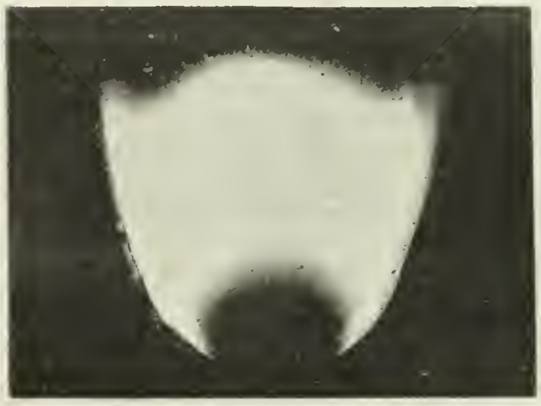
1st. That of all enrichers, benzene, for the average consumer of gas, gives the greatest value for the money.

2nd. Toluene and xylene are better enrichers, but their non-volatility precludes their employment.

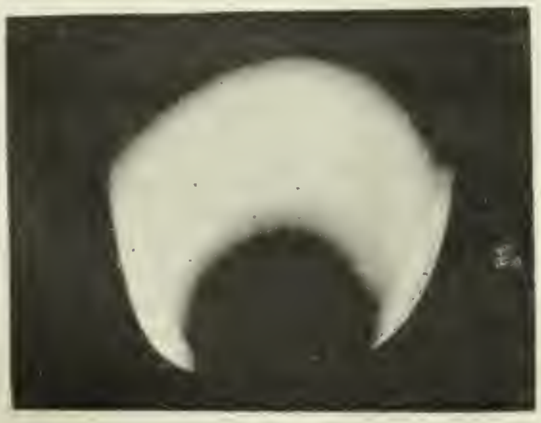
3rd. Naphthalene is the cheapest and greatest enricher, but cannot be supplied with gas from the gasworks because of its non-volatility. It could, however, be used for the street lamps with a carburetting apparatus, which would give 50 per cent. more light for a mere fraction. Were separate mains employed and water-gas used in connection with naphthalene, the cost of street lighting would be reduced to a minimum.



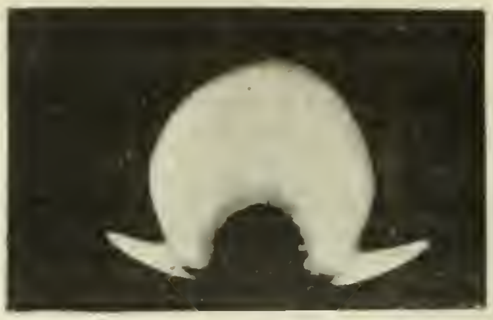
Disilluminated Gas. Owing to the quivering of the Flame, the Black Band over the Lower Luminous Layer is not very Distinct.



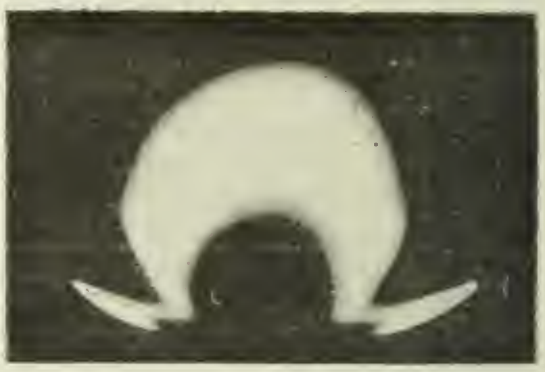
Disilluminated Gas and Benzene, showing the Contracted Size of the Non-luminous part of the Flame.



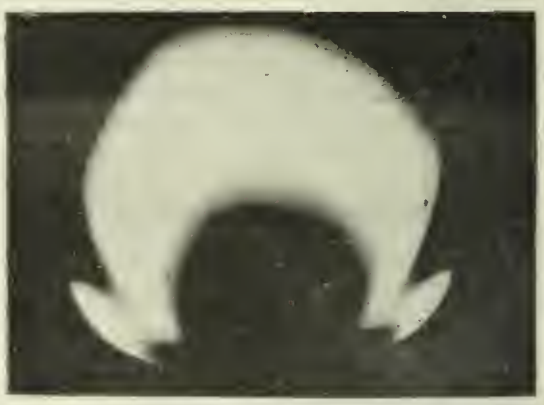
Disilluminated Gas and Heptane.



Water-Gas and Benzene.



Water-Gas, Benzene, and a little Pentane.



Water-Gas, Benzene, and more Pentane.

### Discussion.

Mr. Ball (gas manager, Rochdale Corporation) said, from the practical gas manufacturers' point of view, he differed *in toto* from Mr. Irwin in the method adopted for determining the value of benzol as an enricher. It was quite possible, undoubtedly, to use benzol in the way described, but there would be great difficulty in securing uniform results. Mr. Irwin's object was to show the value of adding benzol and other hydrocarbons as enrichers to ordinary coal gas, and the gas manager desired to know what, say benzol would do, when added to 15-, 16-, or 17-candle gas, and it was of little interest to him what its effect might be upon gas deprived of its illuminants, such as Mr. Irwin had used. The fact that an increase of 16 candles had been found when the enriched and unenriched gases were burnt in a union-jet burner (and a small union jet too), although only three candles of an increase was found when the samples of the same gas were tested in an Argand burner tended to show that the former was an entirely unsuitable burner for the gas tested before enrichment, and not that the whole improvement was due to benzol. The method adopted by Mr. Irwin of passing the gas over the surface of the benzol would probably be found to result in the liquid gradually becoming denser and the enriching effect diminishing. This was found to be the case when the benzol was volatilised by steam heat, and one would expect it to be much more so when the gas simply carried away the benzol mechanically. Referring to the figures quoted by Mr. Irwin, as the values arrived at by Dr. Bunte and others, it was most difficult to compare the figures without knowing the conditions under which the experiments were conducted, and whilst he should be delighted if the values quoted could be obtained in ordinary working, he was bound to say that as yet they had only been able to approximately reach the figure quoted by Mr. Stenhouse in his paper read at the previous meeting.

Mr. Wm. Thomson asked whether Mr. Irwin had made any experiments by burning the different mixtures of gases under pressure or by means of hot air as in the Wenham burner. Could Mr. Irwin explain the reason why two little wings of light formed at each side of the flame when burning naphthalene as an enricher?

Dr. Lewkowitsch wished to know how Mr. Irwin had estimated the solubility of benzene, as the paraffins experimented on were doubtless of American origin? He suggested that Russian petroleums should be tried, the naphthenes in this petroleum forming an intermediate group between the open-chain paraffins and the closed-chain benzenes. As to the theory of the flame, would it not be advisable to burn the gases in Smithells' flame-dividing apparatus, and to examine the gases?

Mr. Grimshaw said he was very much disappointed that nothing had been said about acetylene, which according to recent reports was coming to the front for enriching coal-gas. In his opinion napthalene used as enricher of coal-gas was still the cheapest, especially at the present price of about 9*l.* per ton, and he thought the most practical outcome of the discussion would be to ascertain whether acetylene or napthalene would be the cheaper. In his own mind he considered that acetylene was not destined to be a rival to the other materials for the enrichment of coal-gas.

Mr. T. Stenhouse, borough analyst, Rochdale, thought the paper would have been of much greater interest had Mr. Irwin explained how the experiments had been carried out, the kind of burners and photometer employed, and when he had used ordinary coal-gas of 15 or 16 candle-power, or disillumined gas. How was the gas enriched by the naphthalene? Were the enrichers used weighed or measured? The paper contained very little information on these points, though the results appeared to be calculated out very finely.

Mr. Irwin, in reply to Mr. Ball, said that he distinctly stated that his experiments were made with the burner most commonly employed, namely, the union jet. He was fully aware that the Argand burner, which was chiefly used for testing in gas works had not given high results with benzene, but he regarded the question from a consumers' rather that a gas manager's point of view, and, so regarded, he considered benzene the most economical enricher. With regard to the carburetting apparatus he never suggested that the laboratory method he had mentioned could be used on a large scale. Were he carburetting in a works he would use either such an apparatus suggested by Bunte or possibly a simple tower packed like a scrubber up which the gas might pass and meet and absorb a stream of benzene descending. In reply to Mr. Thomson,—the reason why regenerative burners gave more light was in all probability that the additional heat supplied caused a greater quantity of marsh gas to be changed into acetylene with less waste in merely maintaining the heat of the flame. In reply to Dr. Lewkowitsch he had estimated the solubility of benzene in water merely by agitating the benzol and water together, taking precaution not to allow more air than possible to be admitted into the mixture. Just before the point of concentration the mixture formed a froth which disappeared again the moment excess of benzene was added. The data given represented volumes of liquid benzene, and not vapour of benzene. With regard to naphthenes he had not made any experiments with them, but he should expect they would follow in their carburetting power the theory he had advanced. In the paraffin series, generally speaking, the higher they were in the series the greater their enriching value. With reference to Mr. Grimshaw's remarks he had at first intended to institute comparisons with acetylene, but as the paper was getting lengthy, and acetylene was being put out of the field altogether by its introducer, Prof. Vivian Lewes, he decided to leave it alone. In reply to Mr. Stenhouse, the kind of photometer used was one of the Bunsen pattern he had constructed for use in his laboratory. It was not on as an elaborate a scale as a gas works photometer, but any error due to the photometer itself would not be sufficient to effect the theory he had advanced in the constitution of enrichers and its relation to their enriching power. In the case where such bodies as naphthalene were employed the burner had to be kept in contact with the stopper of the vessel containing the enricher kept at a constant temperature of, say 100° C. Trials had to be made at first to find at what temperature the best result could be obtained with the substance to be experimented on and afterwards the test made. He had arranged an apparatus by which he could pass a constant stream of gas over the enricher, say half a cubic foot. It would be interesting to test a benzene hydrogen gas with a regenerator, in which case he doubted whether the gain in enrichment would be anything like so great as with ordinary gas. It would be his desire at some future time to repeat these experiments with more elaborate apparatus and with the aid of experience already gained to complete the work.

# ON KUHLMANN'S BALANCES WITH MIRROR-READING.

BY DR. B. W. GERLAND.

On a former occasion I had the pleasure of introducing Kuhlmann's balances of equal sensibility for every load with telescopic reading. Their advantages for quick and exact weighing were so decided that they were soon appreciated in university and works laboratories. However, the telescope had its inconveniences: the eye had to be brought to it, it was in the way in its place in front of the balance, and, above all, it required a good illumination of the scale. Kuhlmann endeavoured to remedy these drawbacks, and, after many trials, succeeded beyond all expectation. Last autumn the new arrangement was thoroughly tested by him and by me in his workshop, with the result that we were convinced of its great advantages, and that nothing better could be suggested. A description has recently been given by Kuhlmann in the "Zeitschrift für Instrumentenkunde, March 1895," of which the following is a short abstract:—

Fig. 1 represents a side view, Fig. 2 the front view of the reading arrangement enlarged. The concave

Fig. 1.

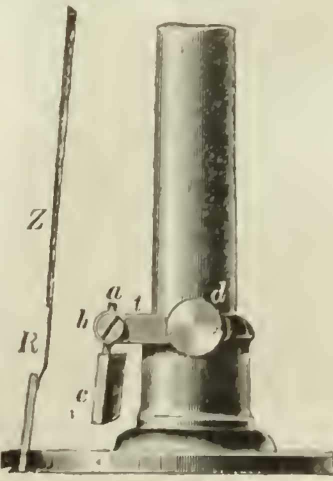
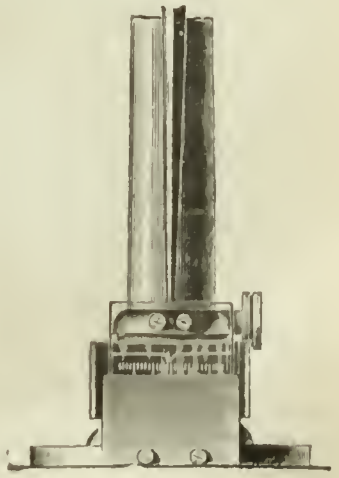


Fig. 2.



cylindrical mirror *c* is adjustable in every direction, so that the magnifying power can be regulated as well as the amount of inclination requisite to reflect the scale to the eye of the observer in the accustomed position. The mirror moves in the vertical round the pin *a*, which rests in the fork cut out of the cylinder *b*, and is fixed in its position by two screws. Cylinder *b* is connected with the arm *t*, and this is movable in a horizontal plane. The screw *d* fastens the whole arrangement to the pillar of the balance. After loosening the same, the mirror is placed at the most advantageous distance from the scale by moving the arm *t*. The scale plate, also on an incline, is fixed to the pillar so that the scale is turned towards the same. The pointer Z swings between mirror and scale-plate, close to the latter. The pointer is at a short distance above its end, opened out in the shape of a rectangular frame. The front view, Fig. 2, shows the reflection, magnified four to five times, of the scale divided into 0·2 mm. with the delicately worked-out end of the pointer swinging rapidly over it. The scale-plate gives efficient protection to it.

The advantages of this mirror-reading over reading by telescope, microscope, or single lens are obvious; in so far as it is done as conveniently as with an ordinary scale, requiring no magnifying, and as it moreover is independent of the source of light, which is received by the scale or by the mirror, and which is in either case transmitted to the eye.

The mirror is also applied to balances built originally for technical purposes, which attain by that an extraordinary exactness with a complete oscillation of only nine seconds for mean load (100 grms. in each pan). This arrangement, with suitable adaptation, is also applicable to other instruments.

Since this paper, Kuhlmann has adopted a further improvement. He makes the pointer swing in the plane of the scale, so that any fault caused by parallax is avoided. This necessitated an alteration in the mechanism for arrestment, so that now the supporting plane for the beam is fixed.

The first instrument supplied with these latest arrangements is before you.

## THE OPENING OF THE SCHORLEMMER ORGANIC LABORATORY IN THE OWENS COLLEGE.

Allusion was made in the last issue of the Journal (p. 525) to the opening of this laboratory on May 3.

The following is the text of the speeches delivered on the occasion by Prof. Dixon, Sir H. E. Roscoe, M.P., Mr. L. Mond, and others:—

Prof. Dixon said he had received a number of letters apologising for inability to attend, including one from Mr. A. G. Vernon Harcourt, President of the Chemical Society. One and all of the writers wished prosperity to the new laboratory that would bear the honoured name of Schorlemmer. Amongst the senders of messages from abroad were Profs. Beilstein, of St. Petersburg, Emil Fischer, of Berlin, L. Meyer, of Tübingen (whom they had just lost), Victor Meyer, of Heidelberg, L. Claisen, of Aachen, and an old friend of Schorlemmer's, Dr. Caro, of Mannheim, from whose letter he read an extract. Prof. Dixon, continuing, said he desired to express, on behalf of his colleagues and himself, their admiration of the noble simplicity of Schorlemmer's life and character. He believed that Schorlemmer was absolutely unguided in any matter, great or small, by any consideration of his own advantage or his own ambition. He wore the gifts of genius with a singular quietness and equanimity, and he used them nobly and well. He was a standing example to both staff and students of unselfish devotion to that which he considered to be his duty as professor. He was ever ready to give his time freely to those who came to him for help and advice. No man could more truly be said to have lived for the sake of his work—work which included scientific investigation of the highest kind; and of that high work Owens College, they were proud to remember, was from the beginning, and remained to the end, the centre and the inspiration. They who lamented him might be sure of this, that there was no tribute which would have been more welcome to him, that there was no memorial which could more fittingly perpetuate his name, than one which, while it expressed their admiration for his life and work, would provide for the continuance and development of that work within the walls of the College where he himself lived and laboured.

Sir H. E. Roscoe, M.P., who was cheered on rising, said it was a painful duty, as well as a great pleasure, for him to take the chair, on that occasion—a painful duty because of the thought that the man whose memory they were called together to honour might still have been amongst them and working for the progress of that science for which alone he lived; a pleasure because of the thought that they were offering a tribute to steady, persevering work, and unselfish devotion to the cause of scientific advancement. In a brief sketch of Schorlemmer's life, Sir Henry said he came of a poor burgher's family at Darmstadt, a little town the birthplace of a larger number of eminent chemists than any other city could boast. In early years he showed his ability, and entered the University of his native land. After he (Sir H. Roscoe) had completed his own regular course of studies in Germany and was about to return to England, William Dittmar, who was then Bunsen's assistant, expressed the wish to come to England with him, and on his (Sir Henry's) appointment to the Chair of Chemistry in that College in 1857, Dittmar accompanied him to England and worked as his private assistant, Frederick Guthrie, who had occupied the position under Frankland, still continuing to teach the 15 students who then formed the sum total of those working in the Owens College laboratory. Soon Guthrie left for the Mauritius, and at the beginning of the session of 1859 Dittmar reigned in his stead. He (Sir Henry) then needed another private assistant, and in those days no competent young Englishman was to be found—now they might be reckoned by scores—and Dittmar advised him to send for a young friend of his who had studied for a year in Giessen. So Schorlemmer came to him, and remained his faithful and intimate friend for 34 years. He at once found out the kind of man with whom he had to deal. He remembered well the energy and ability with which Schorlemmer attacked the problem of distilling hydrofluoric acid, both under increased and diminished pressure, and how some of the strong acid injured his hand, forming a wound which did not heal for months. Two years later Dittmar resigned, and Schorlemmer was placed in the position of the sole assistant and demonstrator to a somewhat increased number of students. In that new position his powers as a laboratory teacher soon made themselves manifest, and much of the subsequent success of their laboratory was due to his tact and knowledge, and to the genuine enthusiasm which he displayed in imparting that knowledge to others. He (Sir H. Roscoe) remembered as though it were only yesterday the first beginning of the original work which had made his name eminent amongst the chemists of the time. Mr. John Barrow, of Gorton, who was then occupied with the manufacture of benzene by the distillation of cannel coal—for the supply from the gasworks was then not equal to the demand,—sent him (Sir H. Roscoe) some of the light oils which he obtained in his process. They were of no commercial value, and had not been investigated. He submitted these oils to Schorlemmer, knowing their investigation was a hard nut to crack, but knowing also that Schorlemmer was the man to crack it. The examination of those oils was the beginning of Schorlemmer's scientific fortune. That was not the occasion to discuss Schorlemmer's scientific work, for was it not written in every manual of organic chemistry throughout the world, and had it not been described fully in his own "History of the Rise and Development of Organic Chemistry," recently edited by his pupil Prof. Smithells? He would only say that Schorlemmer's investigations on the constitution of the hydrocarbons marked an era in modern organic chemistry; and whilst his work in itself had a purely scientific value, it, like much other work of a similar character, enabled other men to build up an industrial structure, the value of which was measured by millions of pounds sterling, and gave now employment to thousands of men. For it was not too much to say that without Schorlemmer's discoveries the knowledge of the constitution of the carbon compounds which we now possess, as typified by Kekulé's theory, could not have been arrived at. And so Schorlemmer worked away as the demonstrator at Owens College, assisted, as numbers grew larger, by the pupils whom they trained, until 1874, when he became the first and only professor of organic chemistry in the kingdom. Turning to the literary talent of the late Prof. Schorlemmer, Sir H. Roscoe said his power of work was simply prodigious, and his knowledge of chemical literature deep as well as broad. He much valued and made use of their admirable medical library. He, of course, lived and died a poor man, though had he chosen he might have amassed a large fortune. His distinction was, however, none the less on that account, but, as some would think, all the more. Schorlemmer added another name to the list of distinguished foreigners who had found a home in these islands. Never again could it be said that England failed to recognise and appreciate the value of the services of those who sought her shores. The names of Herschel, of von Hofmann, of Max Müller, and, lastly, of Schorlemmer, indicated that we were not slow to give honour to those who were once strangers in the land, but who had made themselves members of our national family. In conclusion, Sir Henry reminded those assembled that they had in the director of the new laboratory—Prof. Perkin—a man able and determined to carry on, in still higher measure, the work which his predecessor inaugurated. They might have good hopes that ere long the time would come when the leaders in chemical industry would appreciate the necessity of a thorough scientific training, as had long been the case in Germany; and that as Giessen was, under Liebig, the means of raising the standard of chemical education throughout the Fatherland, so the chemical department of Owens College might, under the direction of Profs. Dixon and Perkin, with their admirable coadjutors, be pointed out as the institution in England which had done the same for this great empire.

Mr. Ludwig Mond said the opening of the first laboratory solely devoted to the study of organic chemistry, at the only University in England which can boast of a professor of that science, marks a distinct step forward in the development of science in this country.

In dedicating this laboratory to the memory of Schorlemmer, to whom science and this University owe so much, we must all regret that it was not vouchsafed to him to have the use of such a special laboratory at his disposal. Nevertheless the spirit which he infused into his work, his pupils, and his books, will be the most valuable endowment which this new building inherits, and will manifest itself in the work of all those who have the good fortune to work here, if they approach their task with the same single mindedness and love of truth that marked the late Prof. Schorlemmer.

His work has been singularly fruitful in clearing up and putting on a sound basis the modern theory of organic chemistry, called by him so appropriately the chemistry of the carbon compounds.

For it was Schorlemmer who provided the fundamental proof of the equal value of the four valencies of carbon, the very corner-stone of the great edifice by which we have obtained an insight into the simple laws upon which the immense variety of organic compounds is built up. And the value of the work not only extends to the chemistry of carbon, for the more we succeed in penetrating into the constitution of the more complex compounds of other elements, the more we are forced to apply the same laws which we owe to the study of organic chemistry to explain their constitution.

Now you may ask—and very properly ask—if organic chemistry is so closely related to inorganic chemistry—if it only treats of the compounds of one element out of the large and daily increasing number of elements from which our universe is built up, why I consider it a great step in advance to have a special laboratory and special professors appointed for the study of the chemistry of this one element. The answer is this:—the subject-matter of chemistry has become so vast a domain and is increasing at such an immense rate that for anyone desiring to further contribute to it, it has become a necessity, after mastering the main facts of the science, to give his attention specially to the details of one or other part of it.

While it is true that carbon is only one out of many elements, it possesses such very special properties that the multitude of its compounds probably outnumbers those of all the rest of the elements together, and it has the unique interest that all the innumerable substances that are found in plants and animals, which build up their tissues and by their constant changes produce the phenomenon we call life, are all compounds of carbon. It is for this reason that we call the chemistry of these compounds organic chemistry, and it is very natural that this branch of our science should be nearer to our hearts than any other branch.

But there is another and stronger reason for having special laboratories of organic chemistry. The methods of investigation and our way of mentally analysing these compounds differ considerably from those applied to inorganic chemistry. In the latter, if we have ascertained by an accurate analysis of a pure substance its percentage composition, this, together with the determination of a few simple physical properties, is usually sufficient to give us a perfect insight into its chemical composition and behaviour. The laboratory methods required for this study are simple, and most of them are well known, so that they can be acquired by sufficient experience. In organic compounds the matter is very different. The percentage composition and the physical properties tell us very little of their chemical individuality and behaviour. Many substances of exactly the same percentage composition possess widely different qualities which are not explained by their physical properties. We must find out how these compounds, many of which are very complex, are built up. We have to unravel the structure of these substances to attain our end, which, in chemical investigation, always means to give an explanation of all the various properties of a substance through its chemical constitution.

To ascertain its structure we have to break the organic substance down by degrees, to take it gradually to pieces; and even that is not enough; but to make sure of the actual arrangement of these pieces in the substance we have to put them together again, we have to rebuild the substance from its proximate constituents, and only after having accomplished this can we consider that we know its constitution.

The methods employed in this work are entirely different from those of ordinary analysis. They are very manifold. The investigator has to make his own choice which of them to apply in any individual case, and wherever he breaks new ground and undertakes the study of a new series of compounds, he has to discover and work out new methods before he can achieve success.

It is evident that a student aiming at qualifying himself for such high-class work should enjoy special facilities, and should, after having gone through a regular course of analytical chemistry, have a chance of prosecuting special organic work in a laboratory fitted specially for it, and where he is undisturbed by the army of beginners who throng an analytical laboratory; and here I may point out that in my opinion the reason why this country has not advanced in organic chemistry as fast as other countries—the reason why von Hofmann's prediction in his Report on the Exhibition of 1862 that "England will be unquestionably at no distant date the greatest colour-producing country in the world," has not been fulfilled, but that Germany has almost entirely taken this industry out of her hands—has been that so few English students of chemistry have devoted sufficient time to the prosecution of their studies.

It is evident from what I have said—and it is the experience of other countries—that in order to attain the necessary experience and certainty in carrying out original investigation in organic chemistry, four to five years of close study and attention, under the leadership of a competent professor, are a necessity; and for carrying on successfully the manufacture of artificial colours it is indispensable that the chemist should be able to carry out independent original research, because new colours have year after year to be discovered and manufactured, and the processes for their production have to be constantly improved in order to compete successfully with rival manufacturers. It was not, indeed, the workman, not the foreman, as so many people in this country still believed; it was the leading mind, which directed the manufactory, upon whom the success of an industrial enterprise depended —his thorough grasp of scientific principles, and his trained habits of scientific thought.

But it may be asked:—"Is it not, after all, too late now for opening a special laboratory for organic chemistry? Is there yet enough to be learned about carbon compounds and of sufficient importance for science in general to repay the intricate and tedious work involved? Is there any hope to match the brilliant results already achieved? Can anything beat the galaxy of brilliant colours which the last 40 years have drawn from coal tar? Has not the time arrived when we should set our face against the supremacy which the carbon compounds have held during this period, and give our attention to the study of other elements which, in the opinion of many in this country, have been only too much neglected? Should we not above all devote our energy to those phenomena common to all elements which we now comprise under the term of physical chemistry or molecular physics?"

I agree that it is desirable to cultivate physical chemistry and inorganic chemistry much more than has been done during the period under review, and I am very glad that the great supremacy which organic chemistry has enjoyed, more particularly in Germany, the home of chemistry, is now being contested by other and equally important branches of our science; but great, and very great, as has been the progress of organic chemistry, it has greater and more important problems still to solve; and in this country, which has given birth to so many of the most important steps in advance of that science, it has not received that amount of general attention which it has deserved in the past, and which it still deserves in the future. I therefore specially and heartily welcome the opening of the first laboratory exclusively devoted to it in England.

Professor Schorlemmer, in his excellent and most suggestive little work "On the Rise and Development of Organic Chemistry" (the careful study and repeated perusal of which I cannot too strongly recommend to the student), after giving a lucid review of the steps by which the great edifice of that science has been built up, gives in his concluding remarks a perspective of the problem still to be solved—wide enough for the most expansive imagination of any searcher after truth.

I cannot do better than read to you a few sentences from this remarkable book:—

"When Ettling, in 1838, found that salicin yielded on oxidation the essential oil of spiræa ulmaria, Liebig wrote to Wöhler: 'This is a remarkable fact; we shall yet make sugar and quinine and uric acid.' In the same year Wöhler and he published their classical research on uric acid, and wrote: 'The philosophy of chemistry will from this work draw the conclusion that the production of all organic matters in our laboratories, in so far as they do not belong any more to the organism, must be regarded not only probable but as certain. Sugar, salicin, and morphine will be made artificially.'"

If to-day we still cannot make morphine, quinine, and similar bodies artificially, the time is near at hand.

If we cannot make quinine, we have already found a partial substitute in antipyrine, and its introduction into therapeutics has lowered the price of quinine considerably.

Another important problem is the synthesis of the ingredients of our daily food, such as sugar, gum, and starch. These bodies are nearly related to each other, for we can convert the two latter into different kinds of sugar, and sugars again into gums. That the synthesis of sugar is imminent has already been stated.

But it is quite different with those important parts of our food which have been called the albuminous bodies. All that we know of them is their percentage composition, and that they contain the carbon atoms linked together partly as in the aliphatic compounds and partly as in the aromatic bodies.

Kekulé, in discussing the scientific aims and achievements of chemistry, wrote: "The hypothesis of chemical valency further leads us to the supposition that also a relatively large number of single molecules may, through polyvalent atoms, combine to net-like, and, if we may say so, sponge-like masses, in order thus to produce those molecular groups which resist diffusion, and which, according to Graham, are called colloids. The same hypothesis leads us, in a most natural manner, to the view already pronounced by our eminent colleague, Pflüger, that such accumulation of molecules may extend yet further, and thus build up the formative elements of living organism. Of these mass molecules, we may perhaps further suppose that through the constant change of position of polyvalent atoms, they will show a constant change in the connected individual molecules, so that the whole—of course with development of electricity—is in a sort of living state; particularly so as, through similar displacements, adjacent molecules may be drawn into the circle of combination and newly formed ones expelled.

"The idea thus brought forward may perhaps be expressed by saying that if ever chemists should succeed in obtaining albuminoid bodies artificially, it will be in the state of living protoplasm, perhaps in the form of those structureless beings which Häckell calls the Monera.

"All attempts hitherto made for the purpose of producing living matter artificially have failed. The enigma of life can only be solved by the synthesis of an albuminous compound."

Prof. Emil Fischer, of Berlin, to whose genius and indefatigable work we owe the greatest advance as yet made in the synthesis of organic bodies suitable for human food, as it was he who succeeded, by a long series of most brilliant scientific investigations, to build up a whole series of sugars from their constituents—Prof. Fischer, in a beautiful lecture delivered not long ago in Berlin, also expresses himself full of confidence that the time will arrive when we may attack successfully even the problem of the constitution and synthesis of the albuminoids, and may thus approach the problem of the origin of life.

Surely with such a prospect before us as the ultimate result of the pursuit of organic chemistry, no amount of work, no amount of thought, no amount of time and trouble devoted to this study, will be too much if it is well employed in leading successfully to the great end in view, although the goal may not be reached for generations to come.

I need not dwell, in this town of Manchester, so famous as a centre of chemical and other industries, and in this county of Lancaster, which I believe is the most densely populated part of the world, and consequently depends more than any other for its food supply, *i.e.* for its very existence from day to day, upon the products of the field of countries far away,—I need not dwell here upon the immense economic importance of the solution of these problems, which have so far been pursued by men of science for the pure sake of knowledge, from the love of truth for its own sake, which is and no doubt will always remain the greatest impetus to the greatest minds. Our progress is measured by the increase of our knowledge which alone enchances our power over the forces of nature, and enables us to turn them to the use of man. A new principle once acquired will soon be found to be applied to the requirements of our daily life. Any advance in pure science is very soon followed by advances in our industries. To cite an example, the immense development in the practical application of electricity which we have all witnessed within very recent years, we owe far more to Faraday's scientific work than to all the numberless inventors who have followed up his discoveries and turned them to practical use. Certainly nothing could be further from my mind than to detract from the merit of the inventor who devotes his energies and his knowledge to utilise the advances of science for improving the conditions of our daily existence. I belong myself to this class, and the best part of my life has been spent in this work.

Scientific discoveries do rarely supply us with all the knowledge required for their practical application. The inventor has frequently to supplement it by other scientific discoveries before he succeeds in his task. But the work of the scientist has to be made first, and the scientific principles have to be elaborated and to be clearly understood before any real important progress in our industries can be achieved.

I therefore appeal to the students assembled here to give their whole attention to the progress of science, for its own sake, without looking forward to an immediate practical result. This is sure to come sooner or later. Let us hope that this new laboratory which we are opening to-day will soon be the scene of active and successful work in the great cause of science, and will have its full share in the scientific triumphs of the future. The mantle of Schorlemmer has descended upon Professor Perkin, who, by the excellent and most important work he has already done, has given the most abundant proof of his worthiness to wear it, and of his ability to take a leading part in the further development of organic chemistry. But the success and renown of the new laboratory will rest upon you his pupils, upon the zeal, the earnestness, and the devotion with which you will prosecute your work.

Dr. E. Schunck proposed a vote of thanks to Mr. Mond for his presence and address, and expressed the hope that by means of the new laboratory the memory of their lamented friend Professor Schorlemmer would remain green, not only in this country, but more particularly in that College and University.

Principal Ward seconded the motion.

The resolution was passed with acclamation, and Mr. Mond briefly replied.

Mr. Alderman Thompson proposed a vote of thanks to Sir H. E. Roscoe.

Prof. Thorpe seconded the resolution, which was passed.

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# Nottingham Section.

University College, Nottingham.

*Chairman: J. M. C. Paton.*

*Vice-Chairman: C. Spackman.*

*Committee:*

L. Archbutt.
*F. J. R. Carulla.*
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*H. Forth.*
J. F. Kempson.
T. Mason.
J. O'Sullivan.
*S. J. Pentecost.*
C. Taylor.
G. J. Ward.

*Treasurer: J. T. Wood.*

*Hon. Local Secretary:*
*R. L. Whiteley,* University College, Nottingham.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Chairman:*—F. J. R. Carulla. *Vice-Chairman:*—J. M. C. Paton. *Treasurer:*—S. J. Pentecost. *Secretary:*—J. T. Wood. *Committee:*—W. G. Johnston, and R. Lloyd Whiteley.

*Meeting held at the Midland Hotel, Derby, on Wednesday, April 24th,* 1895.

MR. J. M. C. PATON IN THE CHAIR.

## NOTE ON THE HYDROLYSIS AND ESTIMATION OF SUGAR.

BY JAMES O'SULLIVAN, F.I.C.

It is well known that if a solution of cane-sugar is heated with dilute acid it is hydrolysed, and invert sugar, consisting of equal proportions of lævulose and dextrose, is formed. It is also known that this action of dilute acids takes place in the cold, but much slower than when heated. In the Jour. Chem. Soc. **51,** 408, I gave the properties of invert sugar and of dextrose obtained from cane-sugar by means of invertase prepared from yeast. The numbers I gave for invert sugar were $[\alpha]_J^{3\cdot85} = -24\cdot5$ T 15·5, with a cupric reducing power $_K$99—100 of dextrose, the factor employed being CuO multiplied by 0·4535. Soxhlet prepared invert sugar by heating a cane-sugar solution with acid, and determined its cupric reducing power, which, he says, is only equal to 96 per cent. of dextrose. It occurred to me that, as the properties of invert sugar, prepared by means of acid in the cold, had not been determined, it was worth while doing so. With this object in view, I made a preliminary experiment, and found that in six days, at the ordinary temperature, a 10 per cent. solution of cane-sugar was completely hydrolysed by 2 c.c. of concentrated sulphuric acid. Two experiments were then made in the following manner:—

10 grms. of pure cane-sugar (Tate's large crystals) were dissolved in about 50 c.c. of water, and to this 40 c.c. of dilute sulphuric acid (4 c.c. conc. acid) when cold, were added. After seven days, the solution was made up to 100 c.c., and its opticity observed, which was found to be − 15·2 in a 200 mm. tube of a Soleil-Ventzke-Scheibler polariscope; and no alteration in this opticity was noticed after three days. The specific gravity of the solution was 1076·24, 15·5/15·5, and a cupric reducing power determined by employing a weighed quantity of the solution, and neutralising it with hydrate of potassium, gave $_K$10·47 grms. for the 100 c.c. Now, 10 grms. of cane-sugar, when completely hydrolysed, produces, theoretically, 10·52 grms. of invert sugar; but I found $_K$10·47 grms., equal to 99·5 per cent.

From the observed opticity, and, assuming that there were 10·52 grms. of invert sugar in the 100 c.c. of solution, the $[\alpha]_J = -27\cdot7$ T 15·5.

The second experiment was performed in the same manner with 2 c.c. of acid; and the numbers obtained in a similar way for the substance in solution were $[\alpha]_J = -26\cdot4$ $_K = 100\cdot8$.

It will be observed that in these experiments the acid was not removed before the properties of the substance in solution were determined.

In order to see what were the properties of invert sugar prepared in this manner, the sulphuric acid being removed, I made the following two experiments:—

10 grms. of sugar were dissolved in about 50 c.c. of water, and to this solution, in a 100 c.c. flask, 30 c.c. of diluted sulphuric (1 c.c. conc.) acid, were added, and the solution made up to 100 c.c. After well mixing, the flask was placed in a vessel through which cold water was kept running. An optical observation was made from time to time, and the course of the hydrolysis from the loss in angular rotation recorded. It was found that after nine days the opticity remained constant, and this was taken as an index of the completion of hydrolysis. To the remaining portion of the solution, carbonate of barium was added in excess, and filtered; to the filtrate, which was alkaline, and contained barium, very dilute sulphuric acid was carefully added, and, to remove excess of acid, I used hydrate of barium; in fact, either the latter or the acid was added until a portion filtered showed only the faintest reaction for sulphuric acid. The solution was heated to

boiling, and cooled. Its specific gravity was 1019·38, or D 3·85 = 5·034 grms. per 100 c.c., and in a 200-mm. tube the opticity was − 6·7, or $[\alpha]_J = -25\cdot5$. Two cupric reducing powers were determined, employing weighed quantities of the solution, with the following results:—

$_{K}$I 99·1, II 98·8.

The second experiment was performed in the same manner with 2 c.c. of acid. In this case the opticity of the solution remained constant after the 7th day, and the numbers obtained for the substance in solution were—

$$[\alpha]_J^{3\cdot85} = -24\cdot2 \text{ T } 15\cdot5^\circ.$$

$_{K}$I. 99·1. II. 98·7.

It is true these $_{K'}$s do not come out a 100 per cent. of dextrose, but they are not sufficiently removed from it to justify, in my opinion, any deviation from the generally acknowledged factor that CuO multiplied by 0·4535 gives invert sugar.

The Fehling's solution with which the last two $_{K'}$s were determined had only been made four days, and two determinations made with it of pure dextrose prepared from cane-sugar by invertase gave—

I. 101·5. II. 100·5.

In the other experiments the Fehling's solution used had been made some months.

In estimating cane-sugar in the presence of substances which are hydrolysed by acid, there is no safer method than that of O'Sullivan (Jour. Chem. Soc. 1886, 49—58).

Fisher has recently found that air-dried yeast yields an extract which hydrolyses maltose; this fact, however, does not interfere with O'Sullivan's method, since invertase as employed by him has no action on maltose.

In one of the above experiments I calculated the constant, after the manner of Wilhemy and Ostwald, to see if the rate of hydrolysis followed that of a simple chemical change, as shown by them, and the following are the results obtained:—

| Time in Minutes. $\theta$ | Fraction Hydrolysed. | Value of $\frac{1}{\theta}$ Log $\frac{1}{1-x.}$ |
|---|---|---|
| 262 | 0·1544 | 0·000277 |
| 1,677 | 0·6332 | 0·000259 |
| 2,788 | 0·7992 | 0·000250 |
| 4,324 | 0·9247 | 0·000284 |

If the dextrose produced had been in the birotatory state these constants would not agree so closely. By diluting a known volume of the solution with a known volume of potassium hydrate, I found that the opticity of the diluted portion was exactly proportionate to the dilution, which is a further proof of the dextrose not occurring in the birotatory state under the conditions of the experiments.

# New York Section.

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G. T. Bruckmann.
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Francis J. Schleicher.
Jas. H. Stebbins, jun.
T. B. Stillman.
J. H. Wainwright.

*Hon. Treasurer:* R. C. Woodcock.

*Hon. Local Secretary:*
Dr. H. Schweitzer, 159, Front Street, New York, U.S.A.

*Meeting held at the College of Pharmacy,*
*Monday, May 6th, 1895.*

MR. A. H. MASON IN THE CHAIR.

## THE EVOLUTION OF SMOKELESS POWDER.

BY ROBERT C. SCHÜPPHAUS, PH.D.

Smokeless explosives, of which gun-cotton and nitroglycerin are the most important representatives, have been known for a long time. The first discovery in this line was made by Braconnot in 1832, when he found that starch and similar bodies were rendered highly combustible through treatment with nitric acid. Six years later, Pelouze took the subject up and extended his researches to cotton, paper, and other vegetable substances. He found that the carbohydrates gained in weight when subjected to the action of nitric acid. Dumas pursued the subject further, and proposed to make nitramidine, as he called nitrocellulose made from paper, into cartridges. But the nitro-bodies produced by these early investigators lacked stability and uniformity, and nothing came of these experiments. The foundation on which the structure of high explosives rests, was laid in 1846 by Schönbein, who first succeeded in producing true gun-cotton, and who introduced the mixed acids bath, consisting of highly concentrated sulphuric and nitric acids. In his subsequent work he enjoyed the collaboration of Böttger, who had independently arrived at the same results. This fundamental discovery was quickly followed by Sobrero's preparation of nitroglycerin in 1847, accomplished in Pelouze's laboratory. The same year, Dr. Maynard, of Boston, discovered soluble gun-cotton, and applied its solution in a mixture of ether and alcohol, collodion, to the purposes of surgery. Nitroglycerin likewise found its first application in the United States, though not for its explosive properties, but as a medicine.

For convenience' sake, I make use of the traditional terms soluble and insoluble gun-cotton. We must not forget, however, that soluble pyroxylin exists in a great many varieties, and that the various grades employed in the arts—as, for instance, the manufacture of celluloid, the production of varnishes, the preparation of collodion, of typical blasting gelatin, of smokeless powder—exhibit great differences in chemical composition and degree of solubility.

The insoluble variety, so-called, is insoluble in a mixture of ether and alcohol and some other liquids, which either dissolve or soften the soluble grade, but is easily dissolved by acetone and compound ethers, such as the acetates of methyl, ethyl, and amyl, and is also soluble in nitrobenzene and nitrotoluene. To avoid tiresome repetitions, I will follow the course which the industrial applications of the soluble grade took, though I may thereby slightly disturb the chronological order. But it is the experience gained in these new industries, which has proved indispensable to the manufacturer of modern smokeless powders. In 1851, Archer and Fry invented the collodion emulsion, and thereby vastly improved the art of photography. In 1860, Barnwell and Rollason proposed to use pyroxylin solutions as varnishes, and to make from such solution a multitude of useful articles. Soon after the subject was taken up by Alexander Parkes, of Birmingham, the inventor of Parkesine, and by Daniel Spill, of London, afterwards manager of the Xylonite Co. In the United States, J. A. McClelland and John W. Hyatt were at work to utilise the valuable properties of soluble pyroxylin. But an invention overshadowing all the others in importance was made by Daniel Spill in 1869, when he first produced a pyroxylin-camphor composition, plastic at about 75° C., by gelatinizing pyroxylin by means of a solution of camphor in commercial grain alcohol. As far as the chemical side is concerned, Daniel Spill must be hailed as the father of the celluloid industry, whilst to John W Hyatt, at that time of Albany, N.Y., the greatest credit is due for devising suitable machinery for the intricate processes involved, for discerning the importance of pure materials, and for the perseverance which he exhibited under most adverse conditions. To-day, the world's daily production of celluloid amounts to 30,000 lb. To us the most important fact is, that there was no difficulty as far back as 1870 to fashion soluble pyroxylin into sheets, rods, or tubes. Nor had it escaped observation that the gelatinized product was not nearly as explosive as the flocculent material.

After this short digression let us return to gun-cotton proper, and to the attempts made to utilise it as a propulsive agent. Sportsmen looked hopefully to it directly after its first production, and fibrous gun-cotton, rammed into cases, was used as a powder charge, but, as is easily understood, with disastrous results. The feverish activity displayed in European countries to make and use gun-cotton gave way to a feeling of apathy after the numerous failures and frightful accidents which were due to faulty processes of manufacture and an insufficient knowledge of the new explosive. But carefully conducted experiments had convinced the Austrian General von Lenk of the great promise of gun cotton, and from 1849 to 1852 he worked indefatigably on improved processes of manufacture. In 1853 the Austrian Government erected works where the General's processes were carried out. Von Lenk recognised that it was necessary to decrease the rate of burning in order to utilise gun-cotton as a propelling powder; that, in other words, it was necessary to diminish the air-spaces in the material to a minimum—to condense it, if I may use the term. What his successors have accomplished by the use of gelatinizing fluids he tried to attain by mechanical means, and to that end twisted and braided nitrated cotton yarn into ropes and cylindrical wicks. In the early sixties no less than 30 batteries of Austrian artillery fired gun-cotton cartridges from rifled cannon; they used smokeless powder. Similar cartridges were tried in small arms, and the bursting charge of shells consisted of von Lenk's plaited gun-cotton. The material was definitely abandoned in 1865, after two large magazines had exploded in 1862 and 1865 from unknown causes. Shortly afterwards, Uchatius, another Austrian officer, tried to introduce nitro-starch into the service, but its lack of stability, as then prepared, and its physical properties unfitted it for the purpose. In the meantime the English Government, to whom von Lenk's process had been communicated, had instituted experiments on a large scale under the direction of Sir Frederick Abel. The same year that von Lenk's labours were brought to such an unhappy conclusion, Abel published his process of pulping and compressing gun-cotton, which marked a new era in the history of this explosive. This method permitted the manufacture of an absolutely stable article; and no higher testimony to its intrinsic worth is needed than the fact that it has remained the standard method of treatment of nitrated cotton all over the world, though in the nitration proper, in the apparatus employed, and in the restoration of spent acids, great improvements have since been made. At this time appeared the first semi-smokeless sporting powder of Col. Schultze, of the Prussian artillery, embodying an idea first propounded by Barnwell and Rollason in 1860, namely, to replace the carbon of ordinary powder by finely comminuted pyroxylin. Schultze was aided in his experiments by Captain Dittmar, of dualin fame, also of the Prussian artillery. The original Schultze powder consisted of wood cut into grains, purified, nitrated, and finally impregnated with nitrate of potassium, or both the nitrates of potassium and barium. Dittmar subjected the wood to a peculiar heating process before nitration, and his powder is to this day manufactured by the American Wood Powder Company. Both these powders were tried in the United States in rifles, by Government officials as well as at the testing station of a large ammunition firm, and found utterly worthless for that purpose. The Schultze powder of the present day is very much like the E.C., which is made from pulped gun-cotton and nitrates, and has been brought to its present state of perfection through the efforts of Messrs. Reid and Johnson. Both these inventors have profited by the experience of the celluloid manufacturers, and employ solvents of pyroxylin to harden the grains. But this powder belongs to a later date, the early eighties.

Messrs. Prentice and Sons, of Stowmarket, the first private manufacturers of gun-cotton, tried in 1866 to supply the wants of the sportsmen in a different way. They made a cartridge of felt-like paper, composed of gun-cotton and ordinary cotton, produced from a mixture of the pulped materials, which found much favour. Later they made a pellet of slightly compressed gun-cotton, waterproofed by an india-rubber varnish. These were not sufficiently uniform for military purposes. Abel produced similar ones which gave very promising results in a Martini-Henry rifle. From 1867–68 he experimented at Woolwich with cartridges built up from compressed gun-cotton fired from bronze field guns, but found little encouragement, though the results were ahead of those obtained with von Lenk's cartridges. The time had not yet arrived when a powder of the highest power, which of its very nature involves the absence of smoke, had become an urgent necessity.

While these attempts were made in England to obtain an improved powder from gun-cotton, which was naturally smokeless, in France experiments were steadily going on with another material, picric acid, which also yielded powders comparatively free from smoke. Two powders, those of Designolle and Brugère, came to the front, the former consisting of picrate of potash, saltpetre, and charcoal, the latter of picrate of ammonia and saltpetre. Brugère's powder especially gave excellent results in a chassepot rifle. Smoke and residue left in the gun were greatly reduced. This powder was used experimentally in the French army up to the time that the mysterious Poudre B made its appearance, and was later superseded by the laminated gun-cotton powder of Vieille and Sarrau. Up to this time several inventions had been made which were to play an important part in the future rapid development of smokeless powders. As early as 1875 Daniel Spill had taken out a patent for the production of tubes for military and other purposes from soluble gun-cotton, and among other solvents for the material he mentions alcohol and ether and nitrobenzene. We have here the forerunner of Hiram Maxim's and of Anderson's gun-cotton cords, and of Prof. Munroe's indurite. The same year gave us Alfred Nobel's magnificent invention of explosive gelatin, the prototype of ballistite and cordite.

In 1882, as previously mentioned, Reid and Johnson obtained their patents for producing hard-grained sporting powders. The French military authorities took early note of their results. The following year Wolff and Max von Forster, a former captain of engineers in the German army, patented a process for the manufacture of grains of compressed gun cotton with hardened surfaces. The surface of the grains was gelatinized by dipping the grains in ethyl acetate, nitrobenzene, or similar solvents of gun-cotton. These grains were to be used as charges for shells and aerial torpedoes. Petri, Fallenstein and Lisch in 1884 brought out an explosive, the base of which consisted of gun cotton dissolved in nitrobenzene. At this time conditions arose that made a powder of high power and free from smoke a necessity. A powder of the highest power must needs be one that is totally resolved into gaseous products it must be smokeless. It had been recognised long before the days of smokeless power that it was necessary to get rid of any solid residue, of smoke to attain ideal results. Smokeless is a concomitant feature of high power and *vice versâ*.

The naval service needed a smokeless powder for the use of its secondary batteries to ward off the attacks of torpedo-boats, and the infantry required an improved powder, if any further advance in the accuracy and range of its rifles was to be made. The calibre of the small arms of all armies has slowly, but surely grown smaller and smaller. And for obvious reasons. A much more steady flight can be imparted to a projectile of smaller diameter and elongated form than to the old fashioned bullet. This new projectile being a good deal lighter, requires a much increased velocity of travel to maintain its energy, its striking force. The greater velocity means a flatter trajectory, an increased accuracy of fire. Black powder, of which only about one-third is converted into gaseous products, which have to project the other two-thirds as dead ballast, was not equal to the new task, especially in the reduced powder chamber. It had already proved unsatisfactory in the interesting struggle between armour and rifled cannon. The great improvements which Major Rodman and Doremus of the United States had made in the physical characteristics of black powder through their invention of prismatic powder had not been sufficient. Heidemann, of the Westphalian powder works and Düttenhofer of the Rottweil works invented nearly simultaneously the brown powder, and brown prismatic is used to this very day in heavy ordnance, though smokeless powder is pressing it close. This brown powder contains more saltpetre, less sulphur and instead of the common carbon underburned charcoal, similar to the charbon roux of Violette, which he proposed in 1847 for sporting powders.

Gäns conceived the idea in 1885 of producing an improved powder through the substitution of sulphur by nitrate of ammonium. By using a certain proportion of the latter in conjunction with charcoal and saltpetre, he imagined to have produced a powder which would not absorb water, and in the explosion of which potassium amide would be formed. Such was, of course, not the case; the powder was far from smokeless, and it was hygroscopic. Heidemann modified Gäns' formula, and produced a powder possessed of remarkable ballistic properties. It furnishes comparatively little smoke that speedily disperses, and is less hygroscopic that any nitrate of ammonium powder hitherto prepared. The pressures in the chamber are lower, along the bore of the gun higher than with brown powder. This behaviour is similar to that of the smokeless powders with guncotton base. For use in machine guns this powder was sealed up. But even when confined it is subject to changes, due to uneven distribution of heat during storage, and consequently lacks uniformity. Though it must be regarded as the first successful attempt towards the production of a smokeless artillery powder, it cannot be considered adapted to the requirements of naval service.

At this time, in 1886, the poudre B of Vieille and Sarrau appears. It consisted principally of gelatinized guncotton in the shape of laminæ, probably combined with picric acid or a picrate, compounds which in the shape of poudre Brugère and Turpin's mélinite had long been employed in the French service. Recalling to our minds what had been accomplished up to that time, we need not wonder that the other European powers experienced no difficulty in duplicating the French powder and improving on it. The rifle powders of the European armies of the present day, with the exception of the English, are laminated gelatinized guncotton, both the soluble and insoluble grades being used. The v. Förster, the Walsrode, the Troisdorf, the latest Wetteren, Riflite, belong to this class. The same compound, produced in proportionately larger dimensions, has been tried in field guns, but with no flattering success, as far as experiments conducted at the Sandy Hook proving grounds indicate. Better results have been achieved with a powder issued by the French Government for the proof of guns, but not used in actual service, the "poudre B. N." This is composed chiefly of soluble pyroxylin and nitrate of barium, and is a kind of condensed tonite, rolled or pressed into dense striated sheets. These are broken along the grooves into strips and packed in bundles to make up the cartridges. There is some smoke and considerable residue.

Alfred Nobel produced an entirely different artillery powder. It had long been known that explosive gelatin, especially when the percentage of pyroxylin was run up, possessed considerable propulsive power. Mixtures containing much more than the usual quantity of nitrocellulose, and even true guncotton in addition, had been prepared. The use of volatile solvents, though not required in the production of true gelatin, to promote gelatinisation, was well known. Celluloid manufacturers had incorporated oils, resins, and similar bodies with their compounds to obtain certain results. Nobel himself produced in 1888 an explosive celluloid, to serve as material for the manufacture of a fuse both waterproof and burning under water. He dissolved in nitroglycerin one sixth of its weight of camphor and incorporated therewith one-half its weight of nitrocellulose by mastication between warm rolls. A compound of similar composition was the first Nobel powder, and the one described in the U.S. patent of 1891 differs only in so far from it as it contains about equal parts of nitroglycerin and nitrocellulose. The presence of camphor, owing to its great volatility, was a serious drawback, and Nobel soon dispensed with it. His proposition to evaporate it by means of a current of warm air is clearly impracticable. An important advance was made in 1889, when it was found that nearly any quantity of suitable nitrocellulose, even in the wet state, could be gelatinized by means of nitroglycerin. This was accomplished by malaxation between heated rolls. It had been a common practice of the workmen in explosive works, at least in the United States, to surreptitiously add water to a batch of gelatin in the course of manufacture to hasten the gelatinizing process. This new Nobel powder, containing a slight percentage of diphenylamin to secure its stability, and cut up into cubical grains, has given excellent results in cannon. Powders of similar composition, but with a reduced amount of nitroglycerin, and cut up into smaller grains, were manufactured for rifles. The original Wetteren powder of Belgium was such a powder, though not manufactured after Nobel's latest process, but by means of a solvent—acetate of amyl in this case.

In 1888 Hiram Maxim, and simultaneously Anderson and Anderson, proposed to give definite shape to gelatinized guncotton by forcing it through holes or slits, and thus form it into strips, cords, and the like, which might be cut up. The grains thus produced, if composed of pure guncotton, are rather difficult to ignite, and certainly not suited to small arms. It is not expedient to force materials below a certain thickness through holes. If thin laminæ are desired, it is better to produce thin sheets and cut these into grains or strips.

Nobel's powder had been submitted to the English Government, and had also become known to certain manufacturers of guns and ammunition, themselves bent upon evolving a suitable smokeless powder. Cordite, composed essentially of guncotton and nitroglycerin, united by means of a mutual solvent, and shaped into cylindrical cords, became first known in 1889. Abel and Dewar, Hiram Maxim and Hudson Maxim, of New York, dispute the priority of the invention. Abel and Dewar preferred to use true guncotton, and added tannin to the mixture as a restraining agent, whilst Hiram Maxim employed castor oil for the same purpose. The cordite, fired at the present time in the large calibres in the English service, contains an addition of vaseline. Hudson Maxim's cordite for rifles, tried at the Springfield Arsenal early in 1890, consisted of about equal parts of military guncotton and nitroglycerin, with a slight percentage of castor oil and of carbonate of magnesium as a neutraliser.

The great claims made for Güttler's "Plastomenite," patented in Germany in 1889, do not seem to be justified, when its composition is considered, nor are they borne out by experience. It is made by dissolving nitrocarbohydrates, such as soluble nitrocellulose, in solid nitrohydrocarbons, dinitrobenzene for instance. I will only add that this process was known and described in the United States in 1882.

Schückler's powder, which was patented in 1890, is made of nitrostarch, gelatinized by means of nitrobenzene. It has not been manufactured to any extent, and there is no reason why guncotton, stable, easily made and eminently adapted to the purpose, should be abandoned in favour of nitrostarch.

Kolf's powder may be passed by, as may be others made of guncotton, but not gelatinized, such as proposed by v. Brauk, v. Romocki, and Dr. Emmens' gelbite. Nor do the various chlorate of potassium mixtures deserve more than a passing notice. v. Brauk's original recipe calls for a mixture of carnauba wax and lycopodium in conjunction with the chlorate. Later he employs gum traganth, dammar, resin, and other substances. Schnebelin's powder, which attracted a good deal of attention some time ago, is made of starch, mixed with a little vegetable pith, and converted into a paste by the addition of a chlorate solution. This paste is rolled out, dried, and grained.

It was not before 1890 that the United States Government took up the subject of smokeless powder. The first powder of domestic manufacture submitted was Hudson Maxim's cordite. Cut in lengths to fit the cartridge cases it gave excellent results, both as regards pressures and velocities. The difficulty of loading was so great, however, that a shorter grain had to be selected, with a corresponding increase in the pressures, but even then giving results far better than could be obtained with Walsrode, Wetteren, Dupont's modified Wetteren, Nobel, or B. N. The same year I submitted a rifle powder of a short cylindrical grain, made of gelatinized military gun-cotton combined with the nitrate of an organic base. Another variety consisted of a compressed mixture of soluble and insoluble gun-cotton, the former only being gelatinated. But the ignition with the primers then in use proved so difficult that I abandoned these powders in favour of a nitroglycerin composition, all the more readily as it was impossible to equal the records of the other nitroglycerin powders. This new powder consisted of a peculiar grade of soluble pyroxylin, nitroglycerin, and shellac. For various reasons I substituted dinitrobenzene for the latter. All my powders contained urea to guard their stability. This powder gave a somewhat better record than the Maxim, and was also fired with satisfactory results in the 8″ B.L. rifle. I give these details because a certain other powder of very similar composition has been extensively advertised. The similarity is by no means accidental. To show how easy it is to invent, and how dangerous a little knowledge is, I quote from the specification :—

"Gunpowder, consisting of gun-cotton, nitroglycerin, lycopodium, and a neutraliser of free acid, such as urea crystals or dinitrobenzol." The equivalence of urea and dinitrobenzene had not been suspected up to October 24, 1893, the date of the patent in question.

The Ordnance Bureau of the United States Navy made extensive experiments with Prof. Munroe's indurite. The method of manufacture consisted in preparing gun-cotton of uniformly high nitration, converting this into a colloid by means of nitrobenzene, shaping this colloid into cylinders or tubes, and hardening these by the well-known process of steaming. Gun-cotton, as first manufactured, was subjected to extraction with suitable solvents to free it from the lower grades. There are no difficulties to obtain a high and uniform nitration on a manufacturing scale by easier means. The choice of the gelatinizing agent does not seem especially fortunate. Though the firing tests with individual samples were very favourable, there seemed to be some difficulty in duplicating results. The ignition, too is very difficult. At any rate, the navy has abandoned this powder, and is now conducting experiments with a powder practically identical with the French B.N. Insoluble gun-cotton has been substituted for the soluble, with a corresponding decrease in the quantity of nitrate of barium incorporated with the gun-cotton.

The Peyton powder, manufactured by the California Powder Works, contains, in addition to gun-cotton and nitroglycerin, ammonium picrate, and apparently some carbon. It has given satisfactory ballistic results in the 0·30-calibre rifle and in the 3·2 field gun. As much as the examination of a couple of grains can show, the powder seems to be prepared by making a dough-like mass of the gun-cotton and nitroglycerin, incorporating the picrate with it, and then moulding the mixture. The incorporation is not thorough, small yellow lumps showing everywhere.

Two years ago Mr. Hudson Maxim and myself began experiments looking towards the throwing of aerial torpedoes by means of powder. In the course of our investigations, we developed a powder which is admirably adapted to artillery use, and has been successfully fired in field guns and in the heavy coast-defence rifles. The Maxim-Schüpphaus cannon powder is a colloid nearly all gun-cotton in the shape of multi-perforated cylinders. It is well understood that a smokeless powder should contain a minimum of nitroglycerin, not only on account of its volatility and the consequent changes in composition, but to minimise the erosive effect of the powder gases. The multi-perforated grains burn with an increasing surface, which means that an ever-growing volume of gas is generated whilst the powder chamber is being enlarged through the travel of the projectile along the bore. In this way it has been possible to rival the records of typical nitroglycerin powders with a powder nearly all gun-cotton.

It remains for me to refer to the decided influence which the improved military powders have exercised on the sporting powders. There are now several brands on the market which are nothing but gelatinized gun-cotton. To this class belong the v. Förster powder, in thin flat or curled laminæ, the rough-edged Walsrode, the globular Dupont, produced by gelatinizing finely comminuted gun cotton suspended in water by agitating it with a solvent insoluble in water, and the nitroid of the Maxim Powder and Torpedo Company. The improvement of the latter powder is in a large measure due to the indefatigable exertions of our able assistants, Messrs. Frederick McGahie, M.E., and Edwin Taylor. A new French sporting powder invented by Mr. Bruneau, contains dichromate of ammonia.

The effect of this vast development on allied industries has been widespread. Special factories have been built to cleanse cotton waste for nitration, and great efforts are being made, more or less successful, to make suitable cellulose from wood. The production of nitric acid shows an enormous increase, and the commercial product is of a concentration and purity never attained heretofore. The manufacturers of sulphuric anhydride have found a new outlet for their product. Acetone plants of large capacity, furnishing a chemically pure article, have multiplied. The manufacturers of black powder machinery have been compelled to turn their attention to the new forms of apparatus.

The production of powder has for ever passed out of the hands of the empiricist. More than ever will the destinies of nations depend on the skill and faithfulness of their mathematicians and chemists.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Improvements in Filters, and in the Manufacture of a Felt or Filtering Medium for use therein.* E. Martin Knight, New York. Eng. Pat. 3188, February 13, 1895.

Crude asbestos is crushed and passed through a carding machine; the separated fibres are allowed to fall one upon another on a sheet of flannel resting on the perforated bottom of a shallow tray, which is quickly moving to and fro under the machine. When a layer of sufficient thickness has been formed, it is consolidated by pressure into a thin sheet, which is said to be so uniform and close in texture that, whilst allowing a rapid filtration of water, it effectually retains on its surface the micro-organisms present in the water.

In the construction of the filter this thin felt is supported between and protected by two layers of open asbestos cloth sewn on to wire frames. The application of the foregoing to a table-filter, a "bucket filter," and a water tank or cistern, are also described.—L. A.

*Improvements in Filters.* T. F. Seitz, Kreuznach, Prussia. Eng. Pat. 5026, March 9, 1895.

The liquid to be filtered, mixed with the filtering material, such as asbestos, is introduced into the annular space between the partly perforated double walls of a cylinder which is suspended within an outer casing. The filtering material deposits itself on the inside of the walls of the double cylinder, and the liquid filters through it into the outer casing, collects in a common chamber, and flows off thence through a pipe.—L. A.

*Improvements in Asbestos Filters.* F. Breyer, Vienna. Eng. Pat. 5739, March 19, 1895.

Hollow vessels of lenticular section, made of perforated sheet metal suitably supported on the inside, are covered with a textile fabric. Asbestos, ground in water to a paste, is well rubbed into the fabric, after which a solution of water-glass is drawn through, and the filtering element thus prepared is dried. It may afterwards be saturated with a solution of calcium chloride, rinsed in pure water, and again dried. A number of such elements, fixed to a common duct, are enclosed within a metal casing, into which the water to be filtered is forced; it filters out through the filtering elements, and passes out by a second common duct. In the same casing, a brushing arrangement is contained, by moving which up and down, the surfaces of the filter elements can be cleansed, the deposit being washed down a sludge pipe. After cleansing, the filter is sterilised, and a fresh filtering surface is formed upon it, by forcing into the casing, boiling water containing in suspension very finely-divided asbestos and kaolin. —L. A.

*Improvements in Centrifugal Separators.* S. C. Rockman, Philadelphia, U.S.A. Eng. Pat. 6283, March 26, 1895.

The revolving cage is of spiral form, increasing in diameter from below upwards; the walls are double, and formed so as to enclose one or more spiral conduits, and they may be perforated. A flat cover is bolted on to the top of the cage, and the whole revolves within a double casing. There is an entrance into each conduit at the bottom of the cage on the inside, and an exit through the cover on the top, controlled by a door. When the cage is revolved, and liquid containing solids in suspension is fed continuously into the spiral cage, it first passes into the conduit, where the liquid portion is expelled through the perforations into the inner of the two casings; the solid portion travels to the top of the spiral conduit, and is thrown out of the opening there into the outer casing, falling down into a hopper at the bottom.—L. A.

*An Improved Apparatus for Steaming or Evaporating, Mixing, and Cooling Fluid Materials.* G. Clement Downing, London. Communicated by Albert Weickmann, Munich, Bavaria. Eng. Pat. 8651, May 2, 1894.

The apparatus consists of a closed metallic vessel with horizontal axis, made preferably of pear-shape in transverse section, with hollow bottom and sides. Above the hollow bottom, a central longitudinal passage open at each end to the interior, is formed, through which the fluids circulate. The bottom of the vessel inside has a double segmental form, and at the centre of each segment a revolving horizontal tube is fixed, and carrying hollow blades through which steam or cold water can be caused to circulate. In the upper part of the vessel another revolving tube is fixed, which carries a number of smaller radial tubes communicating at their ends with four longitudinal perforated tubes, over which wire gauze is stretched, so that the whole forms a revolving gauze drum, through the tubular framework of which, liquid or steam can be forced into the vessel. Liquid forced into the apparatus through this upper tubular system becomes finely divided and scattered, and is partly evaporated by the hot hollow walls of the vessel, which are filled with steam. The portion falling to the bottom is further splashed about and circulated by the rotating blades, driven towards one end, and returning to the other end through the enclosed passage at the bottom. The vessel may be used with steam at any suitable pressure, or vacuum.—L. A.

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

## II.—FUEL, GAS, AND LIGHT.

*Importance of Acetylene in Gas-making.* E. Schilling. Journ. Gasbeleucht. 1895, **38**, 243.

One thousand cubic metres of gas can be raised four candle-power (from 12 to 16) by 16 kilos. of benzol, costing 4·80 marks, but the cost of the 53·5 kilos. of calcium carbide required to produce sufficient acetylene to effect the same increase is 26·75 marks. By comparing the heating values of acetylene and gas we find them to be as 13,390 : 5,100 per cubic metre, and the relative cost per 1,000 units of calorie, 11·2 pfennige (in material alone) for acetylene, and 2 pfennige for gas (100 pfennige = 1 mark). This would mean that the cost of one horse-power in a gas motor burning acetylene would be 40 pfennige (¼ cub. m.). Bredel calculates that the expense of producing carbide, even by utilising the Falls of Niagara, would be for material and power, 322 marks, or, including wages, repairs to plant, &c., 478 marks per ton (1 mark = 1 shilling).
—C. S.

*Danger from Sparking of Electro-Motors in Coal Mines.* Zeits. f. Elektrotechnik u. Elektrochem. 1895, 513—514.

No case of an explosion started by sparks from an electromotor is as yet known to have occurred ; nevertheless the fear of accidents from this cause has hindered the use of electro-motors in coal mines. The writer of an article to this effect in the *Electricien* (January 26, 1895), states that even a dangerously explosive mixture requires a temperature of 900°—1,000° before it will explode ; and that the temperature of the sparks from a motor must be much lower than this, for no oxidation is observed at the collector or the brushes, and copper begins to oxidise at 700°. [The editor of the Zeits. f. Elektrotech. u. Elektrochem. remarks that this reasoning scarcely justifies the statement, for the spark would not heat the copper to its own temperature.] But at the ends of the brushes, as they become worn, the sparks may develop into strong flaming arcs under certain circumstances (*e.g.*, when the brushes are shifted or the current strength is altered) ; so that due caution should be exercised. Accidents to the leads are also a source of danger, especially when high potential currents are used ; when the conductor is broken a strong, hot, flaming arc may be produced, and this may set fire to combustible matter in the neighbourhood or to any explosive gases.

These possibilities have made people shy of using electricity in coal mines, especially for operating coal-cutting machines, which naturally occupy the most dangerous positions in mines. English dynamo makers have endeavoured to meet these objections by enclosing the collector and brushes in an air-tight casing. But mining engineers have felt that explosive gases would gradually make their way into the (supposed) air-tight casing, and so convert it into an infernal machine which might at any moment explode like a bomb. The dynamo makers reply that the casing can be made quite explosion-proof by forcing carbonic acid into it under pressure ; for the presence of as little as 14 per cent. of carbonic acid makes an explosion impossible.

Polyphase motors without brushes or collector will remove all difficulties arising from sparking. No danger need be apprehended of breakage of permanent leads if they are properly laid down. But in the case of movable or exposed conductors the greatest care should be taken to avoid danger through breakage, sparks, or arcs.—D. E. J.

*A Property of the Non-Luminous Atmospheric Coal-Gas Flame.* L. T. Wright. Proc. Chem. Soc. 1895 [151], 72.

The author points out that the separation of the atmospheric gas flame (Bunsen flame) into two distinct parts described by Teclu (J. Proc. Chem. **44**, 246) and Smithells and Ingle (Trans. Chem. Soc. **61**, 204 ; this Journal, 1891, 992—994) was discussed by himself in June 1887, in a paper "On the Induction of the Explosive Wave and an altered Gaseous Condition in an Explosive Gaseous Mixture by a Vibratory Movement," an abstract of which was published in Roy Soc. Proc. **42** (see also this Journal, 1887, 362—364).

The experiments described in that paper were made with a mixture of coal-gas and air in combustion tubing of ¾ in. diameter.

The analytical results of that inquiry confirm those obtained by Smithells and Ingle, and bring out a characteristic of the inner flame. It is able to maintain a stationary position in the glass tube against various velocities of egress of the gaseous mixture. The distribution of the oxygen amongst the three principal products of combustion, viz., carbon monoxide, carbon dioxide, and water, differs, however, with the velocity of the gaseous current in the tube. The carbon dioxide increases and the carbon monoxide decreases with increased velocity of the gaseous current.

### PATENTS.

*Improvements in or in connection with Self-generating Vapour Burners or Apparatus for Vaporising Liquid Hydrocarbons for Heating, Lighting, or other Purposes.* E. T. Owen, London. Eng. Pat. 7035, April 9, 1894.

The chief claim is for means of regulating the supply of oil to the burner and thus ensuring a steady flame. This object may be attained by introducing an air chamber into the supply pipe, at some point between the reservoir and the vaporising chamber ; the air in this chamber takes up the back pressure when vaporisation is too rapid. A loop or return pipe connecting one part of the oil-supply pipe, adjacent to the retort or vaporising chamber, with another part of the supply pipe more distant therefrom, may be used to fulfil the same function as that of the air chamber. There are also claims for the arrangement of the burner from which the mixed oil vapour and air are to be burnt, and for means to start the vaporisation ; these can only be understood by reference to the drawing which accompanies the specification.—A. G. B.

*Process of Deodorising Petroleum and other Hydrocarbons.* A. J. Tempère, Paris, France. Eng. Pat. 10,772, June 2, 1894.

Amyl acetate is added to the petroleum, in proportion varying with the quality of the latter, but 10 grms. of the acetate to 1 litre of petroleum is an average proportion. The product possesses an agreeable, slightly acid odour, and burns as well as the untreated petroleum does ; the claim covers the addition of any equivalent substance in substantially similar proportions, capable of producing the like results.
—A. G. B.

*Improvements in and in Apparatus for Burning Liquid Hydrocarbons for Generating Steam or other Heating or Lighting Purposes.* T. Burrows, London. Eng. Pat. 11,410, June 12, 1894.

The hydrocarbon oil is caused to flow from an apparatus like a bird fountain into the bottom of a cylindrical shaft, in the wall of which is a ring of holes for the admission of air immediately above the surface of the oil. By means of the oxygen of the air admitted through these ignition holes the oil is kindled, but its combustion is immediately checked by a grid upon which is packed some incombustible material, such as pieces of fireclay, asbestos balls, or metal chains, which allow free passage of gas and vapour, but prevent the passage of flame. The depth of this material should be 1 ft. in a shaft 3 ft. high ; above it is a number of rings of holes in the wall of the shaft, and other inlets for air. At this point the vapour of the oil, which has been volatilised by the heat of the flame burning at the bottom of the shaft, together with the incompletely burnt gases from this flame, will obtain sufficient air for their complete combustion. The flame at this point will be all the hotter for the column of hot material which the vapour has traversed in its ascent. For its more complete vaporisation, the oil may be admitted into the shaft at a point about the middle of the height of the column of incombustible material.—A. G. B.

*Apparatus for the Manufacture of Carbonised Powder from Peat, Sawdust, and such like.* N. K. H. Ekelund, Jönköping, Sweden. Eng. Pat. 11,522, June 13, 1894.

The apparatus consists of a number of horizontal flues placed the one above the other and communicating with each other at alternate ends; each flue contains a screw for the transportation of the peat powder, which is fed into the top flue through a hopper kept continually full to prevent admission of air. The flue from a furnace at the bottom of this brick structure is made to pass in between the flues which contain the peat, so that the products of combustion travel in the direction contrary to that of the peat powder, which is therefore systematically dried and carbonised. The peat must be dried in the upper flues before it is carbonised in the lower flues; to this end, the series is divided into two compartments by an enlargement at the end of the central flue, in which is contained a subsidiary conveyor working at such speed that the enlargement is kept full of the peat. In this way it is possible to draw a current of air through the upper flues to carry away the water vapour and to collect the products of distillation of the peat from the lower flues, neither operation interfering with the other. From the lowest flue, the carbonised peat falls into a conveyor surrounded with cold water, to chill the material, and from this into a block fuel press.—A. G. B.

*Incandescence Lamps for Liquid Hydrocarbons.* S. Marcus, Vienna, Austria. Eng. Pat. 5509, March 15, 1895.

The vaporisation of the combustible liquid in this lamp is effected by radiated heat, emanating partly from the incandescent body and conducted to the vaporisation chamber at the top of the wick by means of metal rods, and partly from a refractory grating inserted in the mouth of the burner, which grating is maintained at a white heat by the flame of the lamp. The combustion of the mixed vapour and air, occurs within the incandescent mantle, which is thus heated to whiteness. No chimney is required in such lamps.—A. G. B.

*Improvement in Fuel, and the Process of Making the same.* G. J. Altham, Swansea, Massachusetts, U.S.A. Eng. Pat. 5703, March 19, 1895.

This fuel is composed of asphaltum and peat, or any analogous material, such as sawdust, tan bark, &c. The materials are ground and thoroughly mixed, and the mixture is heated to make it coherent, after which it is permitted to cool and broken up for use. The asphaltum should constitute 20—50 per cent. of the mixture; if it be above the upper limit the fuel will be too soft, if below the lower limit the coherence of the material is too small. Such fuel ignites readily, burns with an intense heat, leaves practically no ash, and does not run during combustion.—A. G. B.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Occurrence of Petroleum in Alsace.* Jasper. Glückauf. 1895, **31**, 215; Chem. Rep. 1895, 91.

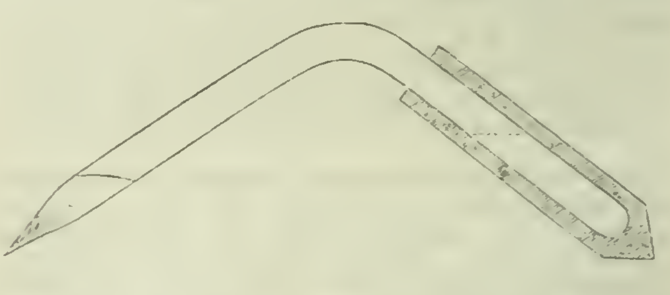
The petroleum industry in Alsace is developing gradually, the output having increased from 853 litres in 1874 to 15,632 litres in 1894. The oil is obtained by boring and pumping. It occurs in tertiary marls, and good wells yield 10,000 kilos. of crude petroleum annually. The crude oil has a specific gravity of 0·82 to 0·95, and boils at 135°—150° C. It yields on distillation 2—3 per cent. of petroleum spirit, 30—35 per cent. of oil, 40—45 per cent. of residues, and 10—15 per cent. of coke.—C. A. K.

*The Petroleum of Salsomaggiore (Italy).* V. Vender. Riv. Scient. indust. 1895, **27**, 14.

The raw product is a reddish-yellow liquid of sp. gr. 0·789 having a yellowish-green fluorescence and an aromatic odour. It evolves inflammable vapours at 15° C., is almost free from sulphuretted hydrogen, and is almost free from oxygenated constituents, so that it only darkens slowly on exposure to the air. The oil is rich in constituents boiling below 150° C., contains very few boiling above 250° C., and yields 41 per cent. of petroleum ether (benzine), 40 per cent. of an almost colourless kerosene of sp. gr. 0·8135 and flashing point 44° C., 6 per cent. of lubricating oil and 0·7 per cent. of paraffin.—C. A. K.

*Preparation of Petroleum from Blubber. Method serving for Lecture Illustration.* C. A. Lobry de Bruyn. Chem. Zeit. 1895, **19**, 855.

Engler showed that when animal fats or fatty acids were distilled under pressure, petroleum was formed. This fact has served as important evidence in favour of the theory that this substance is of animal origin. The experiment may be easily carried out in the following manner:—A glass tube bent in the shape shown in the figure, is filled $\frac{1}{2}$ or $\frac{1}{3}$ full with blubber and carefully sealed up. The limb containing the substance is enclosed in a piece of gas-piping as shown, and packed with sand so that the glass does not come in contact with the iron of the tube.



On heating the tube strongly by means of a powerful Bunsen burner with three branch jets, water and petroleum distil over into the cool limb; the presence of the former may be shown by introducing into the tube before sealing up, a few crystals of a dyestuff such as water-blue. After completion of the experiment, the heated end contains a brown residue, but carbonisation does not take place. The other portion contains petroleum, water, and compressed inflammable gases; the whole system forms in fact a miniature petroleum spring.

On opening the tube the nature of the contents may be exhibited. No acrolein is formed, as when dry distillation takes place under ordinary atmospheric pressure.—H. I.

*The Oxidation of certain Constituents of Petroleum.* D. Holde. Chem. Zeit. 1895, **19**, 144.

The author of this communication points out that the fact that but little caustic soda is needed for treatment of petroleum after it has been partially refined by means of sulphuric acid, in no way indicates that any oxidation which may have taken place, is of small significance, for he considers that oxidised bodies of neutral or basic character such as will not necessarily absorb caustic soda, may be present, and may impair the quality of the oil by their presence.—B. B.

### *Influence of Temperature on the Chemical Purification of Petroleum.* R. Zaloziecki. Chem. Zeit. 1895, **19**, 78.

It is known that in washing petroleum distillates with sulphuric acid the concentration and purity of the acid have an important effect on the quality of the refined product, but the question of temperature, which the author considers of equal moment, does not appear to have received proper attention on the part of chemists.

The best results are invariably obtained, by conducting the acid-washing process at as low a temperature as possible. The author worked at temperatures ranging from 0° to 25°, and obtained whiter and purer products the more closely he approached the lower limit. Working under identical conditions as to concentration and purity of acid, the distillate obtained after the acid treatment at 25° had a distinct yellow colour, whilst that following an acid treatment at 0° was almost colourless, with simultaneous diminution of the difficulties accompanying the process of purification, *i.e.*, at the lower temperature, the rate of clarification increased with the yield of refined product.

The action of sulphuric acid on petroleum is of twofold character:—(1.) Elimination and solution of impurities. (2.) Oxidation of the heavier portions. Although the rate of absorption is not materially influenced by slight variations of temperature, the oxidation increases rapidly with a rise of temperature, as is evinced by the copious evolution of sulphurous anhydride. Moreover, at a higher temperature, the solvent properties of petroleum for resin acids, and more especially for oxidation products, increases, the result being the contamination of the distillate with impurities, which it is impossible to completely remove either by washing with soda-lye and water or by other means.—D. B.

### *The Influence of Temperature and Light on the Chemical Purification of Petroleum.* R. Zaloziecki. Chem. Zeit. 1895, **19**, 875—877 and 956—958.

The acid-tar or "sludge acid" resulting from the treatment of petroleum by sulphuric acid contains among other substances aromatic sulphonic acids, pyridine bases, phenols, and sulphur compounds, along with such decomposition products as unsaturated and polymerised hydrocarbons and alcohols, accompanied by resinous and bituminous bodies. Some of these—resins, colouring matter, petroleum acids, and sulphides—have been dissolved out from the oil, others are the result of the polymerising and oxidising action of the acid, and the whole constitute an unstable product particularly susceptible to the influence of temperature and light. An asphaltic body, which separates from the tar after a while and is readily soluble in oils, imparting thereto a deep colour, is probably the result of oxidation, as sulphurous acid is simultaneously evolved. Water (in about equal volume with the acid) readily splits up the tar into three layers, a lower red-brown stratum of sulphuric acid, an upper thick brown oil, and an intermediate layer of black, viscid substance soluble in water and containing sulphuric acid derivatives. The upper oil chiefly consists of the acid asphalt already mentioned, which when dissolved in oil cannot be again got rid of by washing.

To determine the effect of temperature and light on the quality of the resulting product, three series of experiments were carried out with a pure Galician petroleum distillate of sp. gr. 0·8148 at 20°, and containing the following volume percentage of fractions, viz., boiling up to 150°, 14, from 150° to 300°, 69; and above 300°, 17 per cent.

The first series, performed with the idea of ascertaining the amount of acid tar produced, the specific gravity of the refined oil, the increase of temperature during the operation, and the final colour, showed that when the acid treatment is effected at 25° the increase in temperature is almost double that observed at − 5°; the loss in petroleum 2½ times as great; the amount of acid tar is increased; the specific gravity is rather higher, and the depth of colour three times as great as at the lower temperature; that is to say, by working at a low temperature both yield and colour of the oil are improved.

The second set of experiments had for its object, in addition to the determination of the amount of acid tar and the colour, the constitution of the three layers into which the tar is divided by water, and the third series was identical with the second, except that light was completely excluded throughout. On comparing the results it was found that at the lower temperatures the conditions of the last series were more favourable to the production of light-coloured oil than those obtaining in the second, but beyond 30°, the reverse was the case.

It is generally assumed that warmth assists the precipitation of the sludge acid on account of the viscid character of this substance, but if, as happens in the cold, the acid employed takes up less matter from the oil, the tar is more fluid and of higher specific gravity, and clarification is accelerated. This was confirmed in the experiments, the oil purified at 0° being light coloured and clearing so completely that merely traces of tarry deposit came down afterwards, even when kept for weeks; whereas when higher temperatures were employed, both the colour and the amount of deposit proportionally increased.

The sulphuric acid actually consumed in the refining process, forms only a portion — less by cold working than warm — of the quantity added; and in fact, an intensified action of the acid is unfavourable, as it is believed that even in the cold this action is sufficient to remove the impurities of the oil, and that warmth merely increases the sulphonating and oxidising effect. The formation of water during these reactions dilutes the acid tar, and thereby facilitates its decomposition and the precipitation of the acid tar, as was experimentally demonstrated, thus accounting for the unfavourable results produced by using insufficiently concentrated acid.

Finally, to test the effect of lights of various colours on the refining process, tubes of oil were enclosed in large vessels containing yellow-, red-, green-, blue-, and violet-coloured solutions and kept for 48 hours. The whitest oil was obtained from a tube kept covered up in black paper, whilst the darkest came from one fully exposed to light, and the depth of the intermediate shades increased in the above-mentioned order. The action is considered to be attributable either to the readily decomposable acid tar suspended in the acidified oil, or the ozonising action of light on petroleum, an effect which is apparently heightened by the presence of the acid.

In view of the results thus summarised, Zaloziecki believes that his opinion respecting the favourable influence of low refining temperatures on the yield, quality, and colour of the product is generally correct for oils of whatever origin, provided they are pure distillates and not decomposition products in the technical sense of the word. He advises that the oil should be pumped into the agitators over-night to cool, and the acid treatment performed in the early morning as being the coolest part of the day. For the production of artificial cold a refrigerating coil is preferable to ice, on account of the moisture given off by the latter. To exclude light the agitator should be covered, and artificial lights should be covered with red or yellow shades, with the exception of one for the examination of the sample.—C. S.

### *The Influence of Temperature on the Chemical Purification of Petroleum.* I. Zahler. Chem. Zeit. 1895, **19**, 215.

Zahler is disinclined to accept without correction Zaloziecki's assertion to the effect that lowness of temperature is the chief factor in the acid process, influencing favourably the colour and quality of the resulting petroleum (See adjoining column). He also controverts the opinion that this is a point hitherto little considered in practice, and refers to the writings of Pawlewski and Zwitka, in support of his contention.

His chief objection, however, to Zaloziecki's proposed axiom, is that as petroleum is a mixture, in proportions differing widely according to the purposes for which the various oils are intended, of hydrocarbons of different degrees of volatility, each of which has its own most suitable temperature for the acid treatment, it is therefore impossible to lay down a hard and fast rule for the temperature at which this treatment should be carried on. Colour, for example, is influenced by the shade of the crude distillate, and the refining processes should, in order to produce the best results, be adapted to the circumstances of each particular oil. The form of the agitators, the duration and mode of mixing, the purity and strength of the acid, all influence colour, and an increased temperature may, by facilitating the deposition of the "sludge acid," shorten the process, and thus prevent the deepening of colour often noticed in the upper layers of the oil after prolonged standing in the agitator.

The time of the year has also to be considered. In summer, refining must be effected at lower temperatures than in winter, because the heat evolved by the interaction of the oil and acid may, particularly when an air blast is used, rise beyond suitable limits; whereas in winter, a certain degree of warmth is necessary to assist the settling down of the acid resin, especially in the case of heavy oils.

Systematic research with the view of ascertaining the most favourable temperature for the acid treatment of the several fractions in petroleum, would be of great practical value as affording an indication to the refiner how to act under all circumstances.—C. S.

### *Action of Atmospheric Oxygen on Mineral Oils.*

J. Hirsch. Chem. Zeit. 19, 41.

*See under* XII., *page* 586.

### *Method of Separating Quantitatively Coal-Tar Hydrocarbons from those of Petroleum.*

R. Henriques. Chem. Zeit. 1895, 19, 958.

*See under* XXIII., *page* 604.

## PATENT.

*Improvements in Treating Paraffin Scale.* J. Calderwood and J. Hodges, Battersea. Eng. Pat. 11,801, June 18, 1894.

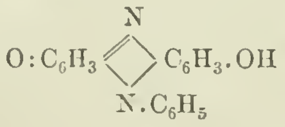
For this purpose a jacketed vessel, provided with internal steam pipes, is used. The melted scale is run into the vessel and allowed to cool slowly. Steam is then passed through the internal pipes, and the oil and soft paraffin which exude from the scale, are run off through a tap at the bottom. In order to further purify the remaining scale, steam or hot water is passed through the jacket, by which means an additional quantity of oil is separated.—J. J. K.

# IV.—COLOURING MATTERS AND DYES.

### *Contributions to the Constitution of the Safranines.*

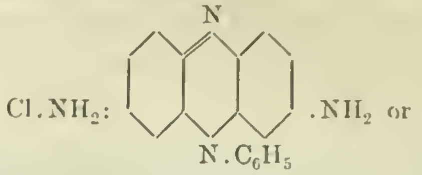
G. F. Jaubert. Ber. 28, 271.

By the action of *p*-nitrosophenol upon *m*-oxdiphenylamine a dihydroxylated phenylphenazine is obtained, probably—

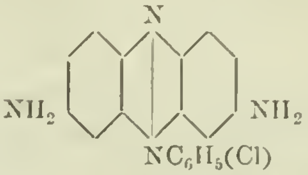


$$O:C_6H_3\overset{N}{\underset{N.C_6H_5}{\diamond}}C_6H_3.OH$$

This substance is identical with Nietzki and Otto's safranol, and the above synthesis throws light upon the position of the amido groups in safranine. The constitution of phenosafranine must be expressed by one of the formulæ already suggested by Bernthsen—



or

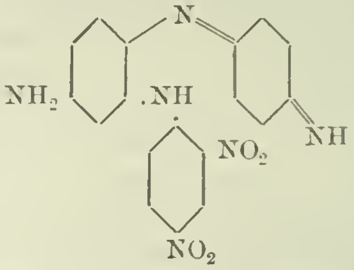


Whether safranine is constituted like a quinone or an ammonium base is still undecided, although the former condition is the most probable. The above result regarding the constitution of the safranines renders possible the synthesis of safranines by the condensation of derivatives of *m*-amidodiphenylamine with *p*-nitroso-aniline or quinonedichlorimide. Thus *m*-amidodi-*p*-tolylamine and quinonedichlorimide produce an isomer of the safranine T of commerce. This dye, on treatment with nitrous acid, yields a monodiazo compound, which with β-naphthol furnishes a blue dye. Condensation between *p*-nitrosamines and mono-substituted *m*-amidophenols leads to safraninones, and these, by the elimination of an amido group, are converted into safranones.—C. O. W.

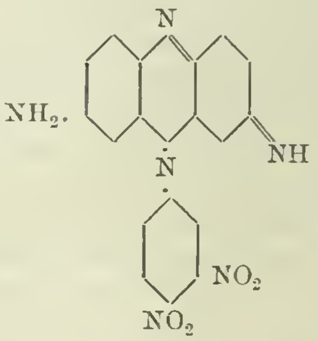
### *Contributions to the Constitution of the Safranines. II.*

G. F. Jaubert. Ber. 28, 508.

The new synthesis of safranines mentioned in the first paper (see previous abstract) takes place in two stages, a blue indamine or indophenol being formed at first, and subsequently the reaction proceeding to the formation of the red safranine by the closing of the azine ring. The isolation of the intermediary blue compound is impossible when quinonedichlorimide is condensed to *m*-amido-*p*-ditolylamine, owing to the rapidity with which the reaction takes place. The product of the first phase of this reaction is, however, easily obtained by oxidising in the cold a mixture of *p*-phenylenediamine and *m*-amido-*p*-ditolylamine. The latter may be replaced by the more easily accessible dinitro-*m*-amidodiphenylamine, in which case a dinitrophenylphenylene blue of the constitution—



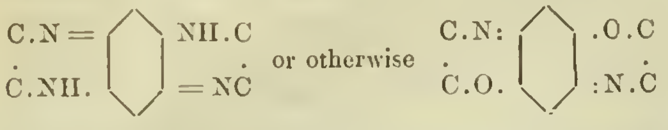
is obtained, which on heating in aqueous or alcoholic solution yields a dinitro derivative of Witt's phenosafranine—



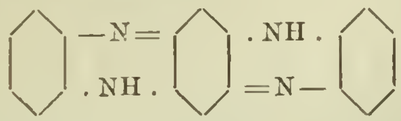
This reaction shows that safranine is toluylene red in which substitution has taken place in the azine nitrogen atom which is not in the para position to the amido groups of the phenazine radical.—C. O. W.

### *Fluorindines.* O. Fischer and E. Hepp. Ber. 28, 293.

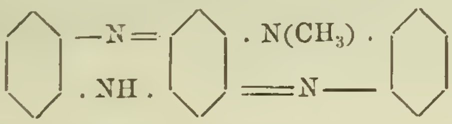
The characteristic feature of the constitution of these compounds is the symmetrical combination of two azine or oxazine rings with one benzene ring, so that derivatives of



must be the simplest types of this evidently very large class of dyes. Homofluorindine—



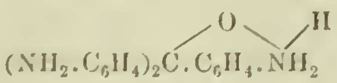
has a free hydrogen atom attached to two azine-nitrogen atoms, a fact proved by the syntheses of methylated and phenylated homofluorindines from dioxyphenazine and monomethyl-*o*-phenylenediamine or monophenyl-*o*-phenylenediamine. Since dioxyphenazine forms with *o*-phenylenediamine homofluorindine, it was to be expected that diamidophenazine should react with monomethyl-*o*-phenylenediamine to form methylhomofluorindine.



This reaction readily occurs when the mixture of those two compounds is heated to 150° C. In these reactions dihydroxyphenazine, B I-anilidobenzene-indone (B I-oxybenzene-indone) can replace diamidophenazine, and the orthodiamines can be replaced by *o*-amidophenols. Moreover, numerous syntheses of fluorindines from dichloroquinone or dioxyquinone and orthodiamines are possible, and also by means of the symmetrical tetra-amidobenzene, fluorindines will be obtainable, so that hundreds of derivatives of fluorindine are now within reach, the colour of which varies from reddish-violet to bluish-violet, and from blue to greenish-blue. The characteristic property of all these dyes is the strong brick-red fluorescence of the solutions of their bases, whilst their salts exhibit a maroon or blood-red fluorescence. The oxazines are weaker bases than the azines, and consequently compounds of the type of triphendioxazine possess less affinity for the fibre than the fluorindines proper. The mixed azine-oxazines occupy a medium position in this respect.—C. O. W.

### *Constitution of the Colour Bases of the Triphenylmethane Series.* H. Weil. Ber. 28, 205.

The generally accepted formula of the rosaniline bases, according to which the latter possess the constitution of a carbinol, does not well coincide with the fact that such carbinols are very strong bases, forming stable salts with 1 mol. of an inorganic acid, whilst the leuco-bases require in some cases as many as 3 mols. of an acid for solution. This theoretical difficulty is removed on accepting for these dyes a formula of the type—



$$(NH_2.C_6H_4)_2C.C_6H_4.NH_2 \quad (O,\ H)$$

In accordance with this formula it was found that:—(1) one of the amido groups of the rosaniline exhibits a different behaviour than the two others; (2) that the oxygen behaves differently than either the oxygen of a carbinol or of an ammonium hydroxide group; (3) that in methylated bases one methyl group behaves as in tetramethyl ammonium hydroxide.—C. O. W.

### *A Constituent of Persian Berries.* A. G. Perkin and J. Geldard. Proc. Chem. Soc. 1895 [151], 75—76.

Persian berries, as is well known, contain a glucoside xanthorhamnin (α-rhamnegin) decomposable by acids into isodulcite and a colouring matter rhamnetin. With hydriodic acid rhamnetin yields methyl iodide and quercetin, the colouring matter of quercitron bark (Herzig, Monatsh. 9, 548—561). It is consequently a quercetin monomethylether $C_{16}H_{12}O_7$. According to earlier workers there is also present a second glucoside which gives a colouring matter more soluble in alcohol than rhamnetin, and therefore called β-rhamnetin. Herzig (this Journal, 1889, 770), when studying this subject, isolated from the berries a glucoside which he regarded as a loose double compound of xanthorhamnin and a glucoside of quercetin (quercitrin ?), for by decomposition it gave a mixture of rhamnetin and quercetin. Hence β-rhamnetin appeared to be quercetin.

In this paper it is shown that Persian berries contain a third substance readily isolated from the mixed colouring matters by extraction with toluene. It forms long yellow needles somewhat resembling anthraquinone, melting at 214°—215° (quercetin and rhamnetin both melt above 280°), has the formula $C_{17}H_{14}O_7$, and crystallises from acetic acid with 2 mols. of acetic acid of crystallisation. The triacetyl compound $C_{17}H_{11}O_7(C_2H_3O)_3$, colourless needles, melts at 154°—155°, the tribenzoyl compound $C_{17}H_{11}O_7(C_7H_5O)_3$, colourless needles, melts at 204°—205°, and the dibromo-compound $C_{17}H_{12}O_7Br_2$, yellow needles, decomposes at 250° before melting. By the action of hydriodic acid it yields quercetin and 2 mols. of methyl iodide, and is therefore a *quercetin dimethyl ether*. Rhamnazin, as the authors have termed this substance, is nearly devoid of dyeing properties. Quercetin being a colouring matter, contains at least two hydroxyls in the ortho position to one another, and in rhamnazin therefore one or two of these hydroxyls must be replaced by a methoxy group, causing this loss of colouring power.

It is known that an aqueous extract of Persian berries ferments at 30°—40°, depositing a yellow powder, the supernatant liquid being of an orange-brown colour. This powder is here shown to be a mixture of rhamnetin and rhamnazin with but a trace of quercetin. The supernatant liquid when boiled with acids gives a considerable quantity of quercetin only. It appears therefore that the ferment contained in the berries (Ward and Dunlop, Annals of Botany, 1889), while readily decomposing xanthorhamnin and the glucoside of rhamnazin at this temperature, exerts but little influence upon the glucoside of quercetin also present.

The colouring matters of Persian berries are rhamnazin (quercetin dimethyl ether), rhamnetin (quercetin monomethyl ether), and quercetin, $C_{15}H_{10}O_7$, itself.

## PATENTS.

### *Improvements in and connected with the Manufacture of Colouring Matters.* J. Baruch and A. Goldsobel, Charlottenburg, Germany. Eng. Pat. 7422, April 14, 1894.

By heating a dibasic fatty acid with a phenol, naphthol, tannic acid, hydroxybenzoic acid, phenol sulphonic or naphthol sulphonic acid to 115°—200° C., a product is obtained which, after neutralisation, can be employed for dyeing and printing fibres. A colouring matter having the same properties as natural catechin is produced by heating together 2 kilos. of phloroglucin, 1 kilo. of protocatechuic acid, and 2—5 kilos. of oxalic acid. According to the claim, the colouring matter can be extracted by alcohol, and is subsequently washed with ether. It is stated that by the employment of other hydroxy derivatives, dyestuffs identical with the natural dyestuffs, such as hæmatein, brazilin, quercetin and bixin can be obtained.—T. A. L.

### *Improvements in the Manufacture of Colouring Matters related to the Indulines and Eurhodines.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 10,854, June 4, 1894.

THIS is an extension of Eng. Pats. 10,138 and 10,138A of 1892 (this Journal, 1893, 593 and 594). In these specifications the production of β-methylhomoeurhodine is described. It is obtained by heating together α-naphthylamine and the azo compound produced by the interaction of diazotised sulphanilic acid and methyl-*p*-toluidine. One of the improvements consists in substituting the corresponding weight of methyl- or ethyl-α-naphthylamine for the α-naphthylamine, in order to obtain a eurhodine alkylated in both the α- and β-positions. Furthermore, if a dialkylated azo compound (for instance, from sulphanilic acid and dimethyl-*p*-toluidine) be used in the melt, it is found that one alkyl group is split off, so that the crude product of the alkylation of *p*-toluidine can be employed, no separation of the alkylation products being required. About 10 kilos. of the dyestuff obtained by combining diazotised sulphanilic acid and the methylation product of *p*-toluidine, are heated with 50 kilos. of phenol to 95° C. on the water-bath, and 9 kilos. of methyl-α-naphthylamine hydrochloride are then added. The temperature rises above 100° C., and after it has sunk below this temperature the reaction is complete. The melt is stirred into cold dilute caustic soda, filtered, and washed until the filtrate is only slightly alkaline. The precipitate is then extracted by boiling with dilute hydrochloric acid (5 per cent. HCl), and after filtering, the dyestuff is precipitated from the cold solution by adding one fourth the volume of 30 per cent. hydrochloric acid. The dyestuff can be purified by dissolving in 50 times its weight of water, saturating in the cold with ammonia, stirring for an hour, and filtering, when the colouring matter, after precipitation with hydrochloric acid, is filter-pressed and dried. A further extension is that relating to the manufacture of β-methyl-eurhodine referred to in Eng. Pat. 17,572 of 1893 (this Journal, 1894, 878). According to the process there described, this compound is obtained by reacting with β-hydroxy-naphthoquinone imide on methyl-*o*-tolylene diamine. The patentees have now discovered that the latter product may be replaced by other alkyl derivatives of *o*-phenylene or *o*-tolylene diamine, giving the corresponding β-alkylated eurhodine. The two substances are heated together in acetic acid on the water-bath and the melt is extracted by boiling with very dilute hydrochloric acid, the base being precipitated by caustic soda. This is then redissolved in hydrochloric acid and precipitated with salt.—T. A. L.

### *The Production of Phenylamido-oxynaphthaline Sulpho Acid and of Colouring Matters deriving therefrom.* S. Pitt, Sutton, Surrey. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 11,157, June 8, 1894.

IT has been found that under certain conditions, amidonaphthol sulphonic acids can be phenylated without the hydroxyl or the sulphonic acid group taking part in the reaction. This reaction proceeds most easily with those acids in which the hydroxyl is in the α-position, as, for example, in the case of γ-amidonaphthol sulphonic acid. When this acid is heated with aniline and aniline hydrochloride, it yields phenylamidonaphthol sulphonic acid having the constitution—

$$2.1'.3'.C_{10}H_5.NHC_6H_5.OH.SO_3H.$$

The following proportions are employed:—25 kilos. of the acid, 25 kilos. of aniline hydrochloride, and 100 kilos. of aniline are gradually heated to 160° C. and kept at this temperature for 4 to 5 hours until a sample after precipitation with dilute acid, gives no colour with nitrite and R salt. The melt is then run into 500 litres of water and 120 kilos. of hydrochloric acid of 21° B. The phenylamidohydroxynaphthalene sulphonic acid which separates, is filtered off and washed with water. The acid so obtained forms colourless needles, is almost pure, and sparingly soluble in water. When suspended in very dilute acid and treated with nitrite, it yields hydroxynaphthylphenylnitrosamine sulphonic acid, which is easily soluble in water. The acid combines with diazo and tetrazo compounds to form dyestuffs, which in general are more sparingly soluble and darker in shade than those from the corresponding non-phenylated acid. The most valuable are the mixed disazo dyestuffs obtained by combining equimolecular proportions of a tetrazo compound, the acid and an amine or a phenol. All these dyestuffs are said to be characterised by their fastness to light and by their behaviour to nitrous acid. By the action of nitrous acid on the azo derivatives of phenylamidonaphthol, they are converted into nitrosamine dyestuffs, which are very sparingly soluble, and if this reaction be carried out on the fibre by passing the dyed material through an acidulated nitrite bath, the colouring matter is completely fixed. Hence the dyestuffs of this class only require to be passed through a nitrous acid bath for their complete fixation, and do not, as in the case of those from the non-phenylated amidonaphthol sulphonic acid require subsequent development. The colouring matters dye unmordanted cotton a blackish-blue. As first components may be employed, *p*-diamines, such as dianisidine, benzidine, tolidine, ethoxybenzidine, *p*-phenylenediamine, and as second components γ-amidonaphthol sulphonic acid, amidonaphthol disulphonic acid H, naphthionic acid or 1.4-naphthol sulphonic acid may be used, dark shades being obtained in all cases.—T. A. L.

### *Production of Red Dye from Para-nitro-aniline.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 11,569, June 14, 1894.

THE colouring matter produced from *p*-nitraniline and β-naphthol is not suitable for cotton-dyeing unless the fibre impregnated with the sodium β-naphtholate be also treated with Turkey-red oil. Although a good red is obtainable by this method, it is difficult to obtain a good discharge, and with this object in view, the patentees have discovered that by substituting other organic substances, such as gum tragacanth, gelatin, starch, meal, or gum, for the sodium ricinoleate, brilliant bluish-red shades can be obtained, on which perfectly white reserves can be produced. The cotton is prepared with a solution containing 4½ kilos. of β-naphthol, 4½ kilos. of caustic soda (40° B.), 70 litres of hot water, and 35 litres of gelatin solution containing 60 grms. of gelatin per litre. After padding and drying, the material, in order to obtain a white reserve, is printed with tin chloride, or sodium or potassium sulphite, before being developed by the diazotised *p*-nitraniline solution.
—T. A. L.

### *Process for Production of Black Azo Dyes on the Fibre.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 11,641, June 15, 1894.

THE shades are produced by padding the cotton fibre with sodium β-naphtholate and developing in a diazo bath containing a mixture of two diazotised amines, either of which gives a dark shade with β-naphthol, but complementary in tint. Such combinations are, on the one hand, dianisidine or diphenetidine, which give dark violets; and on the other, *m*-nitraniline, benzidine, or tolidine, which produce yellowish-orange and dark brown. The necessary primary colours, blue, red, and yellow, being contained in these dyestuffs, the resulting shade is a black. The two following solutions are prepared:—(1.) 1,360 grms. of dianisidine sulphate, 2 litres of ice-water, and 400 grms. of hydrochloric acid (21° B.), are diazotised with 1 kilo. of nitrite solution (290 grms. per litre), and 1 litre of ice-water is added, the whole finally being made up to 7½ litres. (2.) 280 grms. of *m*-nitraniline, 690 c.c. of hydrochloric acid, and 2 litres of hot water, cooled subsequently with 2·5 kilos. of ice, are diazotised with 500 c.c. of the nitrite solution used above, and the whole is diluted to 7½ litres. The black printing solution is made up by mixing 900 c.c.

of (1), 600 c.c. of (2), 1·5 kilos. of thickening, and 150 grms. of sodium acetate, and if necessary a resist can be printed simultaneously, giving very clear whites.

—T. A. L.

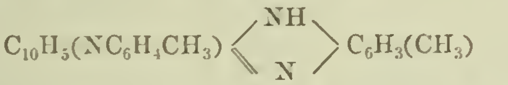
### *The Manufacture or Production of Colouring Matters.*

H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 11,717, June 16, 1894.

By the action of diazotised aromatic amines on the symmetrical or mixed dialkylated *m*-naphthylene diamines, azo colouring matters of the following general formula are obtained:—

$$(1:3:4),\ C_{10}H_5(NHR)(NHR')(N:N.R'');$$

where R represents any radicle of the fatty or aromatic series, such as methyl, ethyl, phenyl, tolyl, or the like; R′, an aromatic radicle, such as phenyl or tolyl; and R″, an aromatic radicle, as for instance, phenyl, tolyl, or naphthyl, or any substituted aromatic radicle. These azo compounds, when heated with mineral acids, yield azine dyestuffs, the group $:N.R''$ being split off as $R''.NH_2$, the resulting compound being a eurhodine (Witt, Ber. **20**, 573 and 579; this Journal, 1887, 505). In the case of the azo derivatives of 1.3.1′-diphenylnaphthylene diamine sulphonic acid, α-phenyleurhodine sulphonic acid is obtained, but it is to be observed that under certain conditions, sulphonation takes place during the formation of the azine if sulphuric acid be employed as the condensing agent. The process is carried out as follows:—5 kilos. of the azo compound obtained by the action of diazobenzene sulphonic acid on 1.3.1′-di-*p*-tolylnaphthylene diamine sulphonic acid are dissolved in 20 kilos. of sulphuric acid (66° B.) and heated at 80°—90° C. until the melt turns a pure green colour. After cooling, the whole is poured into ice-water, and a sulphonic acid is precipitated which is a derivative of *p*-tolylhomo-eurhodine, having the formula—



$$C_{10}H_5(NC_6H_4CH_3)\left\langle\begin{matrix}NH\\N\end{matrix}\right\rangle C_6H_3(CH_3)$$

$$(N.C_6H_4CH_3:NH:N=1:3:4)\text{ and }(NH:CH_3:N=1:4:6).$$

After filtering off, the acid is converted into the sodium salt, which dyes unmordanted wool red from an acid bath. A further series of dyestuffs can be obtained by alkylating these colouring matters. The ethyl alkylated dyestuff gives bluish-red shades on wool from an acid bath, fast to acids, alkalis, and light. The first part of the process described under the present patent refers to the production of azine dyestuffs from derivatives of the dialkylated 1.3-naphthylene diamines described in Eng. Pats. 8898, 16,780, and 19,623 of 1893 (this Journal, 1894, 511, 801, and 942), but the alkylation of α-methylhomo-eurhodine, phenyleurhodine, phenylhomo-eurhodine, and sulphophenyleurhodine claimed in Eng. Pats. 10,138A, B, and C of 1892 (this Journal, 1893, 594), is disclaimed in the present specification.—T. A. L.

### *Improvements in and connected with Yellow Colouring Matters.*

I. Levinstein and Co., Lim., and I. Levinstein, Manchester. Eng. Pat. 12,145, June 23, 1894.

These colouring matters, which are proposed as substitutes for fustic, Persian berries, and the like, are obtained by combining in equimolecular proportions, diazotised β-naphthylamine-γ-disulphonic acid with hydroxy-carboxylic acids, such as salicylic or *m*-cresotic acid. The colouring matter obtained is easily soluble in water and is faster to light and milling than the colouring matters obtained from the monosulphonic acid. The following working proportions are given:—341 kilos. of the monopotassium salt of β-naphthylamine-γ-disulphonic acid after diazotisation, is run into a solution containing 145 kilos. of salicylic acid and 84 kilos. of caustic soda, with constant agitation. After stirring about three hours, the temperature is raised to 40° C., and after another three hours the solution is boiled up and the colouring matter precipitated with salt, filter-pressed, and dried.—T. A. L.

### *The Manufacture or Production of Colouring Matters.*

H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 12,742, June 30, 1894.

This is an extension of Eng. Pat. 14,345 of 1893 (this Journal, 1894, 723), in which was described the preparation of anthracene dyestuffs by the action of concentrated or fuming sulphuric acid on di-*o*-nitro-anthraquinone in presence of boric acid. The patentees have now discovered that a new series of colouring matters can be obtained by the addition of an amine of the benzene series to the melt. A mixture containing 10 kilos. of di-*o*-nitro-anthraquinone, 200 kilos. of sulphuric acid (66° B.), and 5 kilos. of crystallised boric acid, has added to it 2·5 kilos. of aniline. After heating for about 1½ hours to 180°—200° C., with constant agitation, the mass is cooled, stirred into water, and the whole boiled up, when the colouring matter separates as a dark violet precipitate. The essential feature in the process is the addition of boric acid to the melt, and a table is given showing the differences between the products obtained when this is omitted. The colouring matter obtained as above, dyes chromed wool an intense greenish-blue.—T. A. L.

### *Manufacture of Nitrosamines.*

J. Y. Johnson, London. From the Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. Eng. Pat. 13,577, July 13, 1894.

The nitroso compounds of the acid anilides, or corresponding derivatives of primary aromatic amido compounds, yield nitrosamines when heated with a 70 per cent. caustic potash solution to 120°—130°. If the heating be gradual, the potassium salts of diazo compounds are formed as intermediate products (this Journal, 1895, 147, and 1894, 1189).

—J. W.

### *Manufacture of New Blue Gallocyanine Colouring Matters.*

J. Bieren and La Société L. Durand Huguenin and Co., Basle, Switzerland. Eng. Pat. 3854, February 22, 1895.

The gallocyanine obtained by reacting with diethylamidoazobenzene hydrochloride or nitrosodiethylaniline hydrochloride upon gallamic acid, can be converted, by the action of aniline, toluidine, or the like, into a new colouring matter which on sulphonation yields soluble sodium salts dyeing blue shades on unmordanted wool or silk and also on chromium mordants. The sodium salt is obtained in the usual manner, and dyes unmordanted wool and silk blue in an acid bath and gives greenish-blue shades on chromium mordants. If fuming sulphuric acid be employed, soluble sulphonic acids are obtained, the sodium salts of which are precipitated by salt from their aqueous solutions. The sodium salts dissolve in concentrated sulphuric acid and in hydrochloric acid to a red solution, which turns yellow and finally blue on the addition of water. The shades of the new colouring matter can also be varied by altering the conditions under which the condensation is carried out. For instance, a redder shade is obtained by using the gallocyanine base instead of the hydrochloride as above, and using aniline and aniline hydrochloride in the condensation. On the other hand, greener shades are produced by employing a higher temperature in the reaction. The specification contains a table showing the difference in behaviour of the original and condensation products to various reagents (*cf.* this Journal, 1893, 137).—T. A. L.

### *Manufacture of Colouring Matters of the Group of the Phthaleïnes.*

H. Imray, London. From Basle Chemical Works, Bindschedler, Basle, Switzerland. Eng. Pat. 4985, March 8, 1895.

New intermediate condensation products are obtained by heating together, or in a suitable solvent, equimolecular proportions of a dialkylated *m*-amidophenol and "anhydrous phthalic acid." These products are soluble in dilute alkaline carbonates, from which they are precipitated by acetic acid in the form of a colourless powder. They combine with diazo compounds and can be alkylated by heating their alcoholic solutions in presence of hydrochloric acid. They can be further condensed with a mono- or dialkylated *m*-amidophenol, and these products can also be alkylated. One method given is as follows:—Equal weights of the above-mentioned substances are heated to 100° C. until the melt ceases to thicken. The product is powdered, dissolved in alcohol, filtered, and diluted with water. On cooling, the intermediate product separates in crystals, which can be purified by recrystallisation from dilute alcohol. The dyestuff dissolves in concentrated sulphuric acid with a yellow colour, and its dilute alcoholic solutions have a greenish-yellow fluorescence. It dyes red shades on wool, silk, and tannin-mordanted cotton. The alkyl ethers give bluer shades.—T. A. L.

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## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

### PATENTS.

*An Improvement in the Sizing, Dressing, and Finishing of Textile Products, and Material for that Purpose.* E. B. Manby, Manchester. Eng. Pat. 943, January 16, 1894.

The size consists of a solution of any form of cellulose, preferably cotton or other white fibre, in zinc chloride solution. This is applied in the same way as other dressing materials, and the zinc chloride then washed out, leaving the cellulose precipitated on the textile material.—R. B. B.

*An Improved Process for Treating Vegetable Substances, suitable for the Manufacture of Woven Fabrics, by Converting them into Soft and Silky Fibres adapted for Spinning and Dyeing.* E. Cadoret and A. Josi, Crefeld. Germany. Eng. Pat. 8893, May 4, 1894.

This invention has for its object the conversion into fibres suitable for textile manufactures, of substances which up to the present time have been but to a small extent or not at all used, such as *urticeæ*, thistles, and the like. The process depends upon methods of chemical treatment having for their objects the disintegration of the resinous, gummy, and other substances, in order to separate the fibres. The material is first placed in an air-tight vessel and there treated with a mixture of liquid ammonia, sour beer, urine, and slightly phosphated water, this mixture producing fermentation under the influence of air, which is admitted into the vessel. By this process the fibres are disintegrated. The material is subsequently treated with a weak solution of ammoniacal soda, and bleached with a solution of a "double hypochlorite of zinc and magnesium," produced by the admixture of solutions of magnesium sulphate and zinc sulphate with chloride of lime. The very unstable hypochlorite gives up its chlorine and bleaches quickly, without leaving behind in the fibre any traces of lime. Then the material is washed in pure and acidulated water, and treated with a suitable dechlorinating agent, such as hyposulphite of soda (sodium thiosulphate), ammonia, &c. Finally, the material is blued, to give more lustre to the fibres.—H. S.

*Improved Process for Removing Pitch, Tar, and other Coloured Impurities from Finished or Partially Finished Fabrics.* K. Herold, E. Balatsch, and A. Bayer, Brünn, Austria. Eng. Pat. 941, January 15, 1895.

The patentee chemically cleans finished or partially finished woollen or hair fabrics by employing heavy or light tar oils in emulsion with the usual fluids used in felting and finishing woollen or hair fabrics, as means for freeing them from pitch, tar, or other impurities.—H. S.

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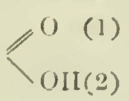
## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Theory of Mordant Dyestuffs.* A. Bernthsen. Chem. Zeit. **19**, 38.

Discussing Kostanecki's theory as to how far the group—



confers the character of a mordant dyestuff on a colouring matter, the author concludes that in several dyestuffs he has examined, there are actually two hydroxyl groups in the ortho position, more especially in certain new mordant colouring matters belonging partly to the diphenylnaphthylmethane series and partly to the methylene blue series derived from 1.2-dihydroxynaphthalene and its sulphonic acids. In support of this view, there exist higher oxidation products of these colouring matters which have a superoxide or quinone character, and apparently contain a $\beta$-naphthoquinone residue, whilst the original colouring matters are the corresponding naphthohydroquinones. This is more especially the case in those colouring matters derived from tetra-alkyldiamidodiphenylcarbinol and the 1.2-dihydroxynaphthalene and its sulphonic acids.—T. A. L.

*Silk Gilding and Silk Dyeing.* H. Silbermann. Chem. Zeit. 1895, **19**, 832—833 and 857—858.

*Gilding of Silk.*—The method of Gonin, by which the fibre was impregnated with gold chloride, the latter reduced by hydrogen, and finally polished by means of a smooth surface, was much too expensive, and was no other than the mere superficial coating of the fibre with gold. By means of electrolysis actual silk gilding is now possible. The silk is made to conduct by soaking in silver nitrate solution, and a conducting surface is produced by treatment with phosphoretted hydrogen with the vapours of a solution of phosphorus in carbon bisulphide, or by reduction with sodium bisulphite solution, grape sugar and dilute alkali, &c. Instead of silver nitrate, lead or copper acetate may be used, and by treatment with sulphuretted hydrogen or by dipping into an alkaline solution of thiourea the fabric may be coated with a conducting surface of metallic sulphide and electro-plated in the usual way.

The silk thus prepared retains its flexibility and feel, and the method is especially applicable to laces, muslins, tulles, &c.

*The Dry Dyeing of Silk* consists in dyeing the fabric in a cold solution of the fatty lake of the colouring matter. The fat deposited gives the fibre a peculiar pleasant lustre, and the fabric is not injured by high temperatures. The nature of the solvent oil, or fatty acid lake may of course be varied. Such baths possess little absorptive power, and the absence of crystalloids (water, salts, &c.) prevents the diffusion of the colour, and hence the lake is deposited only superficially or mechanically in the pores of the fibre, and a fast colour cannot be obtained.

According to Boussier and Boissel the aniline colour is dissolved in concentrated soap solution, and the lake precipitated by the addition of acid. After drying, the precipitate is dissolved in benzene, ether, carbon bisulphide, &c.

According to Holliday (Eng. Pat. 2668, 1883), the colouring matter is dissolved in olive oil, or in a fatty acid, best oleïc, or in a mixture of the two, and diluted with benzene, &c. After dyeing in this bath, the fabric is exposed to air, steamed, and finally the excess of fat removed by benzene, &c.

Faster colours are obtained by the use of resins. Resin is boiled with alkali to complete saponification and mixed with the aniline colour; the resin lake is separated by the addition of alum, and after drying is dissolved in benzene.

Petitdidier dissolves the colour in alcohol and mixes it with a solution of gum or wax in benzene. As before, the excess of wax is removed after dyeing, by washing with benzene. The colour may also be dissolved in benzene, and gums or stearin added. Many colours soluble in alcohol may be mixed in such solution with benzene, and the emulsion used direct.

For all these methods the silk fibre must be carefully purified in the "dry way," and it is advisable to add to the last bath 5—10 grms. of oil or oleïn per litre. The colour is moreover often improved by the addition of 2—5 grms. of oil per litre to the dye-bath. Since the dye-baths are not exhausted they may be worked continuously.

Dry dyeing is especially applicable to thin and fine silk fabrics, such as gauzes, tulles, &c., which often contain ungummed silk, and cannot for various reasons be dyed in aqueous baths.—H. I.

## PATENTS.

*Improvements in the Process of and Apparatus for Bleaching and Treating Fibrous Materials and Fabrics.* E. Cadoret and A. Jost, Crefeld, Germany. Eng. Pat. 8558, April 30, 1894.

This invention consists in employing first a vacuum and afterwards compression in order to impregnate textile fabrics with liquids or gases for the purposes mentioned above.

The process depends upon the principle that a liquid or gas injected into the pores of any substance penetrates more completely into such substance if it meets no elastic medium in its course. This is effected by exhausting a vessel and afterwards admitting under pressure the liquid or gas with which the fabric is to be impregnated.—H. S.

*Improvements in Apparatus for Dyeing Yarns and Slubbings or Rovings, or otherwise treating the same with Liquids.* J. Pritchard, Galashiels. Eng. Pat. 10,392, May 29, 1894.

In one modification of this invention, the dye-bath consists of a semi-cylindrical trough having in its axis a rotating shaft on which are fixed two or more radial arms carrying at their outer parts small frames for the yarn, &c. When moved by the rotation of the shaft, the frames with the hanks are carried through the liquid. As each frame has two or more bars, the hanks nearer the main shaft have shorter courses through the liquid than those further out, and to prevent inequality in dyeing from this cause, the small frames can be turned half round at intervals to reverse the position of the several hanks.

In another modification the vat is circular, but otherwise the arrangement is very similar to that described.—R. B. B.

*An Improvement in Thickening and Fixing Calico Printers' Pigments, Colours, and Mordants.* E. B. Manby, Manchester. Eng. Pat. 10,466, May 30, 1894.

The ordinary albumin fixing is replaced by a solution of cellulose in chloride of zinc solution. The chloride of zinc is subsequently removed by washing or steaming.—R. B. B.

*Improvements in the Manufacture of Soluble Metallic Phosphate Compounds.* C. Raspe, Berlin. Eng. Pat. 13,199, July 7, 1894.

*See under XX., page 595.*

*Improvements in Dyeing or Printing Fibres Black, or Shades approaching thereto, with Aniline, its Homologues or Derivatives.* W. J. S. Grawitz, Nogent-sur-Marne, France. Eng. Pat. 2614, February 6, 1895.

Blacks dyed with a salt of aniline, together with a chlorate as oxidising agent, are liable to fade. This defect may be overcome by employing a soluble sulphocyanide and a compound of vanadium along with the chlorate. For example, the dye-bath is thus prepared :—Aniline salt, 1,295 grms., ammonium sulphocyanide, 570 grms., sodium chlorate, 710 grms. These substances are dissolved separately and mixed lukewarm. The bath is diluted to 13 litres, and when cold 1 grm. vanadate of ammonium dissolved in 100 grms. water is added. The textile materials impregnated with this mixture take a fine black on ageing.—R. B. B.

*An Improved Means or Method of Dyeing and Bleaching Warp upon a Warp Beam.* G. Keighley, Burnley. Eng. Pat. 5075, March 11, 1895.

An improvement on Eng. Pat. 5186 of 1894 (this Journal, 1895, 363). In order that the warps may be evenly dyed or bleached it is necessary to interpose one or more layers of calico or other permeable material between the perforated beam and the warp. Or, if the liquor enters from outside, the permeable material is wrapped round the perforated tube.—R. B. B.

# VII.—ACIDS, ALKALIS, AND SALTS.

*Thirty-first Annual Report on Alkali, &c. Works, by the Chief Inspector.* Proceedings during the year 1894, presented to the Local Government Board and to the Secretary for Scotland.

During the year 1894 there were registered in England, Ireland, and Wales, under the Alkali, &c. Works Regulation Act, 1,056 works, 102 of which are alkali works and 954 are works which come under the schedules of other works. These numbers show an increase of one alkali work and of nine other works since 1893. The number of processes under inspection is 1,520, which is an increase of 25 upon that of 1893. There are also 126 works registered in Scotland, which makes the total number of registered works 1,182. Concerning the Scotch works a separate report is presented to the Secretary for Scotland.

The inspectors have paid a total of 4,992 visits to works during 1894, and have made 5,032 tests of escaping gases. A table is given showing the average amount of acid gases escaping in each district, together with the average acidity taken over the whole of 1894, as compared with the years 1893 and 1892. From this it is seen that the average amount of hydrochloric acid in chimney gases during 1894 was 0·089 grain per cubic foot of gases, which is less than one-half of the legal limit, viz., 0·2 grain per cubic foot; that the amount of hydrochloric acid escaping, expressed in percentage of that produced, was 1·736, which is only about one-third of the legal limit of 5 per cent. The average escape of sulphuric acid, from the apparatus of manufacture, expressed as $SO_3$, was 1·266 grains per cubic foot; the legal limit is 4 grains per cubic foot.

There were seven prosecutions during the year under the Act: two for the escape of noxious gases, three for non-registration of works, and two for obstructions of the inspector in the exercise of his duty. Concerning this the report says: "It is much to be regretted that in these two cases there should have been introduced a spirit so much at variance with the open-handed confidence that has generally been maintained between the inspectors and the manufacturers."

*Alkali Works.*—From the following table it will be seen that the total consumption of salt in these works has diminished year by year, but that nevertheless the amount decomposed by ammonia-soda works continues to increase.

Salt decomposed in the Leblanc and Ammonia-Soda Processes (including Scotland).

| — | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Leblanc process....... | 434,298 | 467.562 | 519,593 |
| Ammonia-soda ........ | 361,603 | 349,609 | 301,897 |
| Total...... | 795,901 | 817,171 | 821,490 |

All departments of manufacture suffered greatly during the coal strike of 1893; expensive fuel and a diminished demand for soda, owing to the contraction of other industries, has kept the alkali trade in a condition of depression from which it is but slowly recovering.

Efforts are still being made to make bleaching powder in connection with the ammonia-soda process, but as yet they have not been largely successful. Great efforts are also being made to supersede both the Leblanc and the ammonia process in the production of soda and also of chlorine by the electrolysis of common salt. There are now three electrical processes on trial commercially. The process of Mr. Castner, of Oldbury, has been at work for about six months. A process by Mr. Vautin has been on trial for a short time on a small manufacturing scale at the works of Messrs. Harrison, Blair, and Co., at Kearsley, but the operations are for the present suspended. In this arrangement fused salt is employed. It lies on a mass of melted lead, which forms the cathode, the anode being a bar of carbon immersed in the fused salt. The lead forms an alloy with the sodium, which, drawn off from time to time, can be utilised in various ways. The chlorine rises from the layer of fused salt, and is led away for absorption in lime, &c. The third method is that of Messrs. Holland and Richardson. Here the soda solution formed about the iron cathode lying at the bottom of a trough of brine flows away to be boiled down and separated by concentration from the undecomposed salt that accompanies it. Works for carrying out this process are being erected at St. Helens by the Electro-chemical Co. They expect to operate on 50 or 60 tons of salt, and to produce 40 tons of caustic soda and 80 tons of bleaching powder weekly.

Concerning Castner's process, some statistics are given in the Appendix, on page 66, in the Report of Mr. Jackson, Inspector in District V. The plant has been put up by the Aluminium Company at Oldbury. Practically pure caustic soda, and chlorine of 95 to 97 per cent. purity, free from hypochlorites, but containing some hydrogen, is produced. The main features of the process consist of a cell, upon the floor of which is a layer of mercury, which forms an amalgam with the sodium liberated by electrolysis from the brine. The cell is divided into three compartments by vertical partitions, which reach to the level of the mercury, but not to the bottom of the cell, and the cell is made to rock so as to cause a rise and fall of $\frac{1}{8}$th of an inch above and below the horizontal twice a minute. This movement is quite sufficient to cause the mercury to flow completely from side to side. The two outside compartments contain the solution of salt and the anodes of carbon; the middle compartment contains the solution of caustic soda. The brine solution continually circulates and is being continuously electrolysed. The chlorine is led away from the end compartments, and the sodium amalgam produced is decomposed in the middle compartment, from which the caustic solution formed is drawn by a pipe, water being admitted from time to time. As no hypochlorites are formed, there is no decrease in electrical efficiency, and the wear on the carbon anodes is very slight — some which have been in use three months show hardly any depreciation. Each cell is 6 ft. long by 3 ft. wide by 6 ins. deep, decomposes $56\frac{1}{2}$ lb. of salt daily, and contains 180 lb. of mercury. Thirty cells have now been erected, worked in two series of 15 each, one cell in each series being idle and kept in readiness in case of need. The 30-cell plant makes 1,200 lb. pure caustic soda per 24 hours. At present the chlorine is used for making potassium chlorate. The following data have been furnished to Mr. Jackson:—" The plant was started in sections and worked intermittently at first, in order to accustom the men to the new work, so that later periods are more favourable for observation. During 91 days continuous running of 14 cells, with an expenditure of 4,540 I.H.P., there were produced 23·05 tons of caustic (78—79 per cent. Liverpool test). This corresponds to 33·67 tons of pure salt decomposed and an evolution of 20·4 tons of chlorine. The foregoing is equal to an average daily expenditure of 49·9 I.H.P., and each I.H.P. decomposed daily 16·6 lb. pure dry salt, equal to 18·8 lb. of ordinary salt. No attempt was made to measure the actual amount of chlorine given off, although for convenience this was converted into potassium chlorate; but as dry salt is electrolysed only, and the solution flowing through the cells remains the same during the whole time, it is evident the chlorine can be easily determined with certainty. As to the loss of mercury, this is very slight, and our observations convince us that now the men have got into the work, in continuous running the loss will not exceed our original estimate of 5 per cent. per annum."

*Sulphate of Ammonia.*—The following table shows the quantity of sulphate of ammonia made during the last three years:—

| —— | 1894. | 1893. | 1892. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Gasworks .................... | 113,634 | 112,179 | 110,748 |
| Ironworks .................... | 10,075 | 8,833 | 11,000 |
| Shale works .................... | 32,891 | 28,485 | 23,105 |
| Coke and carbonising works.... | 3,448 | 3,265 | 4,973 |
| Total ............ | 160,048 | 152,762 | 149,826 |

Referring to the methods of disposing of the sulphuretted hydrogen given off by gas-liquor in the manufacture of sulphate of ammonia, the chief inspector points out that, when practicable, the best plan is to burn it and pass the resulting sulphurous acid and steam into a sulphuric acid chamber. Where this cannot be done, and the quantity of sulphuretted hydrogen is large, the best method of dealing with it is found in the Claus kiln; and when the amount of gas is too small to warrant the use of the Claus kiln, then absorption in oxide of iron should be adopted. The burning of the sulphuretted hydrogen in the boiler fires is only admissible in very small works.

Other methods are also adopted, such as passing the gases through water containing lime and sulphate of iron in suspension; passing them through arsenical sulphuric acid, &c. A table is given which shows the various ways sulphuretted hydrogen is dealt with in the works in each district. Some remarks valuable to makers and users of gas-liquor will be found in the Appendix in the Report of Mr. Forbes Carpenter on pages 54—57.

*Tank Waste.*—All the waste at Widnes, St. Helens, Oldbury, and some other places is now treated by the Chance-Claus process. The old heaps of waste, however, still remain, and the drainage from them continues to give trouble.

A fatal accident occurred recently at Irvine, in Scotland. A workman, repairing a tank containing hydrochloric acid, was overcome by sulphuretted hydrogen gas, liberated by the acid leaking on to the foundation, which was made of tank waste. Although tank waste may sometimes be suitably used as a foundation, it should never be used in a situation where there is a risk of acid coming in contact with it.

*Tar Works.*—Nearly all the tar-distilling works throughout the kingdom have now been brought into conformity with the requirements of the Act, and means have been taken to prevent nuisance by consuming the gases evolved from the ends of the still worms, and by the adoption of methods of working the pitch bays, which prevent the contamination of the air with the acrid gases given off by the hot pitch.

*Felt Works.*—Some difficulties have been met with in dealing with the pungent vapours that are given off in the process of saturating felt with tar and pitch. Most of these works are in Belfast, and Mr. Ballard, the inspector in Ireland, has given this matter special attention. It is suggested that the fumes given off when the tar comes in contact with the heated rollers through which the felt passes should be collected by placing an iron hood a few feet above the machines, and drawing the fumes off to a suitable condenser by a fan.

*Coal Smoke.*—Concerning this question the chief inspector says that the report of an association of manufacturers which was formed a few years ago in Manchester to consider the efficacy of various appliances for the prevention of black smoke may shortly be expected, and that "it is understood that this will show abundantly that means now exist for preventing the discharge of black smoke without any sacrifice of economy, and that by the use of good automatic stokers, a saving is effected as compared with intermittent hand-firing, in that a cheaper coal can thus be employed with equal efficiency."

*Open House Fires.*—Although it may be truly said that factory chimneys may be kept clear of black smoke, as much cannot be said of domestic coal fires. The chief inspector, however, strongly recommends the adoption of a furnace or stove in the basement of each house, which shall be so arranged as to heat a supply of fresh filtered air, which shall then be allowed to freely enter the passages and rooms of the house and so warm them. In this way it would not be necessary to have the numerous coal fires which are now required in cold weather in our houses. From actual experience he finds that with such a stove and by using gas fires in such of the rooms as it is found desirable, a very great economy is effected.

*Works in Scotland.*—The number of works registered under the Act has remained the same as last year. The tests of the chimney gases, &c., show that the standard of efficiency has been maintained. From the report of Mr. Curphey, the inspector for Scotland, we learn that in one works a novel method of decomposing nitre in the vitriol manufacture has been in experimental operation, and that the results so far are encouraging. The nitrate of soda is mixed with lime and subjected to the action of a current of steam, whilst heated externally by the gases coming from the pyrites burners. The products of the decomposition are nitric acid, nitrous gases, and caustic soda, with lime. In this way the formation of "nitre cake" is avoided, and the soda of the nitrate is obtained in a valuable form.

Mr. Donald's process for the manufacture of bleaching-powder from chlorine generated by the action of nitric acid on hydrochloric acid, has made some progress during the past year, but it is still in the experimental stage.

—H. S. P.

*Some Reactions of Ammonium Salts.* W. R. E. Hodgkinson and N. E. Bellairs. Proc. Chem. Soc. 1895 [152], 114.

The authors examined the action of some metals on so-called ammonium salts. They chose for this purpose such salts of oxy-acids as may be melted in a comparatively dry state without appreciable decomposition.

So far they have only examined the nitrate and sulphate. These salts were dried and carefully melted, and the metal, in foil or thin sheet, introduced. The temperature in each experiment was maintained a few degrees above the melting point of the salt.

Metallic copper acts immediately on the fused salts, ammonia gas and a little hydrogen being evolved. When the temperature is maintained below 160°, the residual product is a mixture of copper sulphate or nitrate with an excess of the ammonium salts; some water also escapes, and, in the case of ammonium sulphate, a small quantity of sulphite sublimes. Nickel and cobalt act in a similar manner, but more sublimate of the sulphite is obtained, and the amount of hydrogen is very small. Mercury does not act so readily, but similar products are formed. The most easily managed reactions are those with silver and palladium. Silver dissolves most easily both in ammonium sulphate and nitrate; the amount of displaced ammonia is nearly equivalent to the silver dissolved as sulphate or nitrate. It is doubtful whether any hydrogen escapes. With ammonium sulphate much sulphite sublimes.

In no case is the exact equivalent of ammonia to that of dissolved metal, obtained. The metallic salt is always in excess, but silver dissolves more readily in fused ammonium sulphate than in sulphuric acid, probably owing to the easy fusibility of the mixed salts, silver sulphate, and ammonium sulphate.

*Formation of Persulphuric Acid.* K. Elbs and O. Schönherr. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 417 and 468.

*See under* XI., *page* 583.

## PATENTS.

*An Improvement in the Manufacture of Cyanides of the Alkaline Metals.* O. Imray, London. From Goerlich and Wichmann, 32, Ferdinandstrasse, Hamburg. Eng. Pat. 8889, May 4, 1894.

The author prepares potassium or sodium cyanide from the corresponding ferrocyanide, by heating the crushed dehydrated ferrocyanide with an alloy of potassium, or sodium, and lead. Usually, one part of potassium or sodium is alloyed with nine parts of lead. The reaction is conducted at the lowest possible temperature, and the fused cyanide separated from the metallic iron and lead which remain.

—J. T. D.

*Improvements in Machinery or Apparatus for Obtaining Salt from Brine.* R. Hodgson, Sparkbrook, Birmingham. Eng. Pat. 9250, May 10, 1894.

The pan, which may be of iron, steel, or wood, supported on several brick pillars, is heated by steam, conducted through an arrangement of pipes made in sections, bolted together, with the top sides flat, set on the bottom in rings, of which two sets of two rings each are shown. The two inner rings are connected to a steam-supply pipe, and to an outlet leading to a steam trap, in such manner that the steam first circulates through the smallest, inmost ring, and then through the second ring. The two outer rings are independently fed with steam in like manner. The joints connecting the two outer rings are at some distance apart, to provide space for an incline rising out of the brine over an outlet in the bottom of the pan, through which salt brought up by a mechanical scraper, falls into the moulds beneath. Two scrapers are carried, one by the shorter and the other by the longer arm, fixed on a vertical shaft passing up through a bearing in the centre of the pan, to which shaft, rotation is imparted through suitable mechanism from any convenient source of power. The intervals between the rings become filled up with salt, forming a smooth floor, and the joints to the pipes are so constructed as not to stand up above the level or present any obstructions to the passage of the scrapers. The inner scraper drives the salt outwards, and the outer scraper carries it up the incline, at the top of which is a drop through a short space, when the salt is discharged through the outlet provided, while the scraper moves on, and down the opposite incline, into the brine. The hot water formed by the condensed steam is utilised in heating the brine before passing it into the pan.—E. S.

*Improvements in the Manufacture of Cyanides.* H. W. Crowther, West Bromwich, E. C. Rossiter, Smethwick, and G. S. Albright, Edgbaston. Eng. Pat. 9275, May 10, 1894.

The authors fuse potassium or sodium ferrocyanide with zinc, getting mixed cyanides of the alkali and of zinc. These mixed cyanides are treated with alkaline carbonate or sulphide, forming alkaline cyanide and zinc carbonate or sulphide, which are separated by settling, or by solution in water and filtration.

They also claim the purification of alkaline cyanides from sulphide or carbonate by fusion with cyanide of zinc, and from cyanide of zinc by fusion with alkaline carbonate or sulphide.—J. T. D.

*Improvements in Apparatus for Evaporating Brine or other Liquors or Solutions, and Extracting the Salts or other Solid Matters therefrom.* A. Chapman, Liverpool. Eng. Pat. 10,906, June 5, 1894.

The pans or vessels of a double, triple, or multiple effect evaporating apparatus, are provided with large tubes carried downwards into a receiver, so as to constitute Torricellian columns, the length of which is such as to make "the vertical distance between the levels of liquor in the receiver and the bottom of the pans not less than the height of a column of mother-liquor equal to the greatest vacuum that can be produced in the apparatus." Each pan is fed separately with liquor, preferably in the manner described in Eng. Pat. 11,529, 1890 (this Journal, 1891, 641). There is a screw or conveyor provided to the receiver, to push the salts to one end, whence they are taken by an elevator to a suitable receptacle. The mother-liquor overflows from the receiver into a tank for return to the pans in addition to fresh liquor. The receiver may be divided, to take separately salts of different grain from the pans. When caustic liquor is being concentrated, the Torricellian columns and receiver are only applied to those pans in which the liquor attains a density of about 52° Tw., at which salts separate. The action of the apparatus is continuous and automatic.—E. S.

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*Improvements in and Apparatus for Effecting the Decomposition of Gases by Means of Porous or Catalytic Material, more especially intended for Use in the Production of Chlorine from Hydrochloric Acid Gas and Air.* J. Brock, V. C. Driffield, and F. W. Wright, Widnes. Eng. Pat. 11,966, June 20, 1894.

The hydrochloric acid gas and air, after passage through a purifier if necessary, are caused to pass through two or more walls of impregnated porous material, in order to increase the decomposition beyond that which occurs when a single wall only is used. The walls of decomposing material are supported between rows of louvres, or their equivalents, within a casing having horizontal inlet and outlet openings for the gases. Each wall compartment (of which three are shown within a casing) has at bottom, projecting below the casing, a discharging nozzle, the walls of which are at a steeper angle than the angle of repose of the material, and a valve enables the porous material to be withdrawn when and in such quantity as may be desired. The top of each wall compartment converges upwards within the casing, and is surmounted by a valved hopper, through which fresh charges of porous material are admitted. The first compartment is fed with partially-exhausted porous material, in order that the heat of reaction may not rise too high.

The apparatus may be used in other cases where gases are to be subjected to decomposition in a similar way; as, for instance, in the manufacture of sulphuric anhydride by passing sulphurous acid and air over platinised asbestos.

—E. S.

*Improvements in Apparatus for Effecting the Decomposition of Gases by Means of Porous or Catalytic Substance, more especially intended for Use in the Production of Chlorine from Hydrochloric Acid Gas and Air.* J. Brock, V. C. Driffield, F. W. Wright, and T. Davies, Widnes. Eng. Pat. 11,967, June 20, 1894.

In apparatus for decomposing gases as described in the title, provision is made whereby any desired quantity of exhausted porous material can be withdrawn, and replaced by freshly impregnated material, without hindering the continuity of the process. To effect this, to each mass of porous material within the decomposing apparatus, an eduction pipe of equal cross sectional area to the mass is secured at the bottom of the casing, and this pipe or passage terminates in a nozzle with sides contracting towards a valve, but at such angles as not to hinder the descent of the material. By opening the valve, any desired portion of the spent or partially spent material may be withdrawn. Fresh material may then be introduced to replace that removed. When the porous material is separated by division walls within the decomposer, each mass is provided with its own pipe and discharging nozzle; but apparatus is also shown in which a single mass of porous material of considerable size is furnished with several eduction pipes, fitted as described. The arrangement may be applied to any form of Deacon decomposer.

—E. S.

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*Improvements in Apparatus relating to the Manufacture of Chlorine.* J. Brock, V. C. Driffield, Widnes; A. Carey, Gateacre, near Liverpool; and G. Ogg, Widnes. Eng. Pat. 11,968, June 20, 1894.

The difficulty experienced in the manufacture of chlorine when hydrochloric acid gas and air react in presence of catalytic substances, due to the tendency of the upper part of the material used, to be more highly heated than the lower part, whereas the contrary would be preferable, is met under the present invention, by dividing the flue space surrounding the decomposer shell into two or more compartments by horizontal partitions, or even by a single partition. By the use of suitable flues and dampers the fire-gases can then be sent, in greater or less quantity at will, through either or any of the compartments, so that the temperature of all parts of the apparatus is under complete control.—E. S.

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*Improvements in the Preparation of Sulphur.* G. S. Albright, Oldbury, and J. J. Hood, Shepherd's Bush, London. Eng. Pat. 11,988, June 21, 1894.

The object of the process is the purification of crude sulphur, which is dark-coloured owing to the presence of organic matters. It consists in heating the substance for a longer or shorter time to a temperature just below the boiling point of sulphur, when the impurities either distil over or act on the sulphur so as to give off hydrogen sulphide and leave carbon. The sulphur is then distilled off or burnt to manufacture sulphuric acid.—J. T. D.

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*Improvements in the Manufacture of Cyanides.* H. Y. Castner, London. Eng. Pat. 12,218, June 23, 1894.

The author prepares alkaline cyanide by direct combination of carbon, nitrogen, and alkali metal, the metal having been separately prepared. The action goes on at a much lower temperature and the yield is much larger than when an alkaline hydroxide or carbonate is used. The operation is conducted in a vertical iron retort set in a furnace. The retort is furnished above with a funnel and siphon bend, through which melted sodium is supplied, and has a conical bottom, also provided with a siphon bend, by which the melted cyanide runs off. Side-pipes at bottom and top serve for entrance and exit of gas, while a hopper near the top allows charcoal to be added without interrupting the process. The retort may contain charcoal, in which case nitrogen is passed through the furnace by the pipes, or it may be packed with porcelain or iron, when a mixture of nitrogen and some gaseous hydrocarbon is passed through.

—J. T. D.

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*Improvements in the Manufacture of Cyanides.* H. Y. Castner, London. Eng. Pat. 12,219, June 23, 1894.

The author claims the use of alkali metal as in the preceding patent, but covers in this patent the formation of cyanides from nascent nitrogen, and carbon either free or nascent. He describes a process the same in all respects as that of the preceding patent, save that ammonia is used instead of nitrogen.—J. T. D.

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*Improvements relating to the Manufacture of Sulphuric Acid and to Apparatus therefor.* A. Staub, Bettenhausen, Germany. Eng. Pat. 12,675, June 29, 1894.

Sulphuric acid is manufactured, without the aid of lead chambers, by bringing together, under pressure, sulphurous acid gas and nitrous acid gas in the presence of air and water. The apparatus employed consists of columns, preferably of baked clay, filled upon a perforated bottom with short clay pipes placed upright and alternated, or with a series of grate- or sieve-shaped plates of burned clay, piled up so that the openings of each alternate with those of the preceding and following ones. The short pipes may be provided internally with oblique, broad, flat projections alternate with each other; or they may have inner helical walls, the arrangements having for their object the retardation of the gases and the bringing of them into intimate contact within small spaces. The column has at the top a device for distributing the liquid that is to descend; also an outlet pipe above the tubular system and an inlet pipe below for the gases. Five of the columns are shown, arranged in series, the exit pipe of one communicating with the inlet pipe of the next, and so on through the battery. At the beginning of the process, the battery may be supplied at a suitable point with nitric acid for developing nitrous acid gas, the first column being supplied with a mixture of sulphurous gas and air and with strong sulphuric acid containing nitrous acid. When the gases react, water is supplied to a column where the excess of sulphurous acid has disappeared. The water rapidly absorbs the sulphurous acid from the gaseous mixture, so that the mixture of nitrous acid gas and air is in contact with an aqueous solution of sulphurous acid, whereby sulphuric acid is produced; the latter is, however, too weak for absorbing the nitrous gas, which remains in the current, and in a following column this weak acid is used to absorb the remainder of the sulphurous acid gas, so that sulphuric acid is again produced. The gas current then consisting chiefly of nitrous acid and air, is acted on by strong sulphuric acid taken from the battery at a suitable point, so that the current of gases leaving the last column will be free from acid gases. Other details are given of the order of the processes, and it is stated that by proper regulation, strong sulphuric acid free from nitrous gas may be obtained in the front columns, and that the concentration in the first column may be raised to 66° B.—E. S.

*An Improved Process for Obtaining Acetic Acid from Pyrolignate of Lime.* Carl von der Linde, Crefeld, Germany. Eng. Pat. 3477, February 18, 1895.

The author claims the use of distillation at a lower temperature *in vacuo*, when crude pyrolignate of lime is decomposed by acids, as a means of drawing over pure acetic acid, free from tar-spirit or oils.—J. T. D.

*Improved Apparatus for Producing Carbonic Acid and other Gases.* O. Alius and M. Treitel, Berlin. Eng. Pat. 5299, March 13, 1895.

The gases produced by roasting limestone in a shaft furnace are drawn off from the top through washing devices, wherein flue-dust is deposited, into a jet pump, into which a stream of potash-lye flows, carrying the gases with it into a "de-aërating" chamber through a pipe bent several times, this chamber forming the upper part of a cooling chamber. Here the carbonic acid gas is absorbed, and an exit is provided for waste gases. The lye is then forced by a pump through a series of cooled pipes into a reservoir, whence part of it passes into the jet pump, and the remaining portion, regulated by a valve, flows into a preliminary heater, and thence into a pair of boilers, where the excess gas is expelled. A regenerating vessel receives the lye after boiling, which passes through cooling vessels back into the de-aërating chamber, in a condition suitable for renewed absorption of gas. The released carbonic acid gas, after passage through a series of cooling vessels, is freed from water of condensation and is taken to a gasometer.—E. S.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*Fused Silicates as Solvents.* F. Knapp. Thonind. Zeit. 1894, **18**, 857.

The proximate constituents of fused silicates prepared in the arts often cannot be stated with the precision attainable for natural silicates (which are commonly crystalline), on account of their amorphous condition. The solvent effect of a fused silicate is well exemplified by that of ordinary glass, which is capable of dissolving 2—3 per cent. of sodium sulphate without suffering injury to its transparency. A larger amount is separated as "glass-gall" ("Glasgalle"), but the residual 2—3 per cent. is truly dissolved, and cannot be leached out with water. On slow cooling, however, many substances dissolved in fused silicates are separated. Separation is accompanied by the formation of a turbidity which can sometimes be found to consist of globules or crystals visible under the microscope. The solubility of metals in glass is illustrated by the formation of clear, colourless solutions of copper and gold, which become red on the occurrence of aggregation.—B. B.

*Employment of Calcium Plumbate in the Glass Industry.* G. Kassner. Sprechsaal. 1895, **28**, 334. Chem. Rep. 1895, 149.

Experiments in which calcium plumbate was employed for glass-melting were in part successful. The glass acquired a greenish colour, but this is ascribed to iron present in the lime used for preparing the plumbate. The glass also showed streaks, probably owing to insufficient mixture. The author was sufficiently satisfied with the results attained, to state that, besides calcium plumbate, the barium salt will probably be successfully employed in glass-making.
—N. H. J. M.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Contributions to the Knowledge of Mortar.* E. Donath. Zeits. angew. Chem. 1895 [1], 14—19.

It is still asserted in some quarters that the lime in common mortar is capable of acting upon the sand with the production of cementitious silicates. This belief is chiefly founded on the presence of soluble silica in common mortar and the assumption that the percentage of this constituent increases with the age of the mortar. The table on p. 574 gives the composition of 11 samples of ancient mortars, proving the variable amount of soluble silica which may be found.

In interpreting the results of the analysis of a mortar, due regard must be paid to the proper assignment of the cement-forming acid oxides to the sand on the one side, and to the lime on the other. The sand itself constantly contains silicates, some of which are fairly easily acted on by acid, and similarly, the lime is never free from silica, alumina, and ferric oxide in a soluble state, derived from the action of the lime itself upon the clay and other siliceous material which constantly accompanies ordinary limestone. Thus, if soluble silica in a mortar be accompanied by corresponding amounts of alumina and ferric oxide, the presumption is that these

| — | Town Wall, 600 Years old. | Church, 620 Years old. | Church, 880 Years old. | Church, 640 Years old. | Church, 610 Years old. | Town Ruin, about 600 Years old. | Church Tower, 410 Years old. | Church, Age Unknown. | Church, Age Unknown. | Church, Age Unknown. | Monastery, Age Unknown. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water | 3·53 | 4·68 | 0·96 | 2·53 | 0·94 | 2·23 | 0·90 | 1·61 | 0·52 | 0·38 | 0·75 |
| Sand | 59·14 | 56·97 | 59·95 | 67·90 | 61·80 | 26·03 | 64·97 | 53·72 | 61·08 | 76·62 | 79·91 |
| Clay | 3·49 | 2·51 | 5·17 | 5·98 | 5·13 | 6·00 | 3·88 | 12·03 | 5·67 | 1·98 | 3·10 |
| Sol. $SiO_2$ | 1·24 | 1·65 | 1·29 | 1·93 | 1·44 | 5·07 | 2·41 | 3·76 | 1·97 | 1·33 | 3·45 |
| $CO_2$ | 12·80 | 13·59 | 12·60 | 8·78 | 12·30 | 26·18 | 11·40 | 11·28 | 11·48 | 8·05 | 5·51 |
| CaO | 15·58 | 16·15 | 15·97 | 10·41 | 13·40 | 21·23 | 13·77 | 8·41 | 15·08 | 10·20 | 5·71 |
| MgO | 0·26 | 0·68 | 0·27 | Trace | 0·13 | 6·78 | 0·24 | 2·70 | 0·36 | 0·90 | 0·19 |
| $Fe_2O_3$ and $Al_2O_3$ | 2·68 | 2·61 | 2·64 | 1·99 | 2·90 | 6·73 | 1·95 | 5·78 | 2·87 | 0·94 | 1·71 |
| Alkalis and loss | 1·28 | 1·16 | 1·33 | 0·48 | .. | .. | 0·47 | 0·71 | 1·02 | 0·40 | .. |
| | 100·00 | 100·00 | 100·18 | 100·00 | 101·04 | 100·25 | 99·99 | 100·00 | 100·05 | 100·80 | 100·39 |
| $CO_2$ calc. from CaO + MgO. | 12·31 | 13·43 | 12·69 | 8·19 | 10·67 | 24·14 | 11·08 | 9·63 | 12·19 | 8·13 | 4·69 |

materials owe their origin to the impurities in the limestone, whereas, if the soluble silica largely preponderate, some countenance is lent to the idea that such silica may have been brought into a soluble condition by interaction of the lime and sand of which the mortar is composed.

The method of analysis adopted by the author is as follows:—20 grms. of the coarsely-powdered sample are treated with 400—500 c.c. of dilute hydrochloric acid (1:6) with gentle warming until $CO_2$ has been driven off. The solution is filtered, and the residue separated into "clay" and "sand" by elutriation. The filtrate is made up to a known volume, and portions taken for the estimation of silica and bases in the ordinary manner. The carbonic acid is estimated by evolution and absorption in weighed bulbs in the usual manner. This method of obtaining the soluble silica in solution in dilute acid is preferable to that of treating the material to be analysed with strong acid, evaporating to dryness, and extracting with sodium carbonate, since in the latter case soluble silica may be derived from the various small quantities of siliceous minerals which accompany the sand and are not perfectly unattacked under these conditions. On the other hand, a slight deficiency in the soluble silica may arise from the failure of the dilute acid when heated to retain the whole of it in solution. A tendency of the method is, therefore, to yield slightly low results for soluble silica. On studying the analyses given in the table above, it is evident that the percentage of soluble silica is small, rarely exceeding 2 per cent., similar quantities being present in mortar of far inferior antiquity. In most instances a high percentage of soluble silica is accompanied by a correspondingly large amount of ferric oxide and alumina, although the rule is not absolute. Certainly no evidence exists for supposing that the lime of the mortar reacts upon the sand, causing an increase of the soluble silica with age.

Certain experiments made by Petzholdt seem to imply that lime acts upon quartz with the formation of calcium silicate, and need consideration in view of the author's own result. Petzholdt made his experiments partly with powdered quartz obtained by heating quartz to redness and quenching it in water, partly with white sand freed from particles of mica by washing, and partly with common ferruginous brown sand. He did not determine the soluble silica already existing in these materials, although the last two kinds certainly cannot be considered as composed entirely of insoluble silica. His experiments were carried out by making up mortar mixtures of the sands described above, and lime, prepared by igniting white marble, and determining the soluble silica in these mixtures after the lapse of various periods of time. In the author's experiments, on the contrary, pure quartz was used, not quenched, but mechanically comminuted, and as the other constituent the purest attainable lime, the quantity of soluble silica being determined immediately after the materials were mixed and then again after the lapse of a suitable number of days, *e.g.*, 14. The quantity of soluble silica found was not greater after the lapse of 14 days than immediately after mixing, whence the author deduces that this direct experiment indicates that no action takes place between quartz and lime under the conditions of experiment. It must not be forgotten in examining mortar mixtures that the soluble silica is not necessarily derived entirely from the impurities in the lime. Ordinary building sands may yield a perceptible amount of such silica. Direct tests on this point showed that a coarse river-sand used for massive structures yielded 0·26 per cent. of soluble silica when treated with dilute hydrochloric acid; a moderately coarse river-sand for common building work gave 1·85 per cent. of soluble silica, and a fine sand used for rendering, 1·52 per cent. It is not to be supposed that this soluble silica is derived from the true sand (quartz), for the small quantities of other minerals, *e.g.*, felspar, granite, gneiss, mica, &c., accompanying the quartz would yield a relatively considerable quantity of soluble silica on treatment with acid, on account of their being by no means entirely insoluble in that menstrum. Inasmuch as it is sometimes stated that granitic or felspathic particles present in sand are capable of uniting with the lime of mortar in the same way as has been asserted (and now disproved) concerning quartz and lime, the author made a direct experiment with pure felspar in a manner similar to that previously adopted by him for quartz, and with a similar negative result. Any beneficial effect which felspar, &c., may have upon the strength of mortar is due to the weathered particles of that felspar, rather than to the felspar itself. No one disputes the action of certain siliceous additions to the mortar, *e.g.*, granulated blast-furnace slag or siliceous ashes, which react in the same manner as the products of weathered felspathic minerals accompanying quartz in ordinary sand.

On studying the analyses of old mortars given in the table it is noteworthy that in the case of Nos. 5, 6, 8, and 11, there is an excess of carbonic acid above that necessary to combine with the whole of the lime and magnesia present. Such an excess has been observed by other chemists, and has been ascribed either to a sort of mechanical absorption of carbonic acid or to the formation of alkaline carbonates. Sample No. 6 contained a good deal of organic matter, which was also present in smaller amount in Nos. 5 and 8, and absent from the remainder. The slow oxidation of this organic matter after the lime of the mortar had absorbed its normal amount of carbonic acid from the air, might tend to supersaturate the lime with carbonic acid and convert it into a bicarbonate. With regard to the adhesive properties of mortar, the main reason for its attachment to the brickwork is no doubt mechanical; nevertheless brick is much more active towards lime than pure sand is, and a certain formation of calcium silicate may take place at the actual point of contact between the brick and the mortar. A warrant for this belief is founded on the known capability of powdered brick to communicate hydraulic properties to lime.—B. B.

### *Slaking Lime and Cements.* H. Le Chatelier. Bull. de la Soc. d'Encouragement, 1895, 10, 52—62.

One of the most noteworthy features of the familiar phenomenon of the slaking of common lime is the development of a considerable pressure when the operation is conducted in an enclosed space. The mechanism of the development of this pressure is absolutely unknown. It is not due to increase of volume of the lime in the act of slaking, for the volume of the slaked lime is smaller than the sum of the volumes of the quicklime and water concerned in the formation of the slaked product. The increase of volume must therefore be *apparent, i.e.*, must arise from the occurrence of spaces between adjacent particles.

That stresses of a high order may be produced by such slaking is proved not only by the fracture of closed vessels in which the slaking may be conducted, but also in the disintegration and "blowing" of briquettes of hydraulic cements containing free lime.

Seeing how important is thorough slaking in such products as hydraulic lime, slaked (as is usual in France) before being put on the market, the industrial value of an exact knowledge of the mechanism of the process of slaking is at once apparent.

Two processes are in use for slaking hydraulic limes and cements, (1) slaking proper, (2) "bulking" (*silotage*). The satisfactory completion of the process of slaking may be ascertained by properly-devised "hot tests."

*Process of Slaking.*—Lime in a porous state, such as is obtained by rapid ignition of calcium carbonate at a temperature just high enough for its decomposition, *e.g.*, 900° C., slakes immediately on the addition of water; dense, compact lime, such as is prepared by the decomposition of a fusible calcium salt, *e.g.*, the nitrate, requires, on the other hand, 24—48 hours for its complete slaking. Density of the lime and consequent slowness of slaking increase *ceteris paribus* with the temperature and duration of the ignition, and are also greatly influenced by the presence of fluxing constituents, *e.g.*, silica and alumina.

Magnesia behaves similarly to lime, but its slaking is slower. When lightly burnt it becomes hydrated on contact with water for a few days; when heavily burnt, on the other hand, it may require months for complete hydration in the cold. Mixtures of lime and magnesia behave in a manner intermediate between those of their constituents. If slaking be conducted at temperatures above the ordinary (*e.g.*, 100° C.) its completion is much more rapid than in the cold. Thus dense, compact lime is slaked in about three hours, and heavily-burnt magnesia in about six hours. Candlot has shown (this Journal, 1890, 72 and 1891, 140) that a 2 per cent. solution of calcium chloride brings about slaking at the ordinary temperature as rapidly as water does at 100° C., but that the disintegrating effect is smaller. This applies to lime, and not to magnesia. The fact that magnesium chloride acts similarly to calcium chloride (doubtless by conversion into the latter in contact with lime) may well be the explanation of the improvement of indifferent hydraulic cement sometimes observed on gauging it with sea-water instead of fresh.

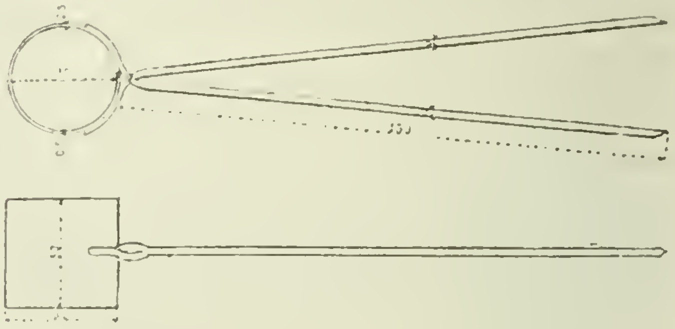
*Slaking of Hydraulic Lime.*—Hydraulic lime (in France at least) consists of calcium silicates associated with free lime, which serves, by its slaking, to disintegrate and comminute the whole mass. This slaked lime in no way contributes to the setting of the whole product, and is therefore reduced in quantity to the minimum necessary to ensure spontaneous pulverisation on slaking. With the view of obtaining the maximum effect from this minimum quantity of free lime, the conditions of slaking should be as favourable as possible; especially should the temperature be high. In practice the temperature of a mass of lime rises during slaking to 200° C., this rise being wholly due to the heat evolved in the act of hydration. In order to attain and maintain this temperature, loss of heat by conduction, convection, and radiation should be guarded against as far as possible, and the quantity of lime slaked at one time should be considerable. In the laboratory, as the quantities operated upon are small, external heat should be applied either by means of the water-bath or, better, by the use of a solution of calcium chloride boiling at 150° C. On a manufacturing scale the process of slaking occurs in four phases. (1.) Spraying water on a thin layer of the lime. The water is absorbed by the capillarity of the porous lime and at first produces no perceptible effect, save on such portions as are lightly burnt. About 1½ times the theoretical quantity of water is used, the excess being spontaneously dissipated by evaporation when the mass becomess hot. Any further excess of water, tending to "drown" the hydraulic lime, is useless and dangerous; for, on the one hand, it tends to hydrate and render inert the calcium silicates on which the setting ultimately depends; and, on the other, it so cools the mass that some free lime remains unslaked, causing the finished product to be latently unsound. (2.) The lime thus wetted is added to the bulk in the bin in which the mass is stored, which should be not smaller than 3 cubic metres, as, otherwise, losses by radiation, &c., become too large. During the heating caused by slaking, part of the water escapes into the air, but another portion penetrates into the cooler parts of the mass, and aids the slow-slaking of any residual free lime it may contain. (3.) The lime, after the first phase of rapid slaking, contains both free lime and uncombined water, which has been derived from more recent layers of freshly sprinkled lime in the manner described under (2). Slaking, however, is not perfect, especially if the hydraulic lime be sufficiently rich in silica and burnt hard enough. Many particles of unslaked lime remain in contact with calcium silicate. The complementary phenomenon of partial hydration of the cementitious silicates also occurs, and can be demonstrated by heating lime in this partially slaked state to a temperature of 150° C., when water will be driven off, although calcium hydroxide is perfectly stable at this temperature. This is an important point, for a reason which will be seen later. (4.) In the fourth and final phase of slaking, the layer, of which the history and behaviour are being traced, is too far from the front of the bin to receive water from subsequent layers during their early stages of slaking. Moreover, moisture from the air is excluded by the thickness and imperviousness of the whole mass of lime. In spite of the exclusion of external water, the process of slaking continues. Proof of this is afforded by the fact that lime taken from the heap 48 hours after slaking will disintegrate when made into mortar, whereas, if a fortnight have elapsed, the quality of the material is unexceptionable. The experiment can be successfully repeated in a closed vessel, all question of the action of water from an external source being thus excluded. It follows that the secondary slaking which takes place in the mass of lime without further access of water, is effected at the expense of the water combined with calcium silicates and aluminates. The mechanism of this transference is perfectly simple. The formation and decomposition of hydrates is limited by a certain vapour tension proper to each temperature. For calcium hydroxide the tension of dissociation is 760 mm. at 450° C.; for the cementitious calcium silicate the same tension is reached at 150° C. At ordinary atmospheric temperature the tension of dissociation for calcium hydroxide is a minute fraction of a mm., whereas that of the silicate is equal to several mm. At 100° C., the tension is still below 1 mm. for $Ca(OH)_2$, while reaching a value of several cm. for the silicate. The necessary occurrence of a transference of water from one to the other, in the interior of the heap of hydraulic lime, is at once obvious, and it is also plain that the rate of transference rises with the temperature. On a laboratory scale, the completion of the slaking by means of this transference takes some months at the ordinary temperature, and about 10 days at 100° C. On a manufacturing scale the action is more rapid, being accomplished in a fortnight, a week being rather too short a time for obtaining satisfactory slaking. This maturing process is too often neglected by manufacturers, and its omission is fraught with danger. When only 48 hours are allowed for slaking, one of two conclusions becomes valid: (*a*) if the lime be well burnt it will be insufficiently slaked; (*b*) if well slaked, it has been too lightly burnt (or has been prepared from a limestone poor in silica). Better and more systematic slaking will greatly improve the quality of commercial hydraulic lime, without adding seriously to its cost.

*Maturing by Storage* ("bulking," *silotage*).—True hydraulic cement should be perfectly free from lime in an uncombined state, but it invariably contains a small quantity of free lime on account of the inevitable imperfection of manufacture. In that class of hydraulic cement obtained as a by-product in the manufacture of hydraulic lime—viz., *ciments des grappiers*—prepared by grinding the residue left unattacked after slaking the bulk of the hydraulic lime, free lime is a normal constituent. The method adopted for improving such cement, consists in storage, slaking being commonly thought to occur from the action of atmospheric moisture. This view is untenable, because the rate of penetration of such external moisture is exceedingly slow; moreover, until the outer layer is saturated, but little can be expected to reach the interior. The cause of the maturing which undoubtedly takes place is precisely that producing the fourth phase of the slaking of hydraulic lime in mass (*v.s.*). A proof of this is found in the effectiveness of storage in a closed vessel, and, in practice, in large bins where maturing proceeds without intentional aëration by turning over. The fundamental distinction between the process of slaking hydraulic lime and that of slaking cement, consists in the much slower rate at which the latter proceeds, the lower temperature of the cement when put into store contributing to the delay. A necessary corollary is that slaking takes place more slowly in winter than in summer. The practical deduction from this exposition of the principles involved in the maturing of cement, is primarily, that enough water should be present in the cement before it is stored in mass to carry out the subsequent internal slaking. In the manufacture of Portland cement, water is absorbed by such portions as are lightly burnt, which thus serve to introduce into the mass of the cement (on grinding) the water needed for complete slaking of the free lime. In the case where clinker particularly well burnt, has been picked to produce a cement of high quality, the absence of these under-burnt and therefore absorptive portions, is compensated for by actually moistening the selected clinker before grinding. With *ciment de grappier*, on the other hand, the hydrated portion (the hydraulic lime, which is the main- as distinct from the by-product) is removed from the clinkered portion, and sufficient water is not left associated with the latter to ensure the slaking of the free lime which it contains. A practical remedy is to grind partly clinkered hydraulic lime (*chaux lourde*) or briquettes of cement already set, together with the true clinker, thus providing the necessary water.

Having regard to what has been said above concerning the effect of temperature upon the slaking of lime and cement, it is evident that it would be advantageous to heat the bins in which the material is stored. By the use of a temperature of 100° C., slaking could be carried out in as short a time as a fortnight even of such refractory materials as *ciments des grappiers*, which are both rich in free lime and slow in slaking.

A further advantage consists in the practicability of manufacturing "natural cement" prepared from cement stone nearly free from alumina. On account of the absence of this oxide, the burnt product is but little fusible, and complete combination of lime and silica does not result, the clinker being, in fact, analogous to *ciment de grappier*. The presence of free lime in the finished product causes it to be unsound, but if this lime be slaked a material superior in strength to Portland cement is obtained. It may be conceded that systematic maturing, especially at a high temperature, would correct the tendency to unsoundness adverted to above. Experiment shows that cement of this class, which "blows" violently when fresh, becomes perfectly free from this defect after it has been kept for some years in well-stoppered bottles.

*Hot Tests.*—In order to carry out methodically such processes of slaking as have been outlined above, the manufacturer must have at his disposal some means of detecting free lime. A test for "blowing" is the simplest and most certain that can be adopted for this purpose, and is best performed at 100° C. The process of testing is carried out by gauging a briquette, keeping it under water for 24 hours, or until fully set, placing it in a suitable vessel of water and bringing the contents to the boil. Boiling is continued for four hours, and at the end of that time no "blowing" or expansion should be perceptible, unless the cement contain free lime. Direct measurement of any expansion that may have occurred, may be performed by means of the apparatus shown in the figure. The cement gauged to normal consistency is filled into a cylindrical mould, and the expansion is made readily measurable by the long levers shown on the right-hand side of the illustration. When the mould is 30 mm. in diameter and 0·5 mm. in thickness, and the levers attached to the mould are 150 mm. in length, their displacement corresponds with the linear expansion (due to blowing) of a bar of cement 0·6 m. in length.



The same method and apparatus may be used by the manufacturer to make certain that his product, when ready for the market, contains no free lime. But all manufacturers of lime and cement are unanimous in protesting against the introduction of this test, alleging that its sensibility is so great as to cause it to lead to the condemnation of a cement containing a quantity of free lime too minute to be of any practical importance. This contention deserves consideration, but in the meantime the test may be profitably used and its indications compared with the behaviour of the cement when actually used as a structural material.—B. B.

### *Effect of Gypsum added to Portland Cement.* F. Schott.

Thonind. Zeit. 1894, **18**, 819; Chem. Rep. 1895, 9.

The author has determined, by means of the Bauschinger apparatus, the alteration in volume of cement approximating in composition to the values given below in the table, and having definite additions of gypsum.

Cements containing only lime and silica showed the least tendency to alteration of volume consequent on the addition of gypsum. Even when as much as 63 parts of gypsum per 100 parts of cement was added, no expansion, but indeed a slight contraction took place. Cement made from kaolin and containing 12·53 per cent. of alumina (being similar in this respect to ordinary Portland cement), expanded considerably before gypsum was added, and after its addition, exhibited much expansion and "blowing." The quantity added (63 per cent.) was that required to form the compound $Al_2O_33CaOCaSO_4$ described by Michaelis. The ferruginous cement behaved *per se* like a good Portland cement, but expanded greatly when dosed with gypsum, this indicating that the action of gypsum upon calcium ferrite is similar to that upon calcium aluminate. Cement corresponding in composition with the formula $2CaOAl_2O_3$ exhibits strong expansion, which is increased to the point of "blowing" by the addition of gypsum. In order to obtain some insight into the mechanism of this

Composition and Alteration in Volume, stated in mm. per 100 m.

| Time of Hardening. | $2CaOSiO_2$ | 100 Parts $2CaOSiO_2$ + 63 Parts Gypsum. | Kaolin Cement containing 12·53 per Cent. $Al_2O_3$ | 100 Parts Kaolin Cement + 63 Gypsum. | Ferruginous Cement containing 12·19 per Cent. $Fe_2O_3$ | 100 Parts Ferruginous Cement + 38·7 Parts Gypsum. | $2CaOAl_2O_3$ | 1 Part $2CaOAl_2O_3$ + 1 Part Gypsum. |
|---|---|---|---|---|---|---|---|---|
| 7 days | 0 | 0 | + 30 | Strong expansion and "blowing." | +10 | + 50 | +190 | + 285 |
| 28 " | 0 | 0 | +120 | | +35 | +220 | +605 | + 785 |
| 90 " | − 5 | 0 | +310 | | +35 | +300 | +705 | +1,240 |
| 180 " | − 7 | −15 | +540 | | +20 | +385 | +775 | Strong expansion and "blowing." |
| 270 " | −15 | −20 | +575 | | +15 | +495 | +880 | |
| 360 " | −20 | −30 | +600 | | +15 | +690 | +920 | |
| 1¼ years | −40 | −45 | +610 | | +15 | +886 | +940 | |
| 1½ " | −60 | −50 | +630 | | .. | .. | .. | |

expansive action, mixtures of the sintered compound $2CaOAl_2O_3$ with 1, 2, and 3 equivalents of gypsum were prepared, finely powdered in an agate mortar, and portions weighing 2 grms. treated in flasks with 50 c.c. of water in order to ascertain the quantity of water with which they were capable of combining. The absorption of water was large; *e.g.*, 100 parts of the compound $Al_2O_3 2CaO$ when mixed with 2 equivalents of gypsum absorbed 117·38 parts of water (18 equivalents) in place of 5 equivalents taken up by the same substance in the absence of gypsum. Such absorption and consequent expansion adequately explain the "blowing" observed. (For a further description of these experiments, see this Journal, 1895, 365 and 366.)—B. B.

## PATENTS.

*Improvements in and relating to the Manufacture of Lime Mixtures and Cements or Mortars suitable for Use in the Production of Artificial Stone.* E. Weckwarth, Lima, Peru, and M. Hoeft, Berlin, Germany. Eng. Pat. 21,735, November 10, 1894.

Burnt or slaked lime in the form of powder is added to a solution or paste of albumin or casein and thoroughly incorporated. Just before use, plaster of Paris in suitable quantity is mixed with the above, and the mixture used in any desired way; when set, it may be polished by gentle rubbing.—J. C. C.

*Improvements in Apparatus relating to the Burning of Materials used in the Manufacture of Cement, Hydraulic Limes, and Similar Substances, and for Obtaining Waste Products therefrom.* J. F. de Navarro, New York, U.S.A. Eng. Pat. 4191, March 2, 1895.

The invention claims the combination of a horizontal combustion chamber, having suitable charging and discharging openings, a cylindrical retort, a hollow axle provided with slits or openings, and on which the retort is fixed, means for heating the retort externally; means for giving a slow rotary motion to the retort; suitably arranged purifiers; the whole constituting an apparatus for burning or calcining cement-making and similar materials.
—J. C. C.

# X.—METALLURGY.

*Dressing and Metallurgical Treatment of Nickel Ores.* A. G. Charleton. J. Soc. of Arts, 1895, **43**, 609—661.

This is a continuation of a paper read by the same author before the Society of Arts in 1894, on *The History, Uses, and Distribution of Nickel.* (This Journal, 1894, **13**, 640.) The author dwells at great length on the dressing of nickel ores in New Caledonia, Canada, Norway, and Germany, devoting several pages to a description from his own notes of the system adopted in the Schneeberg district (Hartz). He then quotes Emmens' views upon the composite character of nickeliferous pyrrhotite (Journ. Amer. Chem. Soc. **14**, 10, and Jour. Anal. and Appl. Chem. 1892, **6**, 10), as evidenced by the results of magnetic concentration, which point to the possibility of nickel being an essential element of the gangue, instead of a constituent of the pyrrhotite. The treatment of the nickel-cobalt ores of New Caledonia (see *The Mineral Industry*, 1892); of Garnierite (vide *Annales des Mines*, 1892); of arsenical nickel ore (Roberts-Austen's *Introduction to the Study of Metallurgy*); of cupro-nickeliferous mattes at the St. Denis works; and of nickeliferous pyrrhotite in Canada, is described. Accounts are also given of the Gossan, Macfarlane, and Mond (nickel carbonyl) processes. Useful schedules of the various processes are presented. Finally the uses of nickel for alloying with copper and similar metals, and for the production of nickel steel for armour plates, ordnance, marine shafts, flanges, and steel wire are dealt with. Questions of cost are in many cases entered into, and the paper concludes with a survey of the present and probable future relations between supply and demand. Frequent references are made to a paper by Sperry, on nickel steel, read this year before the American Institute of Mining Engineers (this Journal, 1895, 487).—W. G. M.

*Liquation in Crystalline Standard Gold.* T. K. Rose. Proc. Chem. Soc. 1895 [152], 107.

It has been suggested by Roberts-Austen that, although no segregation occurs on the solidification of alloys of gold with silver and copper, some rearrangement might be expected to take place when these alloys are made crystalline and brittle by the addition of small quantities of bismuth or lead. The author accordingly rendered standard gold impure in three successive experiments by the addition of 0·2 and 0·4 per cent. of bismuth and 0·2 per cent. of lead respectively, casting the metal in a spherical iron mould, and assaying various parts of the mass.

The observed variations in the composition of different parts of the mass can be explained by assuming that in these alloys a saturated solution of gold and silver in bismuth or lead (no doubt containing a little copper in addition) remains molten after the greater part of the gold and copper has solidified. Those constituents which are the first to become solid are thus enabled to assume a definite crystalline form. Moreover, as the portion of the material which remains molten longest is pushed towards the centre of the mass during cooling, the interior is enriched in both gold and silver.

### *Some Reactions of Ammonium Salts.* W. R. E. Hodgkinson and N. E. Bellairs. Proc. Chem. Soc. 1895 [152], 114.

*See under* VII., *page* 571.

### *Smelting of Copper Slags in the Herbertz Furnace.* L. Rürup. Chem. Zeit. 1895, **19**, 599—600.

Previous experience with a Herbertz steam-jet draught furnace, which had been satisfactory except that the slag had carried too much copper, induced the author to experiment with a new pattern of this furnace erected at Cologne. The new furnace differed from the old chiefly in being water-jacketed to a height of 0·75 metre above the air inlet, so that the brick lining was scarcely attacked; in having a door (through which the tap-hole is driven) in the hearth, to facilitate cleansing, and in being provided with fume-depositing chambers for the waste gases. The inside diameter of the melting zone was 600 mm., and the steam-jet was placed at a height of about 2 metres above the top of the hearth; a charging bell was provided. The slag used for the experiment contained 35 per cent. of copper and 7·98 per cent. of FeO, the weight being 2,200 kilos. The furnace was first filled with coke to a height of 800 to 900 mm. above the air inlet; in two hours it had become ignited throughout; regular charging was then commenced, and maintained throughout in the same cycle:—50 kilos. of slag, 40 of limestone, then 50 of slag and 25 of coke. The steam-jet was now started, and smelting commenced, with a constant vacuum of 15 cm. throughout. Within half an hour a free-flowing slag began to fall past the air-slot, and in another half hour the slag-level in the hearth had risen to this point, so that the slag notch was opened. The slag was very fluid, and contained only 0·1 per cent. of copper, whilst the copper was sufficiently hot, and held less than 0·3 per cent. of iron, requiring therefore far less refining than the copper similarly smelted in the ordinary blast-furnace, which usually contains the whole of the iron in the charge. To minimise the sulphur in the copper, both the tap-hole channel, and the moulds into which the metal was run, were painted with a mixture of 2 parts lime and 1 part of clay. Compared with ordinary blast-furnace practice, the results are said to be excellent, only 1,500 instead of 4,000, kilos. of coke being required to start the Herbertz furnace, whilst subsequently it requires but 25 (in place of 50) kilos. of coke per 100 of slag charged. Then, as above mentioned, the copper is practically free from iron, and the slag is quite as clean as that produced by the older plant. The refining of such a copper would be more readily and economically effected in a converter than in an ordinary refinery; but a very thorough poling would be required. The dross from the converter, containing only 1 to 2 per cent. of copper, could be rejected, whilst refinery slag, with about 40 per cent. of copper and much iron, must be re-smelted, so that the iron in the charge would be constantly increasing.

The converter would be specially useful for the treatment of waste aluminium bronze, which by frequent re-meltings takes up so much silicon from the crucible that it may become useless. Scrap may only be worked up in castings which will not be subjected to rolling or drawing; or, preferably, it may be refined. An experiment was tried in an ordinary refinery, in which, after the metal had been melted for an hour, a blast was let on to hasten the oxidation. By poling simultaneously, the dross formed was quite grey and pulverulent, and consisted of 94 per cent. of aluminium with 6 per cent. of copper. Samples removed in a ladle, showed that the bath was composed of several superposed layers of different alloys, the lowest containing the most copper. Ingots cast during the first evening showed a variation of shades from a deep red colour (when they contained 0·07 per cent. of aluminium) to a gold-yellow (with 1·3 per cent.). On the second evening the copper contained only 0·02 per cent. of aluminium, but the dross produced during that day carried 35 per cent. of copper.
—W. G. M.

### *Investigation of Aluminium Alloys.* A. Riche. J. Pharm. Chim. 1895, **1**, 5.

The low strength of tin makes the addition of lead necessary for the preparation of commercial alloys of this metal. Seeing that lead poisoning frequently follows the use of such alloys, the author has sought to replace lead by some other metal, and suggests the use of nickel. Aluminium alloys easily with tin if half the total tin be fused at a high temperature and then the aluminium and finally the rest of the tin be added. Tin-aluminium alloys rich in tin can be readily worked, and can even be rolled to foil 0·5—0·2 mm. in thickness, but the material becomes brittle on keeping, and after a time can be rubbed to powder between the fingers. Moreover, tin-aluminium alloys are more easily attacked than the pure metals by water, acids, and alkalis. The alloy containing 25 per cent. of aluminium gives off hydrogen when acted on by water, the evolution being sufficiently vigorous to allow of the reaction being shown as a lecture experiment. Alloys of this class are consequently useless for the purpose which the author had in view.—B. B.

### *Ternary Alloys of Iron with Chromium, Molybdenum, and Tungsten.* J. S. De Benneville. Iron and Steel Institute, Spring Meeting, 1895. The Ironmonger, **71**, 282.

The author has continued his experiments on these alloys to ascertain in what order of "chemical affinity" chromium, tungsten, and molybdenum stand to iron. The alloys were made by melting these elements in pairs with the iron, forming tungsten-chromium irons, molybdenum-chromium irons, and molybdenum-tungsten irons. The proportions taken were not based on equal weights, but on the atomic weights. They were first as 1:1 in the iron, then as 5:1 and as 1:5. In the tungsten-chromium irons there is a conclusive indication that the iron by preference alloys itself with the chromium. Even when the preponderance of tungsten over chromium is as great as five atoms to one, or 19 grms. to 1, the iron exercises a selective choice in favour of the chromium. In the molybdenum-chromium irons, the chromium is again by preference taken up by the iron. The probable reason for these results is considered to be the more ready dissociation of the chromium molecule. There appears from these results to be very little difference between molybdenum and tungsten as regards their combination with iron, taking them in reference to chromium. In the molybdenum-tungsten irons there is a slight difference in favour of molybdenum. A large number of the results of a chemical examination of the residues obtained after the action of different reagents on the alloys is then given. These results point to a varied structure in the alloys. There appears to exist, side by side, a number of compounds, some readily attacked by reagents, and others inert, distributed with considerable uniformity throughout the mass. The compounds formed are not all ternary compounds. A small percentage of iron, in several cases accompanying large percentages of molybdenum or tungsten, show that these elements are present, in part at least, in some form other than that of ternary alloys.

The form in which carbon exists in these alloys shows their heterogeneity. In one example, carbon was present in at least three forms, all being combined carbon:—(1) carbon evolved as ill-smelling hydrocarbons by the action of dilute acids; (2) carbon present in the residues obtained by acting on the alloys with bromine, which residues are not attacked by dilute hydrochloric acid; and (3) carbon found in the prismatic crystals. In these ternary alloys also is found the more complex carbide of chromium, with iron and molybdenum, or tungsten. The hardness of these alloys cannot be attributed simply to change of carbon from the graphitic to the combined form, but to the formation of definite carbides. Then follow a large number of extracts from and references to the work of different authors in relation to the theories of combination of various alloys and of chemical solutions, from which he draws analogies between the two. The existence of definite compounds in certain metallic solutions pointed to the belief that an analogous condition existed in these iron alloys, and that, in cooling, a number of alloys would be formed dependent on the temperature of their solidification. Such alloys, however, would not necessarily possess chemical stability in regard to reagents. He suggests also, "Can there not exist in iron and these ternary alloys, when passing through successive stages of liquidity, compounds analogous to the hydrocarbon series?—that is, the existence of polymeric forms, or of compounds differing but little in their percentage composition." By the progressive action of increasingly active solvents various compounds of different degrees of stability are obtained, the same metals being found in the solutions obtained by each solvent. Such a result indicates that the character of the compounds in these alloys is not similar. The molybdenum, tungsten, and iron removed by the weak solvent, silver nitrate, are not combined in the same manner as the metals in that portion which is unattacked by this solvent, but decomposed by hydrochloric acid, nor in the manner in which these elements are found in the still more stable residues. The last named are the compounds with high solidifying point and great density, which separate out from the metallic solution at a comparatively early stage.—A. W.

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### *The Effect of Arsenic on Steel.* J. E. Stead. Iron and Steel Institute, Spring Meeting, 1895. The Ironmonger, **71**, 256—275.

Full details of a large number of experiments and mechanical tests to show the effect of varying quantities of arsenic on steel are given in this paper. A consideration of them leads to the conclusion that between 0·10 and 0·15 per cent. of arsenic in steel for structural purposes does not appear to have any material effect on its mechanical properties. The tenacity is but slightly increased, the elongation is apparently not affected, and the reduction of area is practically equal to that of the same steel without the addition of arsenic. When 1 per cent. of arsenic is present the tenacity is increased, the elongation slightly reduced, and the contraction materially reduced. The bending properties are fairly good. With 1·5 per cent. the tenacity is still further increased, the elongation and contraction further reduced, and the bending properties are poor. With 4 per cent. of arsenic the tenacity is increased, but the elongation and contraction become *nil*. The effect of quenching the steel after heating to redness was to improve the bending properties in every case where arsenic was present in large quantity. The tenacity of the quenched materials has not yet been determined. Hot-working has not been affected in the slightest degree by even 4 per cent. of arsenic. From the fact that such material, when heated below its burning point, can be readily hammered and rolled, it may be concluded that arsenic has not the slightest tendency to produce red-shortness.

Arsenical steel does not appear to be more liable to corrosion than the same material without arsenic; in fact, oxidation is retarded by the presence of small quantities of this element. Welding is made more difficult by arsenic, and, when welding material is required, its presence should be most carefully avoided, as even small quantities are deleterious. This property has previously been noticed by Harbord and Tucker. Electric conductivity is materially reduced by even small quantities of arsenic, 0·25 per cent. diminishing it by about 15 per cent. As an appendix the author describes his analytical methods. These, however, are embodied in a paper read before the Newcastle Section of this Society (this Journal, 1895, 441—446).

In the course of a lengthy discussion on this paper Mr. Paul stated that further proof should be brought to bear before concluding that arsenical steel containing 0·3 per cent. of carbon bent better after quenching in water, as the results of his own investigations were decidedly contrary to this conclusion. He says it would appear as though they might safely class arsenic with silicon or manganese. Mr. Snelus said that in making "Delta" metal he had found that the presence of arsenic in zinc had enabled the latter metal to alloy with more iron. By prolonged action of molten zinc upon finely-divided iron, one could attain to upwards of 12 per cent. of iron in zinc. He found that without any arsenic the maximum amount of iron he could get into the zinc was generally a little over 10 per cent., whereas with 2·25 per cent. of arsenic he got 14·15 per cent. The importance, in analysis, of separating the arsenic from the phosphorus was discussed. Hitherto in some cases arsenic had been weighed and calculated as phosphorus, and had been considered to have equally deleterious effects. These experiments show that it is incorrect to class arsenic with phosphorus, and to condemn a steel as containing too much phosphorus by considering these two elements as one.—A. W.

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### *Siemens' Process for Extracting and Depositing Gold.*

Zeits. f. Elektrotechnik u. Elektrochem. 1895, 532—534.

This paper is based upon information supplied by the firm of Siemens and Halske. The following is a brief outline of the process:—The auriferous ores and residues are treated with a dilute solution of potassium cyanide, which dissolves out nearly all the gold; the solution is then electrolysed by a current from a dynamo and the gold is deposited on lead plates. Finally the lead is cupelled off.

*Nature of the Ore.*—Since the method depends upon extraction by means of potassium cyanide, it is advisable that the ores should not contain substances capable of decomposing the cyanide. Such substances are:—Free sulphuric acid, ferrous and ferric sulphates, foreign metals and such of their compounds as are soluble in potassium cyanide. Soluble substances are removed by washing the ore with water, in which process lime may be used. The solvent action of potassium cyanide is slow and incomplete when the gold is present in the form of coarse grains. When the ore is very rich, the percentage yield becomes reduced. Hence the method is best adapted for the treatment of auriferous quartz, pyrites, and tailings of medium and low grades containing metallic gold in a finely-divided state. Ores should be reduced to fine powder before extraction: tailings (residues after amalgamation) are already in this state.

*Extraction.*—This is carried out in large iron vessels of about 100 cubic metres capacity. The potassium cyanide solution is poured over the gold-sand or tailings and mixed by means of special stirring apparatus, the construction of which is modified according to the nature of the raw material (tailings or slime). When the extraction is sufficiently complete the solution is conveyed into the depositing tanks and the spent sand is removed.

*Depositing Tanks.*—These are also made of iron, but are of much smaller capacity (about 20 cubic metres). The gold is deposited electrolytically upon thin lead plates in the form of an adherent powder. After the gold has been deposited, the solution is enriched with as much cyanide as is required to make up for the amount lost in extraction and deposition. It is then conveyed back to the extraction-tanks and can be used over again.

*Consumption of Cyanide.*—The potassium cyanide is decomposed by the air and the carbonic acid present in it, as well as by the gold and other metals. The amount thus consumed depends upon the nature of the ore or tailings. Works in the Transvaal dealing with 3,000 tons of tailings per month have been found to consume 0·25 lb. of cyanide per ton of tailings (the latter containing about 5 dwt. of gold per ton).

*Expenses, &c.*—Details of the initial and working expenses of works in the Transvaal capable of dealing with 3,000 tons of tailings per month are given. Of these the following may be of interest. Mechanical power used—(1) for electro-deposition = 5 horse-power; (2) for all purposes (including electric lighting and electric transmission of power for driving the stirring apparatus, &c.) = 25 horse-power. Approximate cost (exclusive of freight, duty, and cost of erection) of apparatus for electro-deposition = 250*l.*; of apparatus for electric lighting and transmission of power = 750*l.* Average yield = 70 per cent.

*Comparison with the MacArthur-Forrest Process.*—In this process the gold is extracted by potassium cyanide, but is deposited from the solution by scrap zinc. This method of precipitation only works satisfactorily with comparatively strong solutions of potassium cyanide. The strength commonly used is 0·3 per cent.; whereas in the Siemens process the solution need only contain 0·08 to 0·01 per cent. In the works above-mentioned the cost of the potassium cyanide used per month during the first year was 75*l.*; whereas works of the same capacity (3,000 tons of tailings per month) employing the MacArthur-Forrest process it is stated, would consume 220*l.* worth of cyanide per month. The use of weaker solutions involves a longer time in extraction and necessitates a larger number of extraction-tanks; but the advantage appears to be largely on the side of the Siemens process. Other advantages are that the gold is obtained as an adherent deposit and that the lead can be recovered. In the MacArthur-Forrest process the gold is obtained as a loose powder mixed with scrap zinc; and when the zinc is removed by acids or other chemicals, both the latter and the zinc are wasted. According to Eissler, the working cost of the MacArthur-Forrest process amounts to 7*s.* or 8*s.* per ton of tailings (in works dealing with 100 tons a day); the cost of the Siemens process is only 3*s.* per ton (see also this Journal, 1895, 38).—D. E. J.

### *Blast-Furnace Gases and Products.* K. J. Bayer. Chem. Zeit. 1895, **19**, 855—856.

Gredt has proposed a method for the recovery of materials carried off by the gases of the blast furnace, in which process they are washed with water. The filtered aqueous washings are stated to leave on evaporation a saline residue containing iodine, chlorine, potassium, and calcium. The author has examined the flue-dust deposited in the tubes leading from the furnace, and divides it into two classes—(1) The ordinary dust, which consists of more or less coarse particles of ore, coke, lime, &c., mechanically carried off by the gases; (2) A finely-divided loose grey-white portion, which deposits in crusts on the upper surfaces of the tubes. On extracting the latter with boiling water, the soluble portion was found to contain considerable quantities of iodine, which would probably pay for recovery, and on cooling a small quantity of fine lemon-yellow needles was deposited. On evaporating the solution of the crystals with sulphuric acid, iodine was evolved and a residue soluble in water consisting chiefly of thallium sulphate, was obtained. After removal of the thallium by the addition of hydrochloric acid, the filtrate so obtained, yielded a metallic sponge on treatment with zinc. The filtrate from the yellow needles. The filtrate from the yellow needles also formed brown precipitates with potassium iodide and with ammonia.

The mother-liquor from the crystals, contained a large amount of iodine, which, according to the author, has its source in the coals used in the furnace, which, in the case under consideration, were of Belgian-Rhine-Westphalian origin. The insoluble residue consisted chiefly of zinc oxide.

In pulling down a blast furnace the author found large quantities of a greenish powder "*Cadmie*," consisting of zinc oxide. In some places where the deposit was not so dense, fine clear brown or greenish hexagonal crystals of zinc oxide were obtained, and in cooler places crystals of iodide of lead and even metallic lead, pure except for traces of silver, were also found, together with crystals of potassium and sodium chloride.—H. I.

### *Determination of Nickel in Nickel Steel.* E. D. Campbell and W. H. Andrews. J. Amer. Chem. Soc. 1895, **17**, 125.

*See under* XXIII., *page* 598.

### *Estimation of Sulphur in Iron.* L. L. de Koninck Chem. Zeit. 1895, **19**, 502.

*See under* XXIII., *page* 597.

## PATENTS.

### *Treatment of Finely-divided Substances, such as Crushed Ores, Slime, Tailings, and the like, for the Separation and Recovery of Metals and Metallic Compounds therefrom, and Apparatus therefor.* G. Robson, Dolgelly, and S. Crowder, London. Eng. Pat. 427, January 8, 1894.

The finely-divided ore is agitated in a moist state with a liquid of lower specific gravity than water, obtained by mixing a liquid hydrocarbon, such as turpentine, paraffin, &c., and a fatty oil, such as colza oil, the proportions varying according to the nature of the material operated on. The metallic matter coming into intimate contact with the oils, is taken up by them and rises to the surface, whence it can be run off with some of the oils into a suitable settling or separating vessel and obtained free from the mixture of oils, which is then ready for use again.

The fatty oil appears to play the principal part, the mineral oil merely serving as a diluent.—A. W.

### *Certain Improvements in the Manufacture of Iron and Steel and other Metals, and in Apparatus to be Employed in the said Manufacture.* H. G. Richardson, Wordsley. Eng. Pat. 6783, April 5, 1894.

By this process the iron or other metal is purified by the introduction of certain purifying materials at the point or place of reduction or conversion of the ore to the metallic state in the blast furnace, or whilst being heated in the refinery furnace. The materials, such as carbonates, oxides, chlorides, &c., of lime, manganese, &c., in a state of powder, are introduced through the tuyère pipes and injected into the furnace by the blast. Attached to the tuyère pipe is a hopper for maintaining the supply of material to the blast, or a gasholder is used when the purifying material is supplied in the gaseous state.—A. W.

### *Improvements in the Manufacture of Steel.* C. de Estéve Llatas, Paris. Eng. Pat. 6974, April 7, 1894.

This process is used to obtain steel of the highest quality, such as "crucible steel," in a Bessemer converter or in a "Siemens-Martin furnace," at a cost but little exceeding that of the ordinary process for low-grade steels. The metal is heated in the converter, or furnace, in the ordinary way, until the bath is brought to the desired point of purity as regards the amount of carbon present. Manganese and silicon, which are first heated to cherry-redness, are then introduced either simultaneously or the silicon after the manganese has been absorbed. The resulting metal should contain—(1) For hard steel:—Carbon, 0·075 to 0·085 per cent.; manganese, 0·020 to 0·030 per cent.; silicon, 0·025 to 0·035 per cent.: and (2) for soft steel:—Carbon, 0·045 to 0·055 per cent.; manganese, 0·040 to 0·050 per cent.; silicon, 0·025 to 0·035 per cent. The addition of 0·012 to 0·020 per cent. of aluminium is advantageous. It may be added in the ladle or the mould, but if added in the furnace should only be introduced at the last moment. Steel thus produced is said to possess greater toughness and homogeneity than ordinary crucible steel.—A. W.

### *Improvements relating to the Manufacture of Nickel and Cobalt.* P. Manhes, Lyons, France. Eng. Pat. 6911, April 6, 1894. (Under International Convention.)

In the manufacture of nickel, a matte is produced of nickel, iron, and sulphur. After eliminating the iron by the older methods, a product is obtained which contains a large proportion of sulphur. In the present process it is this material, practically free from iron, which is treated. The sulphur is completely eliminated by simple fusion with alkaline or basic fluxes mixed with the corresponding chlorides, such as a mixture of lime and chloride of lime. The fusion may be effected in any suitable furnace or in a crucible, provided that they are furnished with a neutral or basic lining. In practice, the author found a mixture of lime and chloride of lime very effective when used partly as a false bed and partly mixed in the charge. The nickel parted with its sulphur to the lime, forming a slag practically free from nickel. This slag is employed in the preliminary melting of fresh ore to matte, and forms a valuable flux by reason of the lime and sulphur it contains. Thus the lime combines with the silica of the ore, and the sulphur is useful in the case of ores containing only small quantities of this element.

The same method applies to the elimination of the sulphur from the cobalt matte.—A. W.

### *Improvements relating to the Treatment of Nickel and Cobalt Ores.* P. Manhes, Lyons, France. Eng. Pat. 6984, April 7, 1894. (Under International Convention.)

By this process nickel and cobalt can be obtained commercially pure from their ores in one operation. There are two principal reactions. The first is the elimination of the iron by oxidation and the dissolution of its oxide in boracite or other suitable flux, forming a fluid slag. By the second, the residual sulphur is eliminated by heating with a basic slag mixed with its corresponding chloride (see preceding abstract). The matte obtained by roughly fusing the sulphide ore, is treated in a converter lined with a basic material. During the blowing, the oxide of iron is dissolved by the boracite flux, which is added just before the blowing commences. When the iron has been completely oxidised, the scoria is drawn off. The reagents, lime and chloride of lime, needed to eliminate the sulphur, are then added and the blowing recommenced, when the pure metal is quickly obtained, together with a basic sulphide slag.

—A. W.

### *Improvements in the Treatment and Utilisation of Old or Disused Vessels or other Articles of Tin-Plate.* F. Redman, and the London and Provincial Tin-Plating Company, London. Eng. Pat. 8967, May 5, 1894.

Old or disused articles of tin-plate are separated into their constituent parts, the solder collected, and the larger and better pieces flattened out and re-tinned, or plated with nickel, copper, or other metal. By dipping the pieces into hot oil or fat, the solder is melted and falls to the bottom of the hot oil bath. Or a suitable furnace is employed, provided with a gutter into which the melted solder runs, and by which it is conveyed to a receiver outside the furnace. The ordinary tinning process is employed for re-tinning.

### *A Method of Protecting Iron, Steel, or other Metal from Oxidation during Heating.* F. Siemens, London. Eng. Pat. 11,138, June 8, 1894.

The pieces of metal to be protected, are coated with a paste consisting of substances which have no injurious effect on the metal, and form a coating which remains intact at moderate temperatures, and a fusible slag at high temperatures. The paste is composed of finely divided fireclay, mixed with materials, such as marl, chalk, dolomite, with ores, oxides, or carbonates of iron or manganese, with siliceous materials or with alkalis, alkaline carbonates, alkaline earths, &c., according to the nature of the metal treated and the temperature employed. The slag formed, protects the metal from oxidation, and does not affect its quality when rolled, hammered, or otherwise worked.—A. W.

### *Improvements in Methods of Partially Decarbonising and Converting Iron.* S. Hufty and J. K. Caldwell, Philadelphia, U.S.A. Eng. Pat. 11,570, June 14, 1894.

The metal is subjected, while highly heated but still considerably below the point of fusion, to the action of the gases resulting from the decomposition of nitro-hydrochloric acid by heat, or of liquids containing nitrogen, hydrogen, and oxygen, such as nitric acid or the ordinary aqua ammonia of commerce, by which means the iron is partially decarbonised.

As an instance of what can be done in carrying out this invention, it is stated that in the treatment of ordinary white iron the use of 30 oz. of acid to every 100 lb. of iron will give good results.—J. H. C.

### *Improvements in the Treatment of Calamine and Similar Minerals or Compounds for the Extraction of Zinc.* Carl Hoepfner, Giessen, Germany. Eng. Pat. 11,724, June 16, 1894.

The calamine or similar mineral is finely powdered, and treated with a strong solution of calcium chloride at a high temperature and under pressure. The zinc solution thus obtained is then electrolysed in an apparatus fitted with insoluble anodes from which chlorine is liberated, and may be utilised for producing chlorate of potash or bleaching powder, &c., whilst pure metallic zinc is deposited on the cathodes. Only a portion of the zinc is thus deposited, the remaining portion being precipitated chemically, preferably by means of hydrate of lime.

—J. H. C.

### *Process for the Treatment of Nickeliferous Iron Ores.* W. T. Gibbs, Buckingham, Canada. Eng. Pat. 13,851, July 18, 1894.

In this process the crude ore is roasted to convert the sulphides of iron, nickel, and copper into their respective oxides. The granulated ore is then finely pulverised and extracted in a closed cast-iron percolator, with ammonia of sp. gr. 0·90, to dissolve the nickel and copper oxides. The clear ammoniacal solution is subjected to a kind of fractional distillation in three cast-iron retorts, each provided with an apparatus for condensing and absorbing the ammonia. The retorts may be connected together so that the solution can flow through each in turn. In the first retort, oxide or hydrate of nickel is precipitated; in the second, a mixture of this with oxide of copper; and in the third and last retort, which contains barely a trace of ammonia, pure oxide of copper is thrown down. The separated oxides of nickel and copper in the first and last retorts are reduced to metal. The mixed oxides in the second retort, which should form only a very small proportion of the whole, are treated again with a fresh batch of the ore in the percolator.

—A. W.

### *Improvements in Processes for Converting Cast-Iron into Malleable Iron or Steel.* Samuel Hufty, Camden, New Jersey, and J. K. Caldwell, Philadelphia, Pennsylvania. Eng. Pat. 15,225, August 9, 1894.

The material to be converted, is first heated in an open-hearth furnace by a reducing flame to a temperature somewhat below the point of fusion. When it has reached the desired temperature, and while it is still subject to the action of the reducing flame, a decomposable oxidising fluid, such as air, steam, or water, is supplied by means of special tuyères in such volume as may be necessary to combine with, and eliminate from the heated iron, the required amount of carbon to be removed, but not in such volume as to form an iron-scale on its surface.—J. H. C.

*Process for Coating Metals with Tin.* L. Bangert, Libau, Russia. Eng. Pat. 20,071, October 20, 1894.

The plates, having been previously pickled in dilute sulphuric acid, are passed down through a bath of molten tin covered with zinc chloride, thence up through a similar bath covered with an oil-mixture composed of about 25 parts of palm-oil, 25 parts of tallow, and 55 parts of mineral oil, such as naphtha, and finally through an oil-bath filled with the above-described mixture. Squeezing rollers are provided for removing the superfluous material from the sheets as they pass through.—J. H. C.

*Improvements relating to the Production of Homogeneous Cast Iron or Steel, and to Apparatus therefor.* A. Lencauchez, Paris. Eng. Pat. 25,322, December 31, 1894.

When new cast-iron is to be treated, it is melted in a refining furnace and maintained in a fluid condition at as low a temperature as possible for about 20 minutes, using a neutral or slightly oxidising flame.

When old iron scrap is to be treated, or metal containing sulphur, the furnace is charged with powdered coke or other carbonaceous matter, ferromanganese and lime are added as may be necessary, and when the charge is fully melted, the temperature is allowed to fall to that at which ordinary cast-iron melts, and so maintained for a time.

In either case, when the desulphurisation is complete, the slags produced are removed, and the temperature is raised to a point just below that at which the oxidation of carbon commences. Air is then blown over the surface so as to oxidise the phosphorus and silicon, lime is added, and sometimes magnetic or other oxide of iron, and the slags containing the various impurities are again skimmed off. The "carburetted iron" or "fine metal," partially freed from manganese, sulphur, phosphorus, and silicon, thus produced, may either be further purified by the well-known "repouring" or "transfer" process, or the refining may be completed in the same furnace. In the latter case, the metal, after careful skimming, must be rapidly raised to the highest temperature possible by means of a rich gas from a gas-producer reinforced by powerful regenerators. The iron is thus decarburised, and the refining completed at as low a temperature as possible; the temperature being raised again for the final fusion for casting.

The whole of the refining is thus divided into six stages:—(1) Fusion; (2) desulphurisation; (3) dephosphorisation; (4) removal of silicon; (5) decarburisation and completion of the refining; (6) fusion for casting.

Sundry improvements are said to have been made in the Siemen's furnace so as to facilitate the required speedy changes of temperature, from the low temperatures employed during the first four phases of the process to the highest temperatures employed industrially, which are imperative for effecting the fifth and sixth phases.

—J. H. C.

*Improvements in Treating Ores or other Substances or Liquors containing Gold or Silver, or both, and Apparatus therefor.* J. Y. Johnson, London. From L. Pélatan, Paris, and F. Clérici, Milan. Eng. Pat. 2493, February 5, 1895.

In this process the finely-divided material to be treated, is placed in a suitable solution for dissolving the gold. The metal is then precipitated by electrolysis without previously filtering, and obtained, either in the metallic state or as an amalgam, according to the nature of the cathode. The solution also contains a metallic salt, such as sodium chloride, to increase the conductivity. The operation is carried out in a special vat, in which the cathode may be lead plates, or, better still, mercury or amalgamated sheets of copper or silver. At the bottom of the vat is an annular groove filled with mercury connected with the cathode, the surface of which accordingly remains clean. With this mercury, any larger pieces of metal falling to the bottom of the vat amalgamate. The contents are agitated by screw blades carried by a vertical shaft, which can be rotated at the required speed. This shaft is made of iron, steel, or copper, &c., and forms the anode. The plates of the cathode are placed on the sides and bottom of the vat.

With ores direct from the mines, the author employs cyanide of potassium (0·1 per cent. solution), together with a solution of salt, and an oxidising compound, such as oxygenated water or potassium peroxide.—A. W.

*An Improved Process for the Extraction of Metals from Oxides and Sulphides.* Claude T. J. Vautin, London. Eng. Pat. 8306, April 26, 1895.

The oxygen or sulphur compounds of chromium, iron, tungsten, titanium, molybdenum, nickel, cobalt, uranium, vanadium, or glucinum are heated at a high temperature, with metallic aluminium in a finely-divided state. The reduction is effected in a vessel lined with fire-clay or other refractory material, and it is generally preferable that the oxide or sulphide should be in excess. Fluorspar, cryolite, or other fluxing material may be added when required.

—J. H. C.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*Manufacture of Accumulator Plates and Testing of Materials.* P. Schoop. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 412—415.

In order to ensure the satisfactory behaviour of accumulator plates, the materials used in their manufacture (lead, antimony, litharge, red lead, minium, lead sulphate, and sulphuric acid) should be carefully tested beforehand. The following tests are simple and sufficient:—

*Lead.*—From each bar a sample is cut off with a knife. The pieces are melted and poured out on a polished steel plate. The plate thus obtained is hung by a platinum wire in a beaker, with a platinum sheet as cathode opposite it. The beaker is filled with 3 per cent. sulphuric acid, to which a little persulphuric acid is added. The electrodes are connected together; after 24 hours the lead plate is considerably attacked, and the impurities (copper, silver, tin) are in solution. Ammonia added in excess should produce no blue colour. On neutralising with hydrochloric acid there should be no precipitate or cloudiness. After standing for some hours with zinc and acidifying, there should be no cloudiness on adding mercuric chloride.

*Litharge, Red Lead, &c.*—Commercial silver-litharge is unsuitable, even when it is free from copper and silver (which cause local action). The small yellow flakes of which it consists, produce on reduction, a spongy lead which is not sufficiently uniform and porous. The red lead used by painters is not always finely ground enough. It may be chemically tested by making it into a stiff mixture with glycerin-sulphuric acid of 1·20 sp. gr., and spreading this upon platinum wire-gauze. After drying, the electrode thus prepared is laid on the bottom of a flat porcelain dish and covered with sulphuric acid of 1·10 sp. gr. A 5 per cent. solution of sodium sulphate is poured into a flat cell of parchment paper, in which is hung a zinc plate as cathode. This cell is placed above the red-lead plate, and a weak current is allowed to pass for 3—4 days. Upon the red-lead plate (which serves as anode) peroxide is formed. The metals present are deposited upon the zinc; they are scraped off and tested in the usual way. Red lead and minium can further be tested by ascertaining their specific gravity. For this purpose, an ordinary litre flask is used. After filling it with the powder, it is gently tapped and filled up again. This should be repeated about 100 times, after which little change in volume occurs. Of samples which are equally finely ground, that which has the lowest specific gravity should be chosen. The fineness of the powder is tested by sifting it through silk gauze having about 5,000 meshes to the sq. cm.

*Sulphuric Acid.*—This should be free from arsenic compounds, chlorine, nitric and nitrous acids. 5 c.c. of the concentrated acid is diluted with 100 c.c. of water and a few drops of silver nitrate solution added. If this immediately produces turbidity, the sample must be rejected; after standing for 5—10 minutes all commercial acids give an opalescence (due to traces of chlorine). Arsenic is detected by adding 50 c.c. of pure sulphuretted hydrogen water to 5 c.c. of the acid diluted as above. After standing for 12 hours there should be no yellow precipitate. Nitrogen compounds are detected by pouring 10 c.c. of the acid into an equal volume of water, and adding a drop of weak indigo solution to the warm mixture. If the blue colour remain for a few minutes, the acid can be used; immediate decolorisation indicates the presence of too much nitric acid.

The pasting of plates with litharge and red lead is protected by Volkmar's patent. The patent subsequently taken out by Faure for pasting with spongy lead or lead-powder is no longer valid, and lead-powder can now be commercially obtained of such fineness that it acts very nearly, if not quite, as well as the spongy lead produced by reduction of the oxides. The lead-powder is made into a stiff paste with dilute sulphuric acid and rubbed with a spatula into the lead grating. In America, this process is not open to general use, for the Brush patent covers the use of lead as well as lead compounds in the form of paste. Hence a New York firm has devised a method of filling the grids with dry lead-meal, which is *subsequently* moistened so as to secure the necessary cohesion. But the Faure process of pasting with lead oxide is still the most largely used. Before the grids are filled they must be brushed with milk of lime and washed with water so as to free them from grease and dust. Most of the pasting is still done by hand, although machines are made and used for the purpose. Hand work is dearer, and the reason why it is still so largely used is that a machine can only deal with one particular size of grid. On account of the very poisonous nature of materials, the greatest cleanliness should be enforced. At meal times and whenever work stops, the men should be made to wash their arms, hands, and faces with warm water and soap, and also to change their clothes. The working clothes (of pure wool) should be cleaned and washed every week. The pasting room should be well ventilated; its floor should be covered with asphalt and washed out twice a day. No man who is not sound in health should be employed in pasting, nor should any workman be kept at it continuously for more than a fortnight at a time, after which he should have a fortnight's work out-of-doors. The first signs of poisoning appear in the digestive organs. The workman loses appetite, and next suffers from sickness and vomiting.—D. E. J.

### *Electro-Chemistry and the Cyanide Process.* Zeits. f. Elektrotechnik u. Elektrochem. 1895, 416.

In the working-up of auriferous material by the cyanide method the actual process of solution is not an electrochemical one; nevertheless, it appears that electro-chemistry must play an important part in the development of the method. For it is employed in producing the solvent—potassium cyanide. So-called 100 per cent. potassium cyanide is now prepared by Erlenmeyer's process—

$$K_4FeCy_6 + Na_2 = 4KCy.2NaCy + Fe.$$

The metallic sodium is made electrolytically. Sodium is largely manufactured nowadays by Castner's method of electrolytic decomposition of caustic soda. Two works are already preparing to manufacture sodium by Borcher's method of electrolysing sodium chloride.

In connection with the actual process of solution the question has been raised (with reference to the validity of the MacArthur-Forrest patent):—"Is gold, as such, directly soluble in aqueous solutions of potassium cyanide?" The answer to this was given long ago by Bragation and Elsner (J. f. prakt. Chem. **31**, 367, and **37**, 333). The latter states that metallic gold only dissolves in cyanides in presence of oxygen, according to the equation—

$$4Au + 8KCy + O_2 + 2H_2O = 4AuCyKCy + 4KHO,$$

and subsequent researches have confirmed this. Accordingly oxidising materials, such as potassium ferricyanide, sodium peroxide, chloride of lime, &c., are used. The electrolytic development of chlorine, oxygen, &c., has already been suggested.

We now come to the third stage, the precipitation of gold from the solution. Here electro-chemistry has won another victory, for the firm of Siemens and Halske have already succeeded in devising a practical method of precipitating gold electrolytically. It only remains to prepare potassium cyanide electrolytically, and the whole of this industry will be in the hands of the electro-chemist. (This Journal, 1895, 38—39.)—D. E. J.

### *Formation of Persulphuric Acid.* K. Elbs and O. Schönherr. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 417—421 and 468—472.

The apparatus used consisted in its simplest form of a beaker in which stood a porous cell of about 100 c.c. capacity. A piece of sheet lead, $2\frac{1}{2}$ mm. thick and 150 sq. cm. in area, surrounding the porous cell, served as cathode. The anode was of platinum wire or foil. By surrounding the beaker with ice the temperature at the anode inside the porous cell, was kept at 8°—15° C. In order to lower the temperature further, the cathode was in some of the experiments placed in the porous cell, in the form of a thin lead tube, through which ice-water flowed. The anode in these cases was a ring-shaped platinum wire surrounding the porous cell. The temperature was thus kept at 5°—6° at the anode. According to theory, one ampère-hour should yield 3·63 grms. of persulphuric acid ($H_2S_2O_8$). Preliminary experiments showed that very little persulphuric acid was produced by the electrolysis of very dilute sulphuric acid (under 1·2 sp. gr.). The formation of persulphuric acid reached a maximum with acids of sp. gr. 1·35 to 1·5, and diminished after this. This interval was closely investigated.

A current of 2 ampères was used. The anode of platinum wire had a surface of 2 sq. cm. Thus the current density was 100 ampères per sq. decimetre. The E.M.F. was 5 volts. It was found that the largest amount of persulphuric acid was produced in the first hour, when the specific gravity of the acid used was 1·450. When sulphuric acid is largely diluted with water, it breaks up into the ions (H)(H)($SO_4$); when moderately diluted it breaks up partly into the ions (H)($HSO_4$); and the more concentrated it becomes the greater is the preponderance of the ions ($HSO_4$). Now what appears to take place in the electrolysis is this:—the ($HSO_4$) ions, under suitable conditions, give up their electric charges and unite to form $H_2S_2O_8$ (persulphuric acid). This process is quite analogous to the formation of $Cl_2$ molecules from Cl ions in the electrolysis of hydrochloric acid. In the latter case, however, free chlorine is always produced, for the Cl atoms have little action upon water. But in the former case, certain conditions must be fulfilled for the formation of persulphuric acid: for the residue $SO_4$ as well as $HSO_4$ reacts upon water, forming $H_2SO_4$ and evolving oxygen. To prevent this reaction we must endeavour (*e.g.*, by raising the current-density) to compel the $HSO_4$ ions to meet and give up their charges without meeting water-molecules.

It might now be assumed that the more concentrated the sulphuric acid the richer would be the yield of persulphuric acid. This is not so; at a specific gravity of 1·5 the yield already begins to fall off. This is partly due to the higher resistance of the concentrated sulphuric acid; partly to its viscosity (which hinders the persulphuric acid from diffusing freely through the liquid, and keeps it at the anode); partly also to the local warming at the anode, which causes decomposition of the persulphuric acid already formed.

As the amount of persulphuric acid present increases, the rate of production falls off; the yield in two hours is certainly much greater than that in one hour, but not quite double. F. W. Küster first suggested that the electrolytic formation of persulphuric acid was not due to oxidation, but simply to an union of ($HSO_4$) ions. This view is supported by another fact. Oettel has shown that for successful oxidising by electrolysis, it is necessary to use a large anode, and to keep the current-density low. Now the production of persulphuric acid is richer as the current-density is larger, and ceases altogether at very low current-densities. Nevertheless there is a certain limit beyond which it is not advisable to proceed—indeed, which it is scarcely possible to exceed. A point is reached at which the ions meet so rapidly that there is not time for the persulphuric acid to diffuse through the liquid. The electrode becomes surrounded by concentrated persulphuric acid; which, like chemically pure sulphuric acid, is almost an insulator.

The yield decreases very rapidly as the temperature rises. At 60° C. persulphuric acid decomposes almost as fast as it is formed. The most concentrated acid which the authors obtained by electrolysis contained 433·8 grms. of persulphuric acid per litre. The acid can be obtained in considerable quantity without using a porous cell or membrane. For this purpose the anode must be surrounded by a wide tube, so that the oxygen developed can escape without stirring up the whole of the liquid; the cathode just dips under the surface of the liquid, so that the hydrogen can escape freely. —D. E. J.

### *Chemical Reactions which take place in Lead Accumulators.* K. Elbs and O. Schönherr. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 473—474.

M. G. Darrieus has published a theory of the chemical reactions which occur in lead secondary batteries, according to which an important part is played by the formation and action of free persulphuric acid. During charging persulphuric acid is formed at the positive electrode and converts the lead oxide and sulphate into peroxide; any excess of persulphuric acid is decomposed into sulphuric acid and oxygen, and this indicates that the charging is finished. According to this theory the really active agent is the persulphuric acid. The authors point out that the theory is not in accordance with their researches on persulphuric acid (see previous abstract), for, with the small current-densities usually employed in accumulator work, only very small quantities of persulphuric acid would be formed, even when the acid has the unusually high sp. gr. (1·3) employed by Darrieus.

With a current-density of 2,800 ampères per sq. metre such acid was found to give 24 per cent. of the theoretical yield of persulphuric acid; when the current-density was reduced to 1,300 the amount of persulphuric acid formed could not be estimated quantitatively, and could only just be detected qualitatively. When acid of 1·15 sp. gr. (such as usually employed in accumulators) was electrolysed in an ordinary voltameter, no persulphuric acid at all was found at a current-density of 4,000; traces only began to appear when the current-density was raised to 10,000. Now the current-densities normally used in working accumulators are much lower than these; *e.g.*, the normal current for charging an 80-ampère-hour accumulator with positives of 20 sq. decimetre area would be an ampère; which would correspond to a current-density of 5 ampères per sq. metre.

It might be objected that the author's researches with platinum anodes are not conclusive; the persulphuric acid might be decomposed into sulphuric acid and oxygen by a catalytic action of the platinum. But if such catalytic action occurred, it would not be possible to prepare with platinum anodes liquids containing more than 400 grms. of persulphuric acid per litre. Furthermore, free persulphuric acid does not convert lead or lead sulphate into peroxide, whatever its concentration may be. When a clean lead plate is dipped into sulphuric acid containing persulphuric acid, it becomes coated with sulphate more rapidly than it does in the absence of the persulphuric acid; but however long it is left, no peroxide is formed. What is still more striking is that when a lead plate, coated electrolytically with peroxide, is placed in sulphuric acid containing persulphuric acid, it gradually loses the peroxide coating, which is converted into lead sulphate with evolution of oxygen. This does not agree with Schoop's experiments on potassium persulphate; the persulphates of the alkalis *do* convert lead and lead sulphate into peroxide. But in accumulators we have only to consider the question of a solution of free persulphuric acid in free sulphuric acid. It is quite true that such quantities of persulphuric acid can occasionally be detected in charged accumulators; but the authors are of opinion that this acid is present only as an accidental and secondary product, and that it is impossible that it should play the part assigned to it by Darrieus.—D. E. J.

## PATENTS.

### *Improvements in Apparatus for Electrolytical Purposes.* H. Guthrie, Manchester. Eng. Pat. 7950, April 21, 1894.

The improvements consist in a diaphragm composed of a soluble, an insoluble, and a depolarising substance, or of any two of these; in means for agitating the diaphragm so as to keep its interstices open; and in rubbing devices for cleaning the electrodes and preventing the accumulation of gases. The diaphragm proper is composed of some soluble or insoluble substance, such as salt or sand, as may be most suitable to the operation in hand, and is held in place by screens of insoluble material. These screens are formed with a series of inclines on the inner surface, so that the granular substance may not reach the top or fall over; while on the sides next the electrodes they present a surface that causes the gases to rise without passing through the diaphragm. By means of a false bottom placed beneath each diaphragm, or in any other suitable manner, provision is made for the removal of portions of the granular diaphragm, so as to allow of its constant renewal. —G. H. R.

### *An Improved Process, and Means used therein, for the Production of Metallic Sodium and Potassium from Salts of the Same.* C. T. J. Vautin, London. Eng. Pat. 10,197, May 25, 1894.

The process consists in the electrolysis of the fused chloride of the desired metal in an iron pot provided with a lid, and heated either externally or internally, as may be most convenient. The upper part of the vessel is lined with a neutral coating, such as magnesia, and the lower portion contains molten lead or tin, which forms the cathode, and is in contact with the sides of the pot. An open exit pipe, the inner end of which is turned over as a siphon, serves to withdraw the alloy formed on the passage of the current, and is cooled by a water-circulating pipe which surrounds it. The alloy is cast in a mould, and then the sodium is distilled off in a retort lined with magnesia or carbon, leaving the lead free for further employment as a cathode. —G. H. R.

### *Improvements in the Process of and Apparatus for the Electrolytic Decomposition of Solutions, and for the Immediate Separation therefrom of the Liquid or Dissolved Electrolytic Products.* L. P. Hulin, Modane, France. Eng. Pat. 11,587, June 14, 1894.

According to this invention, the use of diaphragms is dispensed with, and porous electrodes are employed, only one surface of which is active. The electrolytic vessel, which is styled "electroly-filter," contains two electrodes, which divide it into three portions, the central one containing the electrolyte, which is kept under pressure. On the passage of the current, it is stated that the liquid ions can pass through the electrodes, and collect in the outside compartments. By this arrangement it is claimed that recombination is prevented, and that the manufacture of caustic soda and hydrochloric acid by the electrolysis of sodium chloride can be carried on with a difference of potential of about 1 volt.—G. H. R.

*Improvements in Apparatus for the Rapid and Economical Production of Ozone by Electricity.* J. H. Lamprey, London. Eng. Pat. 11,810, June 19, 1894.

The improvement consists in the employment of conductors formed of wires, on which are strung metal beads or discs alternating with beads of glass or other di-electric material. In one form of apparatus, the wire connected with one terminal of the source of alternate current supply is enclosed in a glass tube, while the wire on which are strung the alternate metal and glass beads is wound spirally round it, and is connected with the other terminal.
—G. H. R.

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*Improvements connected with Electrical Furnaces.* P. M. Justice, London. From E. G. Acheson, Pennsylvania, U.S.A. Eng. Pat. 12,221, June 23, 1894.

This invention relates more especially to the manufacture of carborundum, which has been described in Eng. Pat. 17,911, 1892 (this Journal, 1893, 847). The furnace is constructed of firebrick or other refractory material, and is long relatively to its width. The electrodes are situated at the ends, and the bricks forming the side walls are placed loosely, so as to permit the escape of gases generated during working. In this furnace, the material to be operated on is not intermingled with the core, but surrounds it, so that it obtains the heat energy in lines diverging from the path of the current. The core is composed of some substance such as granular carbon, whose resistance is low relatively to that of the refractory material to be acted on, so that the current may be confined to the core as far as possible. The size of the grains should vary in accordance with the size of the furnace and the strength of the current being used. For instance, in an 8-ft. furnace, where the maximum value of the energy of the current is approximately 100,000 watts, and the diameter of the core 10 ins., the individual grains forming the core are preferably three-sixteenths of an inch in diameter. The material to be treated is placed around the core, and in the case of carborundum is preferably composed of a mixture of 20 parts by weight of coal, coke, or other form of carbon reduced to small particles, 29 parts of sand, 5 parts of common salt, and a sufficient quantity of fibrous material, such as sawdust or cork, to the extent of about 2 parts by weight. The electrodes are preferably formed of a number of rectangular bars confined in a suitable clamp, and in order to ensure the even distribution of the current, strips of copper are inserted between the ends of the carbons, and are brought together and secured to the terminal conductor.—G. H. R.

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*Improvements in the Manufacture of Soluble Metallic Phosphate Compounds.* Carl Raspe, Berlin. Eng. Pat. 13,199, July 7, 1894.

*See under XX., page 595.*

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*Improvements in or connected with Electric Accumulators.* S. Hammacher, Boppard, Germany. Eng. Pat. 20,596, October 27, 1894.

The improvement consists in the employment of the sulphonic acids of the phenol group in the formation of pastes for electrodes, with the addition of the oxides of lead, manganese, or antimony. The sulphonic acids of naphthalene, diphthalic acid, carbolic acid, or creosote, are preferably employed. The proportions for mixing may be somewhat as follows:—1 part by weight sulphonic acid, 9 parts by weight water, and 90 parts by weight of the oxide employed. The paste obtained is made into plates and dried. They are then placed in a bath of dilute sulphuric acid, which converts the resulting lead phenol compounds into insoluble sulphonic salts.—G. H. R.

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*Improvements in Electrical Galvanic Batteries.* G. Laura, Turin, Italy. Eng. Pat. 4245, February 27, 1895.

The cell is of the zinc-copper type, the copper being in a saturated solution of sulphate, and the zinc in a saturated solution of sodium chloride. The elements are superposed, and separated by a diaphragm composed of a mixture of powdered marsh mallow ("althæa") and sodium chloride, contained between discs of cloth.—G. H. R.

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*A New Apparatus, whereby a Battery of Great Internal Resistance is rendered capable of Generating an Induction Current in Coils of Low Internal Resistance.* G. Laura, Turin, Italy. Eng. Pat. 4255, February 27, 1895.

The apparatus is virtually a secondary battery formed of two plates of thin lead wound spirally, but so as not to touch each other. These plates, previously fitted with their conductors, are placed in a glass vessel, some paraffin wax is run in to hold them in position, and the vessel is nearly filled with strong sulphuric acid.—G. H. R.

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*A New Process of Electrolysis, and Apparatus therefor.* E. Andreoli, London. Eng. Pat. 4939, March 8, 1895.

The apparatus consists of a tank divided into three compartments by means of two porous partitions; the outer compartments contain the anode and cathode respectively, which are connected to a source of electricity in the usual manner. The central compartment contains metallic plates, sheets of metal, or metallic gauze, which are not connected with the anode and cathode, nor with any electric generator; and the sheets next the anode compartment are preferably coated with paraffin wax, or the like, on the side next the sheets adjacent to the cathode compartment, so that they may be insulated from them. Any suitable electrolyte is placed next the anode and cathode, and the solution to be treated by indirect electrolysis is passed through the central division.—G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Percentage of Fat in Palm Kernels.* H. Noerdlinger. Zeits. angew. Chem. 1895 [1], 19—20.

Palm-kernel oil, which must not be confused with palm oil, is obtained from various West African settlements, the kernels being freed from their shells, imported, and crushed in European countries. The percentage of oil in the kernels varies a good deal with the place of production, as may be gathered from the following table:—

| —— | —— | Average Content. |
|---|---|---|
| | | Per Cent. |
| I. Sierra Leone ...... | British possession ..... | 48·6 |
| II. Island of Sherbro.. | „ „ ..... | 46·7 |
| III. Liberia............ | Negro republic ........ | 49·4 |
| IV. Grand Bassa....... | „ „ ........ | 50·2 |
| V. Half Jack.......... | French possession ..... | 50·8 |
| VI. Apollonia .......... | British possession ..... | 47·2 |
| VII. Dixcove........... | „ „ ..... | 48·4 |
| VIII. Cape Coast Castle.. | „ „ ..... | 50·2 |
| IX. Winnebah ......... | „ „ ..... | 46·1 |
| X. Quitta............. | „ „ ..... | 48·4 |

| — | | Average Content. |
|---|---|---|
| | | Per Cent. |
| XI. Togo District ...... | German possession..... | 52·1 |
| XII. Togo District ...... | French possession ..... | 49·3 |
| XIII. Lagos.............. | British possession...... | 50·4 |
| XIV. Benin.............. | " " ...... | 49·8 |
| XV. Niger.............. | " " ...... | 50·5 |
| XVI. Brass.............. | " " ...... | 52·5 |
| XVII. Calabar............ | " " ...... | 50·9 |
| XVIII. Bonny............ | " " ...... | 51·0 |
| XIX. Opobo............. | " " ...... | 52·3 |
| XX. Cameroons......... | German possession..... | 49·0 |
| XXI. Congo............. | Free state ............. | 47·4 |
| XXII. Loanda............ | Portuguese possession.. | 50·9 |

—B. B.

*Action of Atmospheric Oxygen on Mineral Oils.* J. Hirsch. Chem. Zeit. **19**, 41.

The author has not succeeded in detecting any oxidation of petroleum by atmospheric oxygen in presence of soda-lye. Air was purified by passing over soda-lime, and was then led through three Woulffe's bottles containing petroleum and decinormal soda-lye in the proportion of 5:1. After passing a strong current of air at about 15° C. for 12 hours through the petroleum, the soda-lye on titration with phenolphthaleïn gave almost exactly the same numbers as before the experiment. The author concludes that a petroleum well purified by means of sulphuric acid and free from unsaturated hydrocarbons as obtainable on a large scale, is unacted on by air even at a temperature of 70° C. and in presence of soda-lye.—T. A. L.

*The Degree of Purity of Commercial Fatty Lubricating Oils.* Holde. Mitt. königl. tech. Versuchsanst. 1895, 1—20.

The author gives a series of voluminous tables of constants differing in no essential respect from those commonly accepted. The customary adulterations are noted. A few claim individual mention. Thus, a sample sold as "olive oil" gave the following results:—In colour it was dirty green: it flowed freely, and had a sp. gr. of 0·9245 at 20° C., and a viscosity (Engler) at 20° C. (water at 20° C. = 1) of 18·9. It flowed sluggishly at 0° C., and acquired a buttery consistency at −5° C. Its iodine number was 74·4, saponification number 182, and it contained 1·29 per cent. of free fatty acid calculated as oleic acid. It gave negative results with the Baudouin and Bechi tests, and showed no tendency to dry. It contained 3·5 per cent. of hydroxy acids insoluble in petroleum ether. The author opines from these data that the oil was an artificially thickened product derived from olive oil, possibly mixed with rape oil. Again, a sample, presumed to be neatsfoot oil, was yellow, clear, and mobile, and possessed the smell characteristic of the class of oils to which it was claimed to belong. It had, however, a viscosity (Engler) of 7·7 at 20° C., and a sp. gr. of 0·8914 at 20° C. (water at 4° C. = 1). It contained 0·12 per cent. of free fatty acid calculated as oleic acid, and had an iodine number of 75 and a saponification number of 158. On saponifying and extracting the soap solution with ether, 11·4 per cent. of higher alcohols were extracted, proving the presence of a liquid wax of the sperm oil type.

A sample of "whale oil" had the usual fishy smell, but possessed a sp. gr. at 20° C. of 0·9484, and a refractive index of 1·511. The iodine absorption was 78 and the saponification number 94. The unsaponifiable matter amounted to 48 per cent., and was identified as rosin oil.

—B. B.

*Manufacture of Olive Oil in Sicily.* Die Oel- und Fett-Ind. 1894, 136; Proc. Inst. Civil Eng. 1895, 107.

More than one-fifth of the olive oil produced in Italy is made in Sicily, its manufacture being the chief industry in that island. The factories are usually small, employing from 10 to 12 men, and are of one storey only. Upon a platform constructed of heavy masonry, and about 1 yard high, an edge-runner of stone, about 16 cwt. in weight and 1 ft. thick, revolves slowly, the motive power being that of a horse or mule. The olives, which should be perfectly ripe, are thrown by hand under the revolving stone, and when crushed are removed by means of a shovel. The output is about 1 cwt. of crushed olives in half an hour.

The pasty mass of crushed olives is next placed in soft, flat rush bags having a very small opening. About 15 such bags are placed one above the other, the openings being upwards. Pressure is then applied by means of a strong wooden screw worked by six or eight men. The pressure is at first applied very gently, then gradually increased. The oil runs through a trough into a tub more than half full of water. The coarser impurities are deposited at the bottom of the water, on the surface of which the oil floats. When the bags have been under pressure for about five minutes they are taken out and their contents again emptied under the edge-runner. This operation is repeated three times. The press residues are then heaped up in a dark room to a depth of about 1 ft. 4 ins., and allowed to remain for three days, when they heat spontaneously. They are then brought to the press for a fourth and last time. The final residue, which amounts to about 70 per cent. of the weight of the olives, was formerly used for fuel; but much of it is now sent to larger oil-mills, where it is treated a fifth time. The crude oil is removed to a room where the temperature is as near 66° F. as possible. In about a week it loses its turbid appearance, and is then placed in other vessels, in which it is kept until required for sale or use.

*Purification of Crude Glycerin.* B. Lach. Chem. Zeit. 1895, **19**, 215.

It frequently happens that the crude glycerin from inferior grades of palm oil and fish oils is so poor in quality as to be unsaleable, and in the absence of a special plant for glycerin distillation, becomes a source of annoyance to the manufacturer.

In a case of this kind, where the crude glycerin of 28° B. strength was very dark coloured, bitter instead of sweet, and contained only 85 per cent. of glycerin, the unsaleable product accumulated to the extent of some 40,000 kilos. A remedy was attempted by distilling it in the fatty-acid stills, and proved immediately successful, yielding 80 per cent. of pale yellow, sweet glycerin, of readily-marketable quality. The operation was effected in a retort holding 3,000 kilos., and by continuous distillation (retort temperature 230° C., steam 300° C.), a further 6,000 kilos. being subsequently added. The first fraction of distillate had a density of 29°—30° B. at 16°, and the second fraction 15°—20° B., subsequently concentrated to 28° B. After 3,000 kilos. had distilled over, the density of the first fraction rose to the unusual height of 33°—34° B., and the consistency became that of honey, apparently due to polymerisation. The second fraction greatly decreased in quantity, and it was noticed that distillation was going on under pressure, which was traced to obstruction of the condenser tubes by the deposition of a thick porous crust. This was obviated in later operations by occasionally blowing steam through the condensing-tube. The retort had to be opened after distilling 6,000 kilos., and the porous vitreous crust broken out; this was sold to an inkmaker at a good price.

The accidental inclusion of a carboy of the 34° B. grade among a parcel of 28° B., led to an inquiry from the purchaser, a dynamite manufacturer, for a further supply of this quality.—C. S.

*Analysis and Valuation of Fish Oil.* V. Vedrödi. Chem. Zeit. 1895, **19**, 600.

*See under* XXIII., *page* 605.

*Separation of the Free Acid of Beeswax.* T. Marie. Rev. internat. des falsificat. 1895, 8, 23.

*See under* XXIII., *page* 599.

### PATENTS.

*Apparatus for Deodorising Fats and Oils.* J. H. Filbert, Baltimore, Md., U.S.A. Eng. Pat. 5197, March 12, 1895.

This apparatus consists of a jacketed cylinder, placed horizontally, provided with a shaft on which are fixed three paddle-wheels, the middle one being of larger diameter than the other two. On the top of the cylinder is a standpipe, surrounded by a steam coil, and having an internal shaft on which on which are revolving blades set alternately at different angles. The oil is run into the inner compartment of the cylinder, and heated by means of hot water in the jacket. The oil is then thoroughly agitated by the paddle-wheels, which throw it up in the form of spray, and a current of air is blown in through an inclined pipe amongst the spray. The action of the air is said to deodorise the oil, and carry the impure vapours along with it up the standpipe, the revolving arms in which prevent the escape of any spray of oil, which runs back into the cylinder.
—J. J. K.

*Improvements in Apparatus for Filtering Oils and the like.* J. J. Tong and J. R. Wood, Manchester. Eng. Pat. 6059, March 23, 1895.

These consist in the employment of a removable oil vessel (provided with an outside steam jacket, to keep the oil hot during filtration) placed on the top of a receiving-vessel with a conical bottom containing water, on which the filtered oil collects. In these vessels are placed sieves covered with straining cloth. The sieves in the upper one are provided with a bell cover, to convey the oil, after passing through each sieve, into a channel (in which any solid impurities settle out) before the oil passes into the next sieve. The sieves are decreased in size from the top one, to enable them to be more easily removed for cleaning.
—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

### PATENT.

*Improvements in Making White Lead.* J. S. MacArthur, Glasgow. Eng. Pat. 9655, May 17, 1894.

Lead oxide is dissolved in a boiling solution of a tartrate of soda or potash, or a mixture of these, or Rochelle salt, and this solution, after filtration, is treated with carbonic acid whilst boiling. The white-lead formed is separated, washed, &c., according to any known method.—J. C. C.

### (*B.*)—RESINS, VARNISHES.

*Tests of a Sample of Linoleum.* H. Burchartz. Mitt. königl. tech. Versuchsanst. 1895, 20—23.

Tests were made to ascertain the quality of the linoleum in respect of its resistance to wear and of its imperviousness to water, as well as to determine the tensile strength of the material and the fastness of the pigments with which it was coloured. The average tensile strength found was 64·7 kilos. per sq. cm.; the absorption of water when the material was immersed was 3—6 per cent., but this was found to be due to the wetting of uncovered fibres of textile material projecting at the cut surfaces of the test piece, for when a direct test for permeability was made by observing the constancy of level of water in a vertical tube cemented on to the linoleum, the material gave no indication of permitting percolation. Tests for resistance to attrition were made by the method commonly used at the Versuchsanstalt, the process consisting in abrading the test piece with a disc fed with emery (20 grms. of Naxos emery No. 3 for every 20 revolutions of the grinding disc) and loaded with 30 kilos. for a surface of 50 sq. cm. After 440 revolutions had been completed, the linoleum had lost in weight 1·9 grms. corresponding with 1·8 c.c., the specific gravity of the material being 1·083. When tested under these conditions the loss of weight undergone by granite was found to be 4·4 c.c., by marble 24·3 c.c., and by oak 7·8 c.c., these figures indicating the great capability of resisting wear which is possessed by linoleum.

Bending tests showed that a test piece of linoleum 15 × 2 × 0·36 cm. could be bent at the ordinary temperature of the air, over a mandrel 2 cm. in diameter, whilst a sharper bend caused the surface to crack.

Tests for resistance to alteration of colour were made by applying water, 2 per cent. hydrochloric acid, 2 per cent. sulphuric acid, 2 per cent. nitric acid, 2 per cent. phosphoric acid, petroleum and soap solution, to the surface of the test pieces. Water and dilute acids were without influence on the pigments. Petroleum produced a darkening, and soap solution had a similar effect, the original colour being, however, in this case, restored by washing.—B. B.

*Examination of Linseed Oil and Linseed Oil Varnish.* H. Amsel. Zeits. angew. Chem. 1895, 73.

*See under* XXIII., *page* 605.

*Examination of Linseed Oil and Linseed Oil Varnish.* F. Filsinger. Zeits. angew. Chem. 1895, 159.

*See under* XXIII., *page* 605.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

*Recent Investigations into the Composition of Hides and of Leather; the Theory of the Formation of Leather.* v. Schroeder. Reprint from the Fifth Jahresbericht der Deutschen Gerberschule, 1895.

In this pamphlet the author reviews the work on the subjects included in the title, which has been carried out during the last few years in the Freiburg Tanning School (compare this Journal, 1893, 279, 610; 1894, 1072, 1073, 1101), and publishes some new figures, together with the conclusions to be drawn from them.

The following table gives, in round numbers, the percentage of prepared pelt which can be obtained, in the experience of the Freiburg School, from the hides named. It must be mentioned that it is the practice of the school to submit the hide, at the stage when it is ready to go into the suspenders, to a final washing in water, to hang it over a horse, and to weigh it as soon as it has finished dripping.

| — | Mean. | Minimum. | Maximum. |
|---|---|---|---|
| Green ox hides, with horns and tail. | 78 | 65 | 88 |
| Salted hides of wild cattle (in packs). | 98 | 85 | 115 |
| Dry-salted wild hides | 150 | 135 | 165 |
| Dried wild hides (oxen) | 200 | 180 | 220 |
| Serons (buffalo hides) | 200 | 180 | 220 |
| Dried, unplastered kips | 200 | 180 | 220 |
| Plastered kips | 160 | 110 | 180 |
| Arsenic kips | 220 | 195 | 235 |
| Dried calf skins, with heads | 195 | 180 | 210 |
| Green horse hides | 70 | 60 | 80 |
| Dried horse hides | 195 | 180 | 210 |

The many analyses which have been made of the Rhenish sole-leather, tanned with pure oak-bark in layers, according to the old-fashioned system, and of the North-German sole-leather, tanned by the more rapid method, using stronger liquors and extracts, yield the following mean results:—

| —— | Rhenish Sole-Leather. | | North German Sole-Leather. | |
|---|---|---|---|---|
| Water | 18·00 | | 18·00 | |
| Ash and fat | 0·80 | | 1·20 | |
| Water-soluble tannin | 3·35 | 5·35 | 5·05 | 8·90 |
| „ organic non-tannin | 2·00 | | 3·85 | |
| True leather substance* | 75·85 | | 71·81 | |
| | 100·00 | | 100·00 | |
| *Containing— Hide substance | 45·28 | | 40·04 | |
| Combined tannin | 30·57 | | 31·77 | |
| Total tannin: 100 of leather | 33·92 | | 36·82 | |

Neither kind of leather contains more than 0·4 per cent. of sugar unless sophisticated. The North German leather contains more lime (about 0·3 per cent.) and more sulphuric acid (0·4—0·5 per cent.) than the Rhenish leather, which contains but 0·1—0·2 per cent. of sulphuric acid. The essential difference between the two kinds, rests however, in their content of tannin; the North German system gives a higher yield of leather, apparently more perfectly tanned, than the old Rhenish system yields, notwithstanding that the sole-leather of the latter is the better of the two.

From the above figures, and those given at the beginning of this abstract, it will be apparent that by the Rhenish system 100 parts of green hide, yielding 78 parts of pelt, the water-content of which is 72 per cent., will give 48 parts of leather, whilst by the North German system 56 parts of leather will be obtained. These figures are mean values; the extremes for both methods must be given as 45—61 per cent. calculated on the green hide, and 58—78 per cent. calculated on the prepared pelt.

It is commonly reckoned that 500—550 parts of oak-bark are required for the production of 100 parts of leather by the Rhenish system; if the amount of tannin in the bark be taken as 10 per cent., this proportion of bark will mean 50—55 kilos. of tannin per 100 kilos. of leather; since the total tannin in the leather is not more than 34 kilos. per 100 kilos., only some 62—68 per cent. of the tannin is used; what becomes of the remainder is not known, but it may be safely asserted that this great waste is a result of the lengthy period over which the process is extended.

The quantity of tanning material requisite for producing leather should be calculated for 100 parts of prepared pelt. When this basis is adopted it is found that the proportion varies from 350 per cent. to 180 per cent. according to whether sole-leather or upper-leather is the product. From the fact that the lighter skins require a smaller proportion of tannin, it was formerly concluded that the light leather contained less tannin than the heavy leather, and this conclusion was made the substructure for a theory of tanning by which it was held that the difference in character between light and heavy leather was due to the difference in the degree of tannage which they were allowed to attain before they were considered finished. This deduction, and therefore the theory based on it, is completely false, and it is so because no allowance was made for the difference in the proportion of water contained in heavy and light pelts.

It has been established by the analyses and investigations now under review, that the proportion of tannin to hide substance in all bark-tanned leather is very approximately the same, and it may be said that undressed leather of all sorts has, when bark-tanned, the following mean composition:—

| | Per Cent. | |
|---|---|---|
| Water | 18·00 | |
| Ash and natural fat | 1·00 | |
| Water-soluble tannin | 4·00 | 6·00 |
| „ organic non-tannin | 2·00 | |
| Pure leather substance: | | |
| Combined tannin | 31·00 | 75·00 |
| Hide substance | 44·0 | |
| | 100·00 | |

Thus, one part of true hide substance will yield 2·27 parts of air-dried, medium, bark-tanned leather, 1·96 parts of poorly-tanned leather, and 2·67 parts of fully-tanned leather. This statement is, of course, wholly untrue, if for one part of hide substance one part of prepared pelt be substituted—how untrue may be judged from the following table:—

| —— | 100 Parts of Pelt contain | | 100 Parts of Pelt yield of Leather | | |
|---|---|---|---|---|---|
| | Water. | Hide Substance. | Mean. | Poorly Tanned. | Fully Tanned. |
| Sole-leather | 71 | 29 | 64 | 55 | 75 |
| Harness leather | 75 | 25 | 57 | 49 | 67 |
| Dressing leather<br>Kips, horse-leather | 78 | 22 | 50 | 43 | 59 |
| Calf-leather | 81 | 19 | 41 | 35 | 48 |

—A. G. B.

*Palmetto Extract. A New Tanning Material.* Schnizer. Chem. Zeit. 1895, **19**, 167.

Palmetto is an evergreen, palm-like shrub, growing in the southern United States of America, especially in Georgia, Florida, Alabama, South Carolina, Louisiana, and Texas, where it covers over six million acres. The growth of the plant being continuous, it may be cut at any time of the year.

The extract, containing 11·5 to 12 per cent. of tannin, is very successfully employed in American tanneries, whilst the residue forms a valuable material for the manufacture of rope, string, and felt substitutes, &c. The entire leaves are finely cut, and with the stems, which are cut into narrow lengths, put into large wooden tubs, and extracted with hot water for 48 hours. The extract may be employed at once for tanning, or may be concentrated for sending elsewhere. For exportation the leaves alone are usually employed; they are then air-dried for some days, and pressed into bales.

In order to obtain the fibre, the residues are treated with chemical agents to remove the silica and glutinous matter of the leaf covering. The fibre is then worth from 30 to 80 dollars per ton.

The tannin process with palmetto extract is the same as in the case of hemlock, &c., and the result is as satisfactory as with oak-bark.

Owing to its high percentage of tannin, and the value of the extracted leaves, palmetto has a considerable commercial importance.—N. H. J. M.

### PATENT.

*Improvements in the Manufacture of Substances suitable for Finishing, Polishing, Preserving, or otherwise Treating Leather, Skins, Hides, and the like.* R. Combret, Paris. Eng. Pat. 9090, May 8, 1894.

The empyreumatic oil, or tar, of birch-bark is incorporated, to the extent of from 2 to 10 per cent., with the blacking or other material used. Thus, the suppleness, strength, and imputrescibility of a Russia leather is imitated and maintained. The oil is incorporated with the material either directly, or in the form of a solution, an emulsion, or an alcoholic extract. For light-coloured leathers a rectified oil may be employed.—W. G. M.

*Analysis and Valuation of Fish Oil.* V. Vedrödi. Chem. Zeit. 1895, **19**, 600.

*See under* XXIII., *page* 605.

## XV.—MANURES, Etc.

*Oxidation of Organic Matter and the Decomposition of Ammonium Salts by Aqua Regia in lieu of Ignition, in the Determination of Potash in Fertilisers.* R. de Roode. J. Amer. Chem. Soc. 1895, **17**, 86.

*See under* XXIII., *page* 598.

### PATENTS.

*Improvement of Manufacturing Guano from the Refuse of Fish and other Animal Matter, and the Extraction of Oil or Fat therefrom.* M. Zingler, London, and W. Chattaway, Twickenham. Eng. Pat. 9200, May 9, 1894.

The refuse matter is disintegrated by mechanical means, deodorised (if putrid) by charcoal, creosote, or the like, and mixed with sufficient sodium nitrate and acid potassium sulphate or other preservative, such as aluminium sulphate, either in the solid state or in solution. As much as possible of the oil or fat is now extracted by hot pressure, by boiling, or by a solvent. The residue, in the form of press cakes, or semi-solid, is dried carefully, tested for fat, which must if necessary be removed as completely as possible by a suitable solvent. It is then powdered and stored in a dry place. From 2 to 3, or 4, per cent. of each chemical is usually required, and others may be added in the proportions suitable to a standard manure; thus, for example, phosphates may be added to animal refuse deficient in that ingredient.—W. G. M.

*A New or Improved Composition or Compound for Use in Agriculture and Horticulture.* G. H. Richards, London. Eng. Pat. 11,296, June 11, 1894.

The following mixture is applied as a wash to the leaves of growing vegetation and the stems of fruit or other trees, for the destruction of insects or mildew:—10 lb. of nicotine or any salt thereof, 5 lb. of eucalyptus oil, 25 lb. of alcohol, 20 lb. of water, and 40 lb. of potassium oleate are mixed together, and heated, forming a liquid. When used, it should be diluted with water.—J. J. K.

## XVI.—SUGAR, STARCH, GUM, Etc.

*The Storing of Beetroots.* Claasen. Zeits. Rübenzuckerind. 1895, **45**, 204.

Considering the low price of sugar, expensive methods of preserving beetroots cannot be employed. Consequently a suitable earth pit of moderate size is recommended to the farmer as the best and most economical means of preservation. In districts having mild winters it is advantageous to employ stacks of convenient size, whereas in colder climates these must from time to time be covered. In such stacks the beet keeps for eight to ten weeks, and any damaged portion should at once be worked up. A degradation in the quality of the beet due to loss of sugar, and to an increase of organic non-sugar, is generally unavoidable. In all investigations and comparisons the precautionary measures already pointed out by the author should not be lost sight of, in particular the weight of the roots, as well as their sugar-content, before and after storing; and, further, such data should be ascertained from impartial sampling.
—J. L. B.

*Beetroot Blight.* Karlson. Zeit. Zuckerind. 1895, **45**, 434.

The author confirms his previous views, namely, that the root-blight is caused by various parasitic fungoids, which penetrate from without through the cleft apertures, without, however, injuring the vesicles themselves. Strong plants, such as have already reached a certain stage of development, and the seeds from healthy beetroots, most successfully resist the spore injections. For practical purposes it is advisable to grow crops of sound beetroots, and to prevent degeneration by careful culture, manuring, feeding, undisturbed ripening, and the avoidance of forced propagation by slips. By these means degeneration is avoided and strong beets of vigorous growth are obtained, producing good seed and withstanding the attacks of vegetable and insect parasites.—J. L. B.

*Determination of Composition of Diffusion Juice.* Casteels Sucr. indigène, 1895, **45**, 346.

The average composition of juice is frequently determined on old samples preserved by the addition of lead acetate or mercuric chloride. The author has carried out comparative experiments, and is convinced that in each case a considerable difference arises, due to at present unknown causes, which should exclude the application of such methods.
—J. L. B.

*Action of Ammonia on Dextrose.* W. E. Stone. Amer. Chem. J. 1895, **17**, 192.

When gaseous ammonia is passed into alcohol containing anhydrous dextrose in suspension, solution of the latter takes place, accompanied by a slight rise in temperature. At the end of 14 days a substance separated, having the composition and properties of an aldehyde ammonia compound of the formula $C_6H_{12}O_6.NH_3$. The white crystalline product melts at 122—123°, and in aqueous solution has a specific rotatory power $[\alpha]_D = 22 \cdot 0° - 22 \cdot 7°$. Birotation was not observed. The combination with ammonia appears to protect the dextrose molecule against certain general reactions, such as fermentation, reduction of Fehling's solution, and the action of phenylhydrazine, or to delay them until the ammonia is split off.—J. L. B.

*The Action of Oxalic Acid on Inulin.* G. Düll. Chem. Zeit. 1895, **19**, 216—217.

The results of the author's researches on this point may be summarised as follows:—

The conversion of inulin into levulose by dilute oxalic acid appears to be direct, without the co-formation of dextrinous intermediate products. Any such bodies resulting from the action of dilute sulphuric or hydrochloric acid should be considered as reversions from the levulose instead of inversion products of the inulin, although the possibility of the formation of intermediate bodies by enzymatic action (inulase) remains. The most probable molecular formula for inulin is given as $(C_6H_{10}O_5)_{18}.H_2O$, and the values of $[\alpha]_D = -40°$ for inulin, and $-93°$ for levulose respectively. It appears, further, that the latter body may readily be obtained in a crystalline condition. A furfurol derivative, $C_6H_6O_3$ (identical with that from sorbose), results from the prolonged action of oxalic acid under increased pressure, and a continuance of the reaction yields levulinic acid.

—C. S.

*Polarisation of Sugar.* Howeg. Deutsch. Zuckerind. 1895, **20**, 390.

*See under* XXIII., *page* 605.

*Estimation by Karcz's Method of Crystallised Sugar in Raw Products and Molasses.* Strohmer and Stift. Oesterr. Zeits. Zuckerind. 1895, **24**, 41.

*See under* XXIII., *page* 604.

*Estimation of Sugar.* G. Opperman. Apoth. Zeit. 1895, **10**, 216.

*See under* XXIII., *page* 605.

## PATENTS.

*Improvements in the Manufacture of Starch.* R. Wilson, Govan. Eng. Pat. 10,956, June 6, 1894.

In this manufacture, a stage is reached at which it is necessary to separate the water from the starch, preparatory to the final drying of the latter. A series of wooden frames is used for this purpose, across which diaphragms of cloth or other suitable materials, suitably strengthened, are stretched and distended. A number of these frames are so combined that there are spaces for receiving the liquid starch, alternating with spaces for water filtering through the diaphragms. Drying of the starch next follows in suitable stoves. The filter system is separated into its constituent pairs of frames, which are severally detached, and are placed in the drying stove.—L. de K.

*Improved Manufacture of Cattle Food.* W. Schwartz, Hanover, Germany. Eng. Pat. 21,224, November 5, 1894.

*See under* XVIII. A., *page* 592.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*The Influence of Varying Mashing Temperatures on the Formation of Isomaltose, and its Estimation by Means of Saaz and Frohberg Yeasts.* A. Munsche. Woch. für Brauerei, **11**, 1372—1377.

A series of starch conversions was made with malt-extract at temperatures ranging from 55°—75° C., each conversion being fermented both with Saaz and Frohberg yeasts. The difference in the amount of extract fermented by the two yeasts was then determined as well as the difference in the amount of copper reduced by the two fermented liquids. The difference in the first case was considered as isomaltose, and in the second was calculated into isomaltose, the reducing power of which was taken as 80 per cent. of that of maltose. The following table gives the results :—

| Mashing Temperature. | Percentage of Isomaltose. | |
|---|---|---|
| | From Extract. | From Copper Reduction. |
| I. 55°—60° C. .......... | 5·69 | 5·70 |
| II. 60°—65° C. .......... | 6·71 | 6·46 |
| III. 65°—69° C. .......... | 8·16 | 7·05 |
| IV. 69°—71° C. .......... | 12·29 | 10·21 |
| V. 71°—75° C. .......... | 9·31 | 9·05 |

The largest amount of isomaltose is produced at a temperature of 69°—71° C., but it will be observed that the two methods do not give concordant results.

The liquid which had been fermented with Saaz yeast yielded an osazone with a melting point of 125° C., probably consisting of isomaltosazone and some other osazone of lower melting point. From the liquid fermented with Frohberg yeast was isolated an osazone melting at 93° C., which, however was probably formed from some body introduced by the yeast.

From further experiments the author is of opinion that isomaltose is not unfermentable by Saaz yeast, and is not completely fermentable by Frohberg yeast, and that this peculiar behaviour of Lintner's so-called isomaltose towards various yeasts may perhaps be due to its non-homogeneity. Whatever explanation of this be accepted, he considers that the physiological analysis of worts by means of Saaz and Frohberg yeasts gives valuable practical results concerning the amount of unfermentable substances in beer worts.

—J. G. W.

*The Collective Species: Saccharomyces Cerevisiæ.* A. Bau. Woch. für Brauerei, **11**, 1366—1371.

Under the specific name *Saccharomyces cerevisiæ* have hitherto been included, from a botanical point of view, a series of yeast types and races. Although the difference between top and bottom fermentation has been recognised for a considerable time, the yeasts producing them were supposed to be capable of transformation one into the other, until Hansen and Jörgensen proved that, although a bottom yeast might acquire temporarily the characteristics of a top yeast, they were in reality two distinct varieties. Besides these two varieties, other yeasts, the Saaz yeasts, have been discovered and classed with *Saccharomyces cerevisiæ*, although they possess a much less attenuative power on beer worts than the ordinary, or Frohberg, yeasts. Top and bottom yeasts of both the Saaz and Frohberg types have been discovered, the collective species, *Saccharomyces cerevisiæ*, therefore comprising the following four types :—

| | |
|---|---|
| 1. Frohberg .................. | Top yeast. |
| 2. Saaz ...................... | ,, |
| 3. Frohberg .................. | Bottom yeast. |
| 4. Saaz ...................... | ,, |

The author has investigated the fermentative action of these on carbohydrates, and points out that it is necessary in this work carefully to distinguish between fermentative action and mere using up of the carbohydrate for the nutrition of the yeast. If this precaution be observed he considers that the physiological properties of a yeast may be used as a basis of classification. The following is a summary of his results with the four types given above :—

No. 1. Frohberg, top yeast. Completely ferments α- and β-isomaltose ; does not ferment melibiose ; splits melitriose into fructose and melibiose, fermenting the former, but having no action on the latter.

No. 2. Saaz, top yeast. Completely ferments α-isomaltose, but is incapable of fermenting β-isomaltose or melibiose. It has exactly the same action on melitriose as No. 1 type.

No. 3. Frohberg, bottom yeast. Ferments completely α-isomaltose, melibiose, and melitriose, but has no action on β-isomaltose. Melitriose is fermented, after prior hydrolysis, into fructose and melibiose.

No. 4. Saaz, bottom yeast. Completely ferments α- and β-isomaltose, melibiose, and melitriose, the action on the last carbohydrate taking the same course as with No. 3 type.—J. G. W.

### *The Origin of the Wine Yeast.* A. Jörgensen. Centr. f. Bakter. u. Parasitenkunde. 1895, **1**, No. 9.

J. J. Juhler showed in 1894 (Centralbl. f. Bakt. u. Parasitenk. 1895, **1**, No. 1) that when *Aspergillus oryzæ* is developing its diastatic properties in converting starch to sugar, its conidia develop into yeast cells, produce alcoholic fermentation, and have all the typical characteristics of the saccharomyces.

The author has therefore investigated the relationship between the moulds and the wine yeasts which are found on the skins of the grape. These various moulds were cultivated in various artificial media, and also on the sterilised skins of grapes. One of these moulds, consisting of typically developed branched hyphæ, when cultivated on alkaline gelatin, developed in the course of a day into the typical form *chalara*, whilst when on acid gelatin it yielded *dematia*. When the *chalara* were transferred to acid gelatin they changed to dematia, and *vice versâ*. Both crops yielded a strong crop of ellipsoid cells (*torulæ*), but no further phase could be produced. When cultivated on sterilised grape skins, however, some of the *dematia* first formed, gradually developed partition walls in the mycelia-threads and formed groups of numerous, slightly rounded, rectangular cells, so that the whole growth closely resembled *botrytis*, whilst others, which always appeared weaker or withered growths, formed only a single row of conidia, the lower of which were first quadrilateral and oïdium-like, but gradually changed to oval cells. When these conidia had reached a certain state of ripeness spores were formed, which developed into ordinary ellipsoidal cells undistinguishable from the wine yeasts. The mycelia threads showing these latter phases of development were always nearly emptied and apparently withering cells, whilst the chalara and dematia, producing torula-like cells, were always in active growth. The most suitable temperature for the yeast phase of development is 20° C., and as the temperature varies more and more above or below this point, the proportion of torula cells produced increases, and above 35° C. the mycelia gradually disappear and only torula formation occurs. The author has not failed to find on a single grape examined the form of mould capable of the above transformation. His further investigations lead him to the conclusion that all the *aspergillus* and *sterigmatocystis* species occurring on the grape have diastatic properties, and are capable, under suitable conditions, of attacking starch, and that during this action their conidia develop into yeast cells. These changes are being further investigated.—L. T. T.

### *Tartaric Acid as a Means for Preventing the Development of Sarcina.* P. Lindner. Wochenschr. f. Brauerei, **12**, 316.

Although the sarcina organism may become established in breweries, even where pure yeast is employed and scrupulous cleanliness observed, and not unfrequently when the outcrop appears healthy and free from wild yeasts, the rejection of such infected yeast is, however, not absolutely necessary, for tartaric acid is found to be an excellent remedy against such contamination, von Huth having used it for that purpose for about seven years, notwithstanding that it has been declared to weaken the normal yeast and to favour the development of secondary types. Von Huth's proposed manner of treatment is thus quoted (American Brewer, 1888, No. 8) :—"For every kilo. of thin fluid yeast 6 grms. of tartaric acid are required. After thorough intermixture the solution is allowed to stand for 6 to 12 hours, and then added to the wort in the fermenting tun"—G. W. A. T.

### *Sulphurous Acid in Wine.* M. Ripper. Forschungsber. über Lebensmittel. 1895, **2**, 12.

As a result of testing several hundred samples of wine, the author finds that free sulphurous acid is present in minute quantities, whereas the proportion of aldehyde-sulphurous acid varies very considerably (from 0·0003—0·0260 grms. $SO_2$ per 100 c.c.). The better classes of wine show a higher percentage of both total sulphurous acid and of aldehyde-sulphurous acid. This, it is suggested, is due to the oxidation of the alcohol contained in the wine to aldehyde, which then combines with the sulphurous acid formed from the sulphur of the barrels. Sulphur added to wine is to be regarded not only as an antiseptic, but also as an aid in the development of the wine. Unripe wines are much improved when their free aldehyde is combined with sulphurous acid. The greater portion of the sulphurous acid present in wine should be in combination with aldehyde, and the free sulphurous acid should not exceed 0·002 grm. of $SO_2$ per 100 c.c.—C. A. K.

### *Improvements at the Lutterbach Brewery to overcome Infection by Wild Yeasts, &c. in Hot Weather.* T. Boch and Co. Bull. Soc. Ind. de Mulhouse, January 1895, 23.

In Upper Alsace (Haute Alsace) the summer temperature is high, and the air is laden with wild yeasts, bacteria, &c. In consequence of this, the brewing of good summer beers under the old conditions became impossible, and the consumption of beer had become largely replaced by that of wine. The above company, therefore, set themselves to overcome the unfavourable conditions. Three powerful cooling and freezing machines of a total efficiency represented by − 260,000 calories per hour were introduced. By this means large quantities of ice (6,000 kilos. per day) and of ice-cold water are produced. Not only is the necessary cooling of the worts, fermentations, &c., thus effected, but the fermentation chambers are supplied, by fans and cold-air pipes, with cooled and filtered air, which enters at a temperature of 2° C., and the storage vaults are also kept cool by cold air and by ice. In this way a great deal of the moisture of the atmosphere is precipitated (largely in the form of ice on the cold-air pipes), and the infection by wild yeast, bacteria, &c., is greatly reduced. The fermenting rooms were specially built with this view, and can in winter be ventilated by windows as usual, in summer almost exclusively by the cold air fans, bringing in the cooled and filtered air. These arrangements permit of having 2,600 hectolitres in the fermentation chambers, and 17,000 hectolitres in the stores. Pure yeast is employed for pitching, and this is made by Hansen's method, three propagators being in use for this purpose. When a wort is pitched with fresh, pure culture yeast, the yeast therefrom is used for pitching the next wort, and so on; but after eight such generations the yeast is rejected and replaced by fresh, pure yeast from the propagators to obviate the possibility of the serious deterioration of the yeast. Special precautions are also taken for the sterilisation of the wort, and the coolers are fed in a hermetically sealed chamber with cooled and filtered air, to prevent infection.—L. T. T.

### *Medium for the Production of Artificial Effervescent Foam in Beverages otherwise deficient therein.* E. Pieszczek. Pharm. Zeit. 1895, **40**, 62.

This preparation is a coarse, dark-brown powder presenting the general appearance of a vegetable extract. When dissolved and shaken up, a compact, fine, and durable foam is produced, even when greatly diluted. On examination, the substance was found to be an extract of Quillaia bark. Kobert states that the form of saponin ("Quillaiasäure") constituting the chief ingredient in Quillaia bark is strongly poisonous; wherefore such a preparation is to be avoided. —C. S.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (*A.*)—CHEMISTRY OF FOODS.

### PATENTS.

*Process and Container for Preserving Milk, Cream, and other Liquids.* W. F. E. Casse, Copenhagen, Denmark. Eng. Pat. 11,393, June 12, 1894.

In the process described, milk, cream, or other liquid is placed in a suitable jacketed vessel, in which the inner wall of the vessel is surrounded by a layer of ice, produced by admitting water into the jacket and freezing it. The outer portion of the vessel is surrounded with non-conducting material. Hook-like projections are also provided in the jacket for holding up and keeping the coating of ice adherent.—L. de K.

*Improved Manufacture of Cattle Food.* W. Schwartz. Hanover, Germany. Eng. Pat. 21,224, November 5, 1894.

The inventor claims the production of a suitable cattle food from molasses.

Molasses contain alkaline potash compounds, mixed with peat, the organic acids of which neutralise the alkali. Peat itself is not devoid of nutritious constituents, but it is unsuitable for food when taken alone; the mixed molasses and peat it is stated, form a wholesome article.

In preparing the food, comminuted peat is saturated with molasses, and pressed into a suitable form.—L. de K.

*Process for the Extraction or Rendering Soluble of Cocoa.* W. Gaedke, Hamburg-Eppendorf, Germany. Eng. Pat. 3166, February 13, 1895.

The object of the invention is the preparation of a cocoa containing from 18 to 22 per cent. of constituents soluble in water.

Cocoa is roasted in any suitable apparatus, at about 120°—150°. When cold, the beans are broken and shelled in the usual manner, and the clean fruit is covered with a solution of caustic alkali or an alkaline carbonate, or even ammonia. The quantity of alkali should not exceed 2 per cent., dissolved in a quantity of water corresponding to 20 or 30 per cent. of the beans, some varieties taking up more moisture than others. Uniform moistening is best effected in a vat, having a steam-jacket, and provided with a stirrer, or a steam-jacketed rotating drum. The beans are afterwards dried at a temperature not exceeding 100°—preferably between 50°—70°. Rendering the cocoa soluble does not, however, depend solely on the alkali, as plain water will have the same effect; but there is a difference in taste between the two products, the one having a pronounced bitter taste, whilst the other has more aroma.—L. de K.

## (*B.*)—SANITARY CHEMISTRY.

*Enquiry into the Nature and Physiological Action of Black-damp, as met with in Podmore Colliery, Staffordshire, and Lilleshall Colliery, Shropshire.* J. Haldane. Proc. Roy. Soc. **57** [343], 249—257.

The author has investigated the composition of undiluted black-damp, and finds it to consist of nitrogen with 12—14 per cent. by volume of carbonic acid.

A mixture of 84 per cent. of air and 16 per cent. of black-damp extinguishes candles and lamps; but it is only when the black-damp increases to 60 per cent. that a mixture is obtained which is fatal to life. Its dangerous property is due to the absence of oxygen, not so much to the excessive amount of carbonic anhydride present.—L. de K.

*Thirty-first Annual Report on Alkali, &c. Works, by the Chief Inspector.* Proceedings during the year 1894, presented to the Local Government Board and to the Secretary for Scotland.

*See under* VII., *page* 569.

*Manufacture of Accumulator Plates and Testing of Materials.* P. Schoop. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 412.

*See under* XI., *page* 582.

### PATENT.

*Improvements in Apparatus for the Treatment of Towns' Refuse, and in the Utilisation thereof for the Generation of Steam.* F. W. Lacey, Bournemouth. Eng. Pat. 13,171, July 17, 1894.

The object of this invention is to render furnaces for burning towns' refuse and sewage sludge more effective, with better provision for the utilisation of the products of combustion in steam-boilers, and to reduce the labour in feeding and in taking out clinkers and ashes. A firebrick furnace is placed inside a jacketed cylinder, the cylinder forming a steam-boiler. A screw-propeller placed in the hopper is used for feeding the refuse tipped therein, into the furnace.

## (*C.*)—DISINFECTANTS.

*Aluminium Vessels for Storing Carbolic Acid.* Balland. J. Pharm. Chim. 1895, 6 Ser. **1**, 309.

Carbolic acid either crystallised or in alcoholic solution has no action on aluminium, either in the cold or at 60°— 70° C., hence the employment of aluminium vessels for storing carbolic acid for military purposes is recommended.—C. A. K.

*The Disinfection of Normal and of Pathological Fæcal Matters.* H. Vincent. Ann. de l'Institut Pasteur, 1895, **9**, 1.

A tabulated statement of the relative disinfecting powers of the following disinfectants is given:—Copper sulphate, cresol, lysol, bleach, solveol, solutol, sodium carbonate, potassium carbonate, carbolic acid, Eau de Javelle, Eau de Labarraque, carbonate of lime, zinc chloride, heavy tar oil, mercuric chloride (1 : 1,000 with 5 per cent. of hydrochloric acid) and ferrous sulphate. Their disinfecting powers per 1,000 c.c. of fæces per 24 hours and their relative costs are stated. For the disinfection of normal excrements copper sulphate, cresol, lysol, and bleach appear most efficient. The addition of mineral acids, especially to copper sulphate, and to chloride of lime, for disinfecting dry closets, is recommended in order to overcome the alkalinity of the decomposing fæces. Pathological fæces are more readily disinfected than normal fæces, owing to their being more liquid. Typhus stools are best treated with acidified copper sulphate; cholera stools with cresol, lysol, acid copper sulphate, or acidified chloride of lime. For pathogenic microbe cultures chloride of lime is most efficient, as previously shown by Chamberland and Fernbach.

—C. A. K.

*New Lamp for the Production of Formaldehyde.* B. Tollens. Ber. **28**, 261.

The lamp consists of a spirit lamp of the well-known pattern, the wick of which is covered by a hood formed of fine platinum wire gauze. The lamp is filled with methyl alcohol, and lighted. As soon as the platinum gauze is in a state of incandescence the glass hood of the lamp is momentarily put on and again removed. The formation of formaldehyde now at once proceeds, methyl alcohol continually evaporating from the wick under the influence of the incandescent platinum. To prevent the lamp from spontaneously inflaming above the gas-hood, one of the chimney-hoods used in connection with Bunsen burners, may be placed over it. With the aldehyde thus continually forming, all its characteristic properties may be easily demonstrated. Formaldehyde being a strong antiseptic, its vapours proving rapidly fatal to micro-organisms, such lamps might be satisfactorily employed for the purposes of disinfection. For this use it has the additional advantage of being indifferent as regards coloured textile materials, which are detrimentally affected by chlorine and sulphurous acid.—C. O. W.

### PATENT.

*Improvements in Sulphur Candles or Fumigators.* C. T. Kingzett, Chislehurst. Eng. Pat. 10,445, May 29, 1894.

The sulphur candle or fumigator is composed of a block of sulphur of which the bottom and sides are enclosed by a casing of metal foil, and having some light fabric or material to serve as a lighter, slightly coated with sulphur. This is held down to the top of the sulphur block, by the upper edges of the sides of the metal foil casing being bent down over it (this Journal, 1894, 657 and 833).

## XIX.—PAPER, PASTEBOARD, Etc.

*Reddening of Sulphite Cellulose.* A. Harpf. Wochenbl. f. Papierfabr. 1895, 586 and 641.

As the result of several analyses it appears that the red coloration observed in sulphite cellulose is not due to the action of oxidising agents such as chlorine or the oxygen of the air upon iron in the cellulose. The colouring matter is not soluble in water, as stated by Wolesky, for if it were, it would necessarily be removed in working up the pulp. Iron in the water used in washing the pulp is the cause of the grey coloration often observed, and consequently water as free as possible from iron should be used in the washing process, and the lime used should also be free from iron. The red coloration, due to the action of chlorine in bleaching on the cellulose itself, can be prevented by boiling the pulp very soft, washing it thoroughly, and drying it in places free from chlorine. The production of the red coloration in the Hollander is checked by the addition of sodium thiosulphate and caustic soda, or of fresh sulphite lye.—C. A. K.

*Reddening of Sulphite Cellulose.* F. Wolesky. Papier Zeit. 1895, 91.

The author confirms Harpf's view (see preceding abstract) that the reddening of sulphite cellulose during bleaching is due to the action of chlorine. A knowledge of this action of chlorine on sulphite cellulose is of importance to the manufacturer, especially when he seeks to produce white papers of a lower grade *in part* from unbleached sulphite cellulose. It may then happen that the mass assumes a dirty reddish tint. In this case either the material employed was not free from chlorine, or the added sulphite cellulose must have lain a long time in a space, the air of which was contaminated with chlorine. Still, valuable assistance in overcoming this evil may be secured in the use of a suitable antichlor, followed by a thorough washing, and only then should the addition of the sulphite cellulose be made to the other material. Other oxidising agents also produce the red coloration in sulphite cellulose, viz., potassium ferricyanide, mercuric chloride, potassium bichromate, and potassium permanganate. Ferric chloride causes a violet coloration. Although these colorations are characteristic for the several reagents, they do not serve for the detection of unbleached sulphite cellulose in paper, since the reaction in this case was not obtained. Hence the author concludes that the colouring matter is soluble in water.—C. A. K.

*Detection of the Presence of Bleached and Unbleached Cellulose in Paper.* C. F. Dahlheim. Wochenbl. f. Papierfabr. 1895, **8**, 588.

*See under* XXIII., *page* 599.

### PATENT.

*Improvements in or relating to the Manufacture of Paper.* J. P. Cornett, Claxheugh. Eng. Pat. 8766, May 3, 1894.

In paper manufacture, the stuff-chests used for containing pulp in dilution or suspension are usually fitted with agitating arms or wings. The present invention consists in substituting a centrifugal pumping apparatus as the agitating medium in connection with the stuff-chest. The vessel used is oblong or oval, and is provided with a mid-feather partition, the pulp being pumped around the latter, whereby the stuff becomes thoroughly agitated and commixed, whilst efficient circulation is simultaneously obtained. —H. S.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*The Action of Alkaline Nitrites on Mercurous Salts.* L. L. de Koninck. Chem. Zeit. 1895, **19**, 750.

On bringing together solutions of a mercurous salt and an alkaline nitrite, a precipitate of metallic mercury is obtained. The explanation usually given is represented in the following equation :—

$$Hg_2Cl_2 + H_2O + NaNO_2 = 2Hg + 2HCl + NaNO_3,$$

and is, according to the author, incompatible with the fact that a mercuric salt is not reduced by an alkaline nitrite, although the reduction of mercuric to mercurous salts in general takes place more readily than the separation of mercury from mercurous salts.

Metallic mercury may be obtained from mercurous salts by double decomposition; thus, when mercurous nitrate is treated with potassium cyanide a precipitate of mercuric cyanide and metallic mercury is obtained. The mercurous salt formed being unstable, decomposes according to the general equation, $Hg_2X_2 = HgX_2 + Hg$.

Powdered mercurous nitrate was treated with a solution of sodium nitrite in excess, and a separation of mercury was obtained. On filtering, precipitating with sodium chloride solution, and filtering off the mercurous chloride, the filtrate was found to contain mercury as a mercuric salt and a nitrite. The reaction may therefore be thus represented :—

$$Hg_2(NO_3)_2 + 2NaNO_2 = Hg(NO_2)_2 + Hg + 2NaNO_3.$$

—H. I.

*Zinc Salicylate.* H. Andres. Farmazeft. 1895, **5**, 166. Chem. Rep. 1895, 118.

According to the author, Hager's method of preparation of this compound, *viz.*, the solution of zinc oxide in salicylic acid, is not a good one, since a discoloured preparation, soluble with difficulty, is obtained. He therefore recommends the precipitation of a solution of sodium salicylate by an equivalent quantity of zinc sulphate. The amorphous precipitate thus obtained, is crystallised from a small quantity of water, and forms small needles, containing two molecules of water of crystallisation.—H. I.

*Creasote-Magnesia.* C. G. H. Thedenius. Nordisk pharmac. Tidskrift, 1895, **2**, 2.

An article by O. Schweissinger on tasteless creasote, led the author to make experiments on various mixtures of magnesia and creasote, in order to get rid of the objectionable taste and smell of the latter substance.

"Creasote carbonate" is almost tasteless, is easily emulsified by the gastric juice, but is expensive. On the other hand, creasote and burnt magnesia, mixed in almost any proportion up to equal parts of each, form a pulverulent mass, in which the creasote is so combined that the compound is almost odourless and tasteless. The mixture is nearly insoluble in water, but on gently warming, or by the addition of a few drops of dilute hydrochloric acid, the powder is changed into a porous mass, which gradually dissolves in the liquid, becoming milky owing to the separation of the creasote. A mixture of equal weights of creasote and magnesia is the best, and forms a greyish-white mass.—H. I.

### *Occurrence of Citronellal together with Citral in Lemon-Oil.* O. Doebner. Arch. Pharm. 1894, **232**, 688.

Lemon-oil contains, in addition to terpenes and the aldehyde citral $C_{10}H_{16}O$ (this Journal, 1894, **13**, 417), a second aldehyde—citronellal, $C_{10}H_{18}O$—which appears to be closely related to citral, and which has also been found in the oil of *Eucalyptus maculata var. citriodora*, and in that of *Melissa officinalis*.—C. A. K.

### *American Oil of Peppermint.* F. H. Power and C. Kleber. Arch. Pharm. 1894, **232**, 639.

The specific gravity of the oil at 15° C. varies between 0·903 and 0·916. The specific rotatory power varies within considerable limits, and does not appear to have any definite relation to the quantity of menthol present. The percentage of menthol present in the form of esters varies between 3·45 and 14·12 per cent.; that of free menthol should not be below 40 per cent. Mitcham oil contains 53·9 per cent. of menthol, Saxony peppermint oil 61·2 per cent. and Japanese peppermint oil 72·7 per cent. The following substances were found as constituents of the American oil of peppermint:—Acetaldehyde, isovaleraldehyde, acetic acid, isovalerianic acid, pinene, phellandrene, lævo-rotatory limonene, cineol, menthol, menthone, menthol acetate, menthol valerianate, a methyl-ester, $C_{10}H_{19}.C_8H_{11}O_2$, a lactone, $C_{10}H_{16}O_2$, and cadinene, $C_{15}H_{24}$.—C. A. K.

### *Ferro-pyrine.* F. Husse. Pharm. Central. H. N.F. 1895, **16**, 59.

Ferro-pyrine is a compound of 3 mols. of antipyrine with one of ferric chloride, $(C_{11}H_{12}N_2O)_3Fe_2Cl_6$, and forms an orange-red powder soluble in 5 parts of water at 15° C. and in 9 parts at 100° C. Ruby-red plates separate from the saturated solution on warming, which melt at 220°—225° C. This is characteristic, and serves for the identification of ferropyrine. 1 grm. of the product should dissolve in 100 c.c. of water to a perfectly clear solution, from which the iron is precipitated as hydrate by the addition of ammonia. Ferro-pyrine contains 64 per cent. of antipyrine, which can be completely extracted with benzene after the precipitation of the iron by ammonia.
—C. A. K.

### *Salithymol.* W. Kollo. Pharm. Post. 1895, **28**, 77.

Salithymol is prepared by dissolving molecular proportions of salicylic acid and of thymol in alcohol, converting them into their sodium salts by the addition of sodium hydrate, and heating the residue after evaporating off the solvent, with phosphorus oxychloride to 120°—130° C. The product of the reaction is extracted with water, and the salithymol, which remains insoluble, recrystallised from alcohol. It forms a white, crystalline powder.—C. A. K.

### *Occurrence of Ortho-cumaraldehydemethyl Ether in Oil of Cinnamon.* J. Bertram and R. Kürsten. J. prakt. Chem. 1895, **51**, 316—325.

During the rectification of oil of cinnamon, the authors obtained from the "last runnings" a crystalline body—probably identical with the stearoptene described by Rochleder (1850)—which they demonstrate to be the *methyl ester of ortho-cumaraldehyde*—

$$C_6H_4(OCH_3)CH:CH.COH\ (OCH_3 = CH:CH.COH = 1:2)$$

The new compound crystallises from alcohol in large hexagonal plates, possessing, in bulk, a faintly yellowish tint, and fuses at 45°—46° C. It is very soluble in alcohol, benzene, acetone, chloroform, and ether, less soluble in petroleum spirit, almost insoluble in water. The substance has a faint, persistent, disagreeable odour; and readily suffers spontaneous decomposition, especially when exposed to air and light, becoming brownish in colour and developing an acrid odour like that of quinone. It boils at 295° C. with partial decomposition; but may be distilled under reduced pressure (12 mm.) at 160°—161° C. The aldehyde readily yields a *hydrazone* and an *oxime*—both crystalline—melting at 116°—117° C. and 125°—126° C. respectively. When fused with potash, the aldehyde yields as chief product *salicylic acid*. Oxidation by aqueous potassium permanganate converts it almost quantitatively into *methyl-salicylic acid*, whilst by treatment with silver oxide, *β-methyl-cumaric acid* is formed. In regard to the latter, an interesting observation was made. Crystals of the acid $C_6H_4(OCH_3)CH:CH.COH$, when exposed to diffused daylight, gradually (in 14 days) lose their lustre and crumble to powder, being almost entirely polymerised into a new acid of double the original molecular weight, which fuses, when pure, at 260°—262° C.

In the case of *cinnamic acid*, exposure to light was found to have a similar polymerising influence, but to a smaller extent, a new acid, melting at 274° C., being produced, probably identical with Liebermann's *γ-isatropic acid*.
—H. T. P.

### *Essential Oils in their Relation to the British Pharmacopœia and Trade.* John C. Umney. Pharm. J. 1895, 946—952; 977—981 and 1039—1046.

A paper read before the Chemists' Assistants' Association, containing a complete report on the composition, chemical and physical properties, and methods of valuation of the principal essential oils of commerce.

### *Mignonette Root Oil.* J. Bertram and H. Walbaum. J. f. prakt. Chem. 1894, **50**, 555—561.

The oil, obtained by the steam distillation of the roots of mignonette (*Reseda odorata*) is light brown in colour, possesses an odour resembling that of horseradish, and has the sp. gr. 1·067 at 15° C. It is feebly dextro-rotatory (+ 1° 30′ in 100-mm. tube). The oil, when heated, begins to boil at 255° C., but cannot be distilled, even *in vacuo*, without suffering partial decomposition. Chemically, it belongs to the class of "mustard oils," and, according to the authors, consists almost wholly of *phenylethyl isothiocyanate*, $C_6H_5.C_2H_4.NCS$. Mignonette root oil, when heated to 200° C. with concentrated hydrochloric acid, readily yields *phenylethylamine* in large quantity. Similarly, by treatment with alcoholic ammonia, it is almost entirely converted into *phenylethylthio-urea*.—H. T. P.

### *Conine and Nicotine.* G. Heut. Archiv. d. Pharmacie, **231**, 376.

*See under* XXIII., *page* 599.

*The Ethereal Oils, their Adulterants and their Detection.* Schimmel and Co. Zeits. f. Anal. Chem. 33, 756.

*See under* XXIII., *page* 605.

### PATENTS.

*Manufacture of Hydroxylamine, Hydrazine, and their Derivatives.* Alfred Wohl, Berlin, Germany. Eng. Pat. 11,216, June 9, 1894.

Nitrates, nitrites, nitro-compounds, nitrosamines, and the like can be reduced to hydroxylamine and hydrazine derivatives by the action of finely-divided metals, such as zinc, in neutral solutions containing a salt like sodium or calcium chloride. For example, phenylhydroxylamine is produced as follows:—100 parts of nitrobenzene and 10 parts of calcium chloride are dissolved in 400 parts of 60 per cent. alcohol. Into this solution 150 parts of zinc powder are quickly introduced, and the mixture heated on the water-bath till the presence of aniline can be detected. The filtered solution is distilled *in vacuo* until the distillate separates into two layers. The phenylhydroxylamine is frozen out, filtered, and pressed.

Nitrosodiphenylamine, $(C_6H_5)_2N.NO$, treated with metal and water, yields diphenylhydrazine $(C_6H_5)_2N.NH_2$. —J. W.

*Production of Para-methoxy- and Para-ethoxy-phenylurea.* O. Imray, London. From The Farbwerke, vormals Meister, Lucius, and Brüning, Hoechst a/Main, Germany. Eng. Pat. 11,708, June 16, 1894.

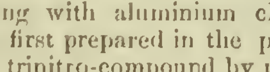
The alkyl ethers of para-oxyphenylurea can be obtained from that substance by heating it in aqueous alcoholic solution of potash or other alkali with the halogen compounds of the alkyls.—J. W.

*Manufacture of Mandelate of Antipyrine.* O. Imray, London. From The Farbwerke, vormals Meister, Lucius, and Brüning, Hoechst a/Main, Germany. Eng. Pat. 11,774, June 18, 1894.

188 parts by weight of antipyrine and 152 parts of mandelic acid (phenylhydroxyacetic acid) are dissolved together in alcohol, benzene, or other solvent, and the solvent is evaporated. A colourless syrup is obtained, which solidifies on standing to a crystalline mass. The same compound is obtained by mixing antipyrine and mandelic acid, melting the mixture on a water-bath, and letting it cool down. Mandelate of antipyrine melts at 52° C.—J. W.

*Artificial Musk.* Charles Denton Abel, London. From the Fabriques de Produits Chimiques de Thann et Mulhouse, Thann, Germany. Eng. Pat. 12,980, July 4, 1894.

Propyl, butyl, and amyl-hydrindene on nitration yield trinitro-compounds, possessing a strong odour of musk. The hydrocarbons are prepared from hydrindene—



$$\left(C_6H_4 \begin{matrix} \diagup CH_2 \diagdown \\ \diagdown CH_2 \diagup \end{matrix} CH_2\right)$$

and the chlorides of the alkyls, by the method of Friedel and Crafts (heating with aluminium chloride). The dinitro-compound is first prepared in the pure state, and then converted into the trinitro-compound by means of a mixture of fuming sulphuric and fuming nitric acids at 50° C. Trinitro-tertiary-butyl-hydrindene forms white needle-shaped crystals, sparingly soluble in cold alcohol, which melt at 139°—140°.—J. W.

*Improvements in the Manufacture of Soluble Metallic Phosphate Compounds.* C. Raspe, Berlin. Eng. Pat. 13,199, July 7, 1894.

The author prepares double phosphates of the alkali metals and other metals (*e.g.*, copper and sodium, tin and sodium, &c.), which are soluble in water. They all contain with 1 atom of phosphorus the equivalent of more than one but less than 3 atoms of monad metal, and are formed by melting together metallic oxide, phosphoric acid, and alkali, by evaporating a solution of alkaline phosphate, phosphoric acid, and metallic oxide, and fusing the dry mass, or by partially neutralising phosphoric acid with alkali, evaporating, and fusing with metallic oxide. Instead of metallic oxide, other metallic compounds decomposable by phosphoric acid may be used. The proportions of the ingredients for different compounds are given in the patent. Double compounds of soluble character and applicable for therapeutic purposes are described; *e.g.*, of zinc and sodium, antimony and sodium, and bismuth and sodium. Applications in dyeing and electro-metallurgy are also mentioned. —J. T. D.

*Production of a Compound of Antipyrine and Ferric Chloride.* Albert Knoll (Knoll and Co.), Ludwigshafen, Germany. Eng. Pat. 2656, February 6, 1895.

564 grms. antipyrine are dissolved in 564 grms. water, and to the solution are added 541 grms. crystallised ferric chloride dissolved in 541 grms. water. On stirring, a hard brick-coloured crystalline mass separates, which is freed from the mother-liquor and washed. Its composition is $(C_{11}H_{12}N_2O)_3, 2FeCl_3$. The crystals are brittle and non-hygroscopic, and have the melting point 225° C., with decomposition. They dissolve in 5 parts of water, with production of a claret-coloured solution.—J. W.

*Production of Homologues of Vanillin.* Sydney Pitt, Sutton. From The Chemische Fabrik auf Actien (vormals E. Schering), Berlin. Eng. Pat. 10,112, May 24, 1895.

In Eng. Pat. 24,177, 1893 (this Journal, 1894, 1218), it was shown that vanillin can be obtained from salts of *p*-benzene-sulphoprotocatechuic aldehyde by methylating these bodies and then splitting off vanillin by saponification of the vanillin sulpho-ethers thus produced. A similar process is now applied to the preparation of substances which contain other alcohol radicals in place of the methyl group in vanillin. Thus the meta-ethyl and meta-propyl ethers of protocatechuic aldehyde have been obtained. These substances crystallise easily from hot water, and melt at 77·5° and 82° respectively. They have been found useful for perfumery.—J. W.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### PATENT.

*Production of Coloured Photographic Pictures by Means of Diazo- and Tetrazo-Compounds.* C. D. Abel, London. From The Actien Gesellschaft für Anilin Fabrikation, Berlin, Germany. Eng. Pat. 10,766, June 2, 1894.

This process may be regarded as an inversion of the primuline process (Eng. Pat. 7453, 1890, and this Journal, 1890, 1001), the diazo- or tetrazo-compound being exposed under a negative and developed by the action of a diazo-compound upon the products of decomposition; for example, the paper is rendered sensitive with a solution of α-diazo naphthaline chloride, and whilst still moist is exposed under a negative. The picture is then developed by treatment with a 10 per cent. solution of sodium acetate; this dissolves the diazo compound not decomposed, which combines with the α-naphthol formed, yielding a brown picture. Other diazo compounds can of course be used for developing other colours.—J. C. C.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### PATENTS.

*Improvements in the Manufacture of Explosive Compounds.* R. E. Brown, Newcastle-on-Tyne, and C. O. Lundholm, Ardeer. Eng. Pat. 11,458, June 13, 1894.

This invention consists in the use of gutta-percha, rubber, balata, the juice of Alstonia scholaris, or a mixture of any two or more of these in the manufacture of smokeless powders of the nitrocellulose and nitrocellulose-nitroglycerin types, in order to moderate the combustion of such compounds and lower the temperature of the resulting gases.—W. M.

*Improvements in Explosives.* D. Hickie and G. F. Beutner, both of London. Eng. Pat. 12,084, June 22, 1894.

The inventors claim "the making into grains of mining explosives of the nitrocellulose class with nitrates and other mixtures which have hitherto been manufactured and used in a rigid form and in blocks or large cartridges."—W. M.

*Improvements in Pyrotechnic Compounds.* J. Graham, Boston, U.S.A. Eng. Pat. 5235, March 12, 1895.

A fluid compound adapted to be used in connection with some absorbent material, such as asbestos, for the production of blue lights, is made by mixing 320 grains of powdered zinc and 80 grains of powdered selenium in 1 gallon of pure carbon bisulphide.—W. M.

*Improvement in Blasting Compositions.* Hans Ritter von Dahmen, Castrop, Westphalia. Eng. Pat. 6327, March 27, 1895.

"Pyrochromates" or chromates are added to blasting compositions in combination with ammonium nitrate, for the purpose of lowering the temperature of explosion. A good composition consists of 91 parts of ammonium nitrate, 7 parts naphthalene, and 2 parts potassium "pyrochromate." —W. M.

## XXIII.—ANALYTICAL CHEMISTRY.

### *APPARATUS, ETC.*

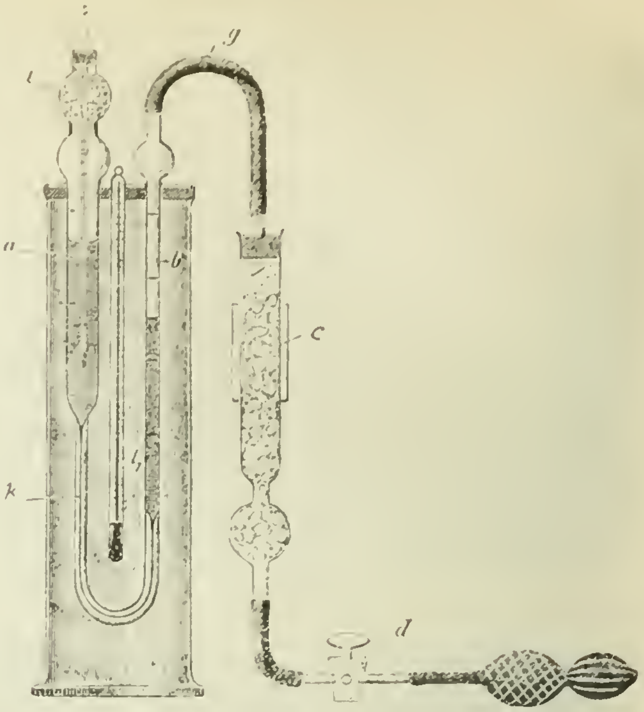
*Simple Viscosimeter.* Neumann Wender. Chem. Zeit. 1895, **19**, 856—857.

The "Fluidometer," as this apparatus is called, consists, as is shown in the drawing, of a glass vessel bent into a U shape, the two limbs *a* and *b* being connected by a capillary tube *k*.

The wide limb, which receives the fluid under examination, holds 10 c.c., and the open end is provided with a ground hollow stopper which is filled with cotton-wool and fitted with a thermometer *t*, graduated into half-degrees. This wide limb is connected by the capillary tube *k*, 20 cm. in length, with the narrower limb *b*, 5 mm. in width, capable of holding 2 c.c., and divided into four equal parts. By means of an india-rubber tube *g* this is united to a calcium chloride tube *c*, and with a three-way cock *d*, one limb of which is connected with a caoutchouc-pump. In order to keep the temperature constant, the whole vessel is immersed in a large glass water-bath provided with a good thermometer $t^1$. Both thermometers must show the same temperature during the experiment, which is thus performed:—

The wide limb is filled with the filtered liquid to the tenth division, the liquid being prevented from entering the narrower limb by closing it with the finger.

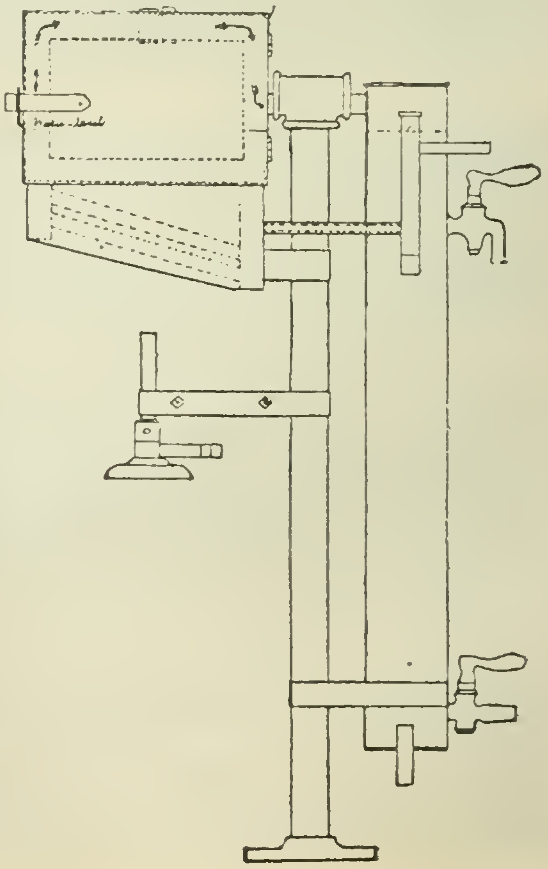
The apparatus is then arranged as in the figure, and when a constant temperature is attained, the three-way cock is opened to the air, and the liquid then rises in the narrow limb; the time required by the fluid to travel between any two marks on this limb is dependent on the nature of the fluid, the temperature, and the pressure which compels it to move.



The time is recorded in the usual manner. In order to repeat the experiment, the three-way tap is placed in connection with the india-rubber pump and the fluid forced out of the narrow limb. In this apparatus there is no loss by evaporation, or vitiation of the results by dust, &c., arising from exposure to air. The apparatus is easily cleaned. The best temperature for experiment is 20° C. with easily volatile substances, and in order to determine the viscosity of fats and thick fluids, the author uses solutions of these bodies in chloroform or benzene, and measures the viscosity of the solutions at 20° C.—H. I.

*New Form of Water-Oven and Still.* L. W. Hoffmann and R. W. Hochstetter. J. Amer. Chem. Soc. 1895, **17**, 122—124.

The construction of the oven will be understood from the accompanying figure.



The heating surface consists of a series of small-bore pipes, connected with water boxes at each end, and inclined so as to afford an easy ascent for the steam generated in them; an ordinary Bunsen burner, with a wing-tip, serves as the source of heat. The steam is carried off at a point about half-way up the side of the oven and passed through a block tin condenser. To reach the condenser, the steam must pass over the top of the drying chamber, as the water-level in the oven is kept about one-fourth of the distance between the top and bottom, thus acting as a lute and compelling the steam to take the indicated course. The water used in cooling the worm also serves as feed-water for the oven, the connecting pipe being of sufficiently small diameter to allow of slow but constant circulation.

With a burner consuming three cubic feet of gas per hour, the oven will get up steam in four minutes and will deliver distilled water in 6·2 minutes, the heating surface being 82·8 sq. ins. and the bottom of the oven 7 sq. ins.

The following advantages are claimed:—

A constant temperature at 100° C.

A large yield of distilled water ($13\frac{1}{2}$ galls. per 24 hours), with a small expenditure of heating material, and practically no cost, as the water-oven is nearly always in use in a working laboratory.

Hot water always at command.

Small space occupied by both oven and still.

General convenience of arrangement.—A. G. B.

## *INORGANIC CHEMISTRY.—QUALITATIVE.*

### *Rapid Method for Detecting Tin.* M. G. Denigès. Rev. internat. des falsificat. 1895, 8, 98.

The author makes use of the stannous chloride test for brucine in presence of nitric acid, for the detection of small quantities of tin. The brucine solution contains 0·5 grm. of brucine dissolved in 5 c.c. of pure cold nitric acid, the whole being made up to 250 c.c. with water, after boiling the solution (after a preliminary dilution) for 10—15 minutes. To carry out the test, a trace of the substance to be tested is treated with a fraction of a drop of hydrochloric acid and the whole evaporated to dryness. The residue is then taken up with water and 1 c.c. of the above brucine solution added. In presence of tin, the characteristic red-violet coloration is seen at once. When only very small quantities of tin are present it is better to take only 4 or 5 drops of the brucine solution; in this way 0·00005 grm. of tin can be detected. Cuprous compounds give the same reaction; ferrous compounds do not. To apply the test to meta-stannic acid, a sample of the substance is treated with 1 c.c. of water, $\frac{1}{2}$ c.c. of hydrochloric acid and a small piece of zinc; the tin separates as a spongy precipitate and can then be tested as above.—C. A. K.

### *New Reagent for Hydrogen Peroxide.* A. Bach. Chem. Zeit. 19, 37.

This consists of two solutions, one containing 0·03 grm. of potassium bichromate and 0·25 grm. of aniline in 1 litre, the other being a 5 per cent. oxalic acid solution. The reagent can be used for detecting hydrogen peroxide in green plants, and, in contradistinction to other reagents, is unaffected by other substances in the plant. The presence of hydrogen peroxide is shown by shaking 5 c.c. of the solution to be tested two or three times with an equal volume of the aniline-bichromate and one drop of the oxalic acid solution. In presence of hydrogen peroxide a violet-red coloration is produced, and one part in 1,400,000 can be detected. The reagent is unaffected by oxides of nitrogen, but, like aniline, is coloured by bleaching powder and hypochlorous acid. In order to detect hydrogen peroxide in the green parts of plants, 25 grms. of leaves plucked in the middle of a bright mild day were shaken up with 75 c.c. of a one-tenth per cent. oxalic acid solution and 5 c.c. taken out at regular intervals of time to be tested in the manner described. Of 25 plants investigated, 18 gave the test for hydrogen peroxide, in two cases the result was doubtful, and in five negative.—T. A. L.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Contributions to the Knowledge of Mortar.* E. Donath. Zeits. angew. Chem. 1895, [1], 14.

*See under IX., page 573.*

### *Slaking Lime and Cements.* H. Le Chatelier. Bull. de la Soc. d'Encouragement, 1895, 10, 52.

*See under IX., page 575.*

### *Estimation of Sulphur in Pyrites.* A. v. Asbóth. Chem. Zeit. 1895, 19, 598—599.

A process recommended by F. Johnson (Chem. Zeit. Rep. 1894, 18, 283) was found to be as lengthy as, and no more accurate than the method given by Fresenius in his text-book. But Hoehnel's sodium peroxide method, as modified by Glaser (see this Journal, 1894, 13, 1095), is preferable to both. The time required is two (instead of five to six) hours, and the results are sufficiently accurate for technical purposes (within 0·5 per cent.). When, however, the pyrites contains silica the numbers obtained are too high; and in this case, if perfect accuracy be required, the solution containing the brominated hydrochloric acid must be evaporated to dryness, redissolved, and filtered. The use of bromine is essential.—W. G. M.

### *Estimation of Sulphur in Iron.* L. L. de Koninck. Chem. Zeit. 1895, 19, 502.

The addition of stannous chloride to the hydrochloric acid used in dissolving the iron, in the method in which $H_2S$ is evolved, is recommended. It is scarcely likely that under the usual conditions, the evolved hydrogen sulphide is oxidised directly by atmospheric oxygen. The retention of sulphur in the dissolving flask is rather due, probably, to the peroxidation of a portion of the ferrous chloride, either by traces of air in the apparatus, or by oxidising substances contained in the commercial acid. It may even be possible, perhaps, to dispense with the troublesome operation of displacing the air from the flask by a neutral gas. But a long series of comparative experiments must first be made. The hydrochloric acid must, of course, be concentrated, or the formation of stannous sulphide would lead to serious errors. The use of the tin salt in no way affects the rapidity of solution, whilst it may help to moderate the first tumultuous action of the acid upon a sample of cast iron.—W. G. M.

### *Determination of Bromine in Presence of Chlorine.* W. Wense. Zeits. angew. Chem. 1895, 1, 13—14.

The method described is adapted for the determination of small quantities of bromine in the presence of considerable quantities of chlorine, and is carried out as follows:—The solution, containing both chloride and bromide—*e.g.*, one of the mother-liquors commonly used as a raw material for the preparation of bromine—is distilled with rather more chlorine water than is necessary to set free the whole of the bromine. The solution and the chlorine water must be as nearly as possible free from uncombined acid, for a reason that will be presently apparent. The distillate is received in a solution containing a known quantity of potassium iodide, of which enough must be present to keep the whole of the liberated iodine in solution. The distillation is stopped as soon as the bromine has completely distilled; this point is reached with degrees of facility differing with the nature of the saline solution; thus magnesium chloride retains both chlorine and bromine more obstinately than solutions of the alkali chlorides do. The distillate is made up to a convenient volume, and the free iodine which it contains is estimated by titrating a fraction in the usual manner. Another portion is evaporated to dryness, and the weight of the salts which it contains, thus determined. All data necessary for computing the amount of bromine are thus obtained. Calling $c$ the weight of chlorine, and $b$ that of bromine:— $c = 0·797\ D - 0·295\ I$, and $b = 1·295\ I - 1·797\ D$, where I is the weight of iodine determined by titration, and D is the decrease of weight suffered by the potassium iodide originally taken, by the action upon it of the chlorine and bromine. Test analyses are satisfactory.—B. B.

### *Separation of Metals by Hydrogen Peroxide in Alkaline Solutions.* P. Jannasch and A. Röttgen. Zeits. anorg. Chem. 1895, **8**, 202. (See this Journal, 1891, 639 and 1037; 1892, 270; 1894, 67 and 1224.)

*Separation of Bismuth and Lead from Cadmium, and of Manganese from Copper and Cadmium.*—The solution of the metals in nitric acid is evaporated to dryness, treated with 5 c.c. of nitric acid (sp. gr. = 1·4), 25—40 c.c. of water, and the solution poured into a mixture of strong ammonia (15 c.c.) and 3—4 per cent. hydrogen peroxide (25—30 c.c.). Bismuth hydroxy-peroxide separates as a dull yellow precipitate, the lead and manganese compounds as blackish-brown precipitates. For removing traces of cadmium, the precipitate is redissolved in nitric acid and reprecipitated. The lead precipitate is only partially soluble in dilute nitric acid, whilst strong acid cannot be employed owing to the destruction of the filter and the production of oxalic acid. This difficulty is overcome by saturating the precipitate with hot dilute nitric acid, and then treating it with hydrogen peroxide.

The following method for the *Separation of manganese from copper and cadmium* gives absolutely correct results. Copper and manganese ammonium sulphates (each 0·5 grm.) are dissolved in 30 c.c. of water, treated with 10 c.c. of strong nitric acid, and poured into a mixture of 40 c.c. of ammonia and the same amount of hydrogen peroxide. The mixture is digested on a water-bath for a quarter of an hour, and filtered, the precipitate redissolved in a mixture of hot dilute nitric acid and hydrogen peroxide, and reprecipitated. Manganese and cadmium are separated in a similar manner.

Pure hydrogen peroxide, prepared by distilling the ordinary solution in a vacuum, must be employed for these separations. The manganese, lead, and bismuth compounds are extremely sensitive to organic compounds, especially di- and poly-basic acids. Acetic acid is, however, without effect on bismuth and lead precipitation.—N. H. J. M.

### *Determination of Nickel in Nickel Steel.* E. D. Campbell and W. H. Andrews. J. Amer. Chem. Soc. 1895, **17**, 125—129.

Dissolve 1 grm. in 25 c.c. of nitric acid (sp. gr. 1·20) and boil until all nitric oxide is expelled. To the cooled solution add a solution of sodium pyrophosphate (13 grms.) in warm (not boiling) water (75 c.c.), and, drop by drop, a 20 per cent. solution of sodium carbonate until the precipitated ferric pyrophosphate just dissolves and the solution attains a dull olive-green colour; an excess of sodium carbonate will turn the liquid red, and must be carefully avoided. Filter the sodium carbonate solution through asbestos, and add 2 grms. of potassium xanthate, freshly dissolved in 25 c.c. of water. Shake at frequent intervals for 10 minutes, by which time all the nickel and copper will be precipitated as xanthate, free from manganese and nearly free from iron. Filter rapidly, and wash four or five times with freshly-prepared solution (1 per cent.) of potassium xanthate. Dissolve the precipitate off the filter with 20 c.c. of freshly diluted fuming nitric acid (1 : 1), wash the filter two or three times with hot water, pass through 5 c.c. of dilute sulphuric acid (2:3), and wash again. Boil the filtrate and washings until fumes of sulphuric anhydride begin to be expelled. Cool, add 20—25 c.c. of water, heat to nearly boiling, and pass in hydrogen sulphide for 2 or 3 minutes. Filter the cupric sulphide, and wash it with hot water containing hydrogen sulphide.

Boil the filtrate to expel hydrogen sulphide, add a few drops of hydrogen peroxide, boil, and precipitate the iron by a slight excess of ammonia, redissolve the ferric hydroxide in sulphuric acid and reprecipitate it. Mix the filtrates and determine the nickel either electrolytically or volumetrically. In the former case add 30 c.c. of disodium hydrogen phosphate solution (10 per cent.), and 25 c.c. of strong ammonia. The liquid should measure about 175 c.c. It is placed in a platinum dish and electrolysed with a current of 0·14 ampère per 100 sq. cm. of dish, for 12 hours, having the electrodes about $\frac{1}{2}$ cm. apart. Wash the precipitated nickel with warm water and alcohol, dry, and weigh as usual.

For the volumetric method, make the mixed filtrates containing the nickel just ammoniacal, add 5 c.c. of silver nitrate indicator (0·5 grm. silver nitrate in 1,000 c.c. water), and 5 c.c. of a 2 per cent. solution of potassium iodide, which will give the solution an opalescence due to suspended silver iodide. Add a standard solution of potassium cyanide until the liquid becomes clear and bright, which will happen so soon as all the nickel has been converted into double cyanide. The potassium cyanide solution is standardised with pure nickel wire.—A. G. B.

### *Manufacture of Accumulator Plates and Testing of Materials.* P. Schoop. Zeits. f. Elektrotechnik u. Elektrochem. 1895, 412.

*See under* XI., *page* 582.

### *Volumetric Determination of Nickel.* Fr. le Cœuvre. Chem. Zeit. Rep. 1895, **19**, 26.

The reagent used is a 10 per cent. solution of KCy, 1 c.c. of which corresponds to 22—23 mgrms. of nickel, and is standardised on nickel-ammonium sulphate. To the nickel solution to be titrated, rendered slightly alkaline with a 5 per cent. solution of ammonia, the KCy solution is added, till the precipitate at first formed disappears, which occurs as soon as the KCy is in the slightest degree in excess.

Ammonium salts, small quantities of free ammonia, and organic acids do not affect the result. With large admixtures of citrates or tartrates, a moderate warming is desirable, and in presence of iron compounds a little ammonium tartrate should be first added to prevent precipitation of the iron. The method is inapplicable for nickel in presence of copper, zinc, or cobalt, but may also be employed for the separate estimation of these metals.
—C. S.

### *Oxidation of Organic Matter and the Decomposition of Ammonium Salts by Aqua Regia, instead of Ignition, in the Determination of Potash in Fertilisers.* R. de Roode. J. Amer. Chem. Soc. 1895, **17**, 86—87.

The author evaporates a solution of the mixed fertiliser, prepared as in the Lindo-Gladding method, with nitric and hydrochloric acids, thus destroying the ammonium salts and oxidising the organic matter—if not completely, at all events to such a condition that it is incapable of reducing platinic chloride. In this way, the losses incurred by ignition are avoided.—A. G. B.

### *Simplified Estimation of Phosphorus by the Molybdate Process.* J. Hanamann. Chem. Zeit. 1895, **19**, 553—554.

To obviate the inconstancy in composition of the yellow phospho-molybdate precipitate, caused by co-precipitated molybdic acid, the solutions are stirred vigorously together at the normal temperature and filtered cold. Stirring well for half an hour suffices, and if the precipitate be collected on a Schleicher-Schüll smooth paper, it may be readily detached, transferred to a platinum crucible, and heated until it has an uniform blue-black colour. It then contains 4·018 per cent. of phosphoric acid. The molybdic solution employed is made with 100 grms. of molybdic acid, 1 litre of a 10 per cent. ammonia solution, and 1·5 litres of nitric acid (sp. gr. 1·246). The precipitate is washed with ammonium nitrate and nitric acid (organic matter being destroyed by nitric or chromic acid). The crucible must never attain a red heat, but the platinum gauze upon which it rests should do so. If the colour of the ignited precipitate be not a clear blue-black, it is cooled, moistened with ammonia, and re-ignited. The filter is burned separately to ash. Results are quite accurate.—W. G. M.

### *Determination of Potash in Kainite.* R. de Roode. J. Amer. Chem. Soc. 1895, **17**, 85.

The author regards the preliminary precipitation with barium chloride, &c., usually practised when potassium in kainite is to be determined, as quite unnecessary, and contents himself with adding platinic chloride, evaporating nearly to dryness, and washing with alcohol and ammonium chloride as usual. He obtains a higher percentage of potash in this way than when he follows the Lindo-Gladding, the alternate, or the Stassfurt method, a fact which is attributed to the retention of the potash by the precipitates produced in these three methods.—A. G. B.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *Detection of the Presence of Bleached and of Unbleached Cellulose in Paper.* C. F. Dahlheim. Wochenbl. f. Papierfabr. 1895, **8**, 588.

The author uses a dilute solution of sodium auric chloride for the detection of unbleached sulphite-cellulose. The solution must be so dilute that it has only a pale yellow colour; it then gives a red-brown coloration with unbleached sulphite-cellulose, whereas bleached sulphite-cellulose and bleached soda-cellulose give a bluish coloration. Bleached straw-cellulose gives no coloration with the reagent, and wood-cellulose is turned yellow. 20 per cent. and downwards of unbleached sulphite-cellulose can with practice, be thus detected in paper free from wood-cellulose, by painting a drop of the reagent on the paper; the dirty brown coloration appears in from 2—10 minutes.—C. A. K.

### *Detection of Chlorine, Bromine, and Iodine in Organic Compounds.* P. N. Raikow. Chem. Zeit. **19**, 902.

The reagent is prepared by warming about 0·5 c.c. of pure sulphuric acid with a small fragment of silver nitrate. When the reaction has been started, it proceeds spontaneously, and the nitrate dissolves to a clear solution without any evolution of nitrous fumes. The clear colourless solution obtained, on gentle warming with an organic halogen compound, gives off yellowish-brown fumes, and turns first yellow, then dark reddish-brown, and, provided sufficient silver nitrate has been added, colourless after a short boiling. The following appearances are observed with the various halogens:—In compounds containing iodine this is liberated, and simultaneously a yellow precipitate of silver iodide is produced, which on prolonged boiling disappears with evolution of iodine. With chlorine and bromine compounds, a white or yellowish precipitate is produced, which in presence of sufficient silver nitrate gradually disappears on prolonged boiling. After a little practice it is possible to detect chlorine and bromine in presence of iodine by the colour of the precipitate. In the case of aromatic halogen compounds, satisfactory results are obtained whether the halogen is in the side chain or in the ring, but decomposition takes place more easily in the former than in the latter case. Further experiments are being made, but the author so far has determined, comparing chlorotoluene with benzyl chloride, that whereas in the latter case silver chloride is formed directly in the cold, it is necessary in the case of the former compound to boil the mixture, and it would thus appear possible in certain cases to determine the position of the halogen.—T. A. L.

### *New Reagent for Acetone.* P. Malerba. Ann. di Chem. e di Farmakol. 1895, **21**, 14.

Acetone gives a red coloration with a 1 to 2 per cent. solution of dimethylparaphenylenediamine, which appears gradually when the reagent is added drop by drop. The coloration lasts for a considerable time and darkens after standing several hours; it changes to a pale violet after the addition of alkali, when treated with concentrated mineral acids. The red-coloured liquid gives two spectroscopic absorption bands between the lines D. and E.—C. A. K.

### *Reactions for Naphthol.* O. Wolff. Pharm. Zeit. 1895, **40**, 44.

Both α- and β-naphthol give the following colour reactions:—On treating the solution of α-naphthol in alcoholic potash with a little chloroform and warming to about 50° C., a clear dark blue solution is obtained, miscible in all proportions with alcohol and ether, but with water only up to equal volumes. On slightly acidifying with hydrochloric acid or acetic acid, the solution becomes a fine red, and then again blue on the further addition of acid. These changes of colour can be repeated.—B. B.

### *Conine and Nicotine.* G. Heut. Archiv. d. Pharmacie, **231**, 376.

These bases can be differentiated by means of phenolphthaleïn, which yields a red coloration with a dilute alcoholic solution of conine, but none with nicotine. This reaction is more delicate with aqueous solutions in the presence of chloroform, and is employed in the following way to estimate the two bases when occurring together. The bases are dissolved in a small quantity of water, and alcohol added until the solution appears clear. To 5 c.c. of the solution are added five drops of chloroform and a drop of a saturated phenolphthaleïn solution, and the whole is thoroughly shaken. The conine is then titrated with $\frac{N}{10}$ sulphuric acid, with frequent shaking, to complete decoloration of the liquid. The nicotine is then titrated, employing litmus as indicator. It is necessary to work with concentrated solutions, otherwise low results are obtained. The presence of chloroform does not interfere with the litmus reaction.
—J. G. W.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Separation of the Free Acids of Beeswax.* T. Marie. Rev. internat. des falsificat. 1895, **8**, 123.

Triturate the mixture of the free acids with 30 volumes of methyl alcohol, heat carefully in a flask, and as soon as the liquid begins to boil, filter through a hot-water funnel kept at 60°. The cerotic acid, of which the filtrate chiefly consists, crystallises out on cooling. This treatment should be repeated in the above manner with a diminishing volume of alcohol until the residue has a constant melting point of 78° C. The dissolved product then melts at 76°. A single recrystallisation from ethyl alcohol raises the melting point to 77·5°. Its purity may be tested by checking the point of fusion by fractional precipitation with magnesium acetate, whereby the acid obtained from different fractions should have a constant melting point; and by fractional crystallisation of the methyl- and ethyl-esters from ordinary ether. From the residue remaining undissolved melissic acid may be easily extracted by repeated treatment with methyl alcohol. It is very slightly soluble, and identical with that obtained from carnaüba wax by Story-Maskelyne and Pieverling. The crude cerotic acid contains between 30 and 40 per cent. of homologous acids.—C. S.

## DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. (*Continued from page 523.*)

A. Lehne and A. Rusterholz.

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| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 118.<br>Brazil Wood.<br>(*Animal fibre.*) | *Conc.* :—Fibre bright ponceau-red, liquid colourless; heated—liquid rose.<br>*Dil.* :—Heated—liquid red; with excess of soda-lye—more bluish. | *Conc.* :—Fibre reddish-brown; liquid brownish; heated—fibre yellowish-brown, liquid yellow.<br>*Dil.* :—Heated—fibre yellowish-brown, liquid faintly yellow. | *Conc.* :—Fibre reddish-brown, liquid brownish-yellow; heated—fibre yellowish-orange, liquid yellow; on addition of water—fibre brighter.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Heated—liquid reddish; on addition of water—fibre somewhat brighter.<br>*Dil.* :—Fibre in the cold reddish-violet, liquid reddish; heated—fibre brighter. | Fibre in the cold, reddish-violet, liquid colourless; heated—liquid reddish. | Heated—fibre and liquid at first scarlet, fibre subsequently becomes brighter, liquid orange. | After protracted boiling liquid faint light yellow. | Boiling soap solution extracts much of the dye; solution bluish-red. |
| 119.<br>Archil (acid bath).<br>(*Animal fibre.*) | *Conc.* :—Fibre carmoisin red, liquid faint reddish.<br>*Dil.* :—Heated—fibre fuchsine-red, liquid faint bluish-red; with excess of soda-lye—faint violet. | *Conc.* :—Fibre immediately carmoisin-red, then ponceau-red, and finally dark orange, liquid bluish-red.<br>*Dil.* :—Fibre magenta-red; heated—fibre dark orange, liquid light orange. | *Conc.* :—Fibre dark violet, liquid blackish-violet; on addition of water—fibre and liquid bluish-red.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Heated—fibre and liquid violet.<br>*Dil.* :—Fibre in the cold reddish-violet, liquid violet; heated—liquid somewhat more reddish; acidified—liquid bluish-red. | Same as dilute soda-lye. | Fibre in the cold fuchsine-red; heated—fibre completely decolorised. | Little action. | (See under fuchsin.) |
| 120.<br>Safflower.<br>(*Animal and Vegetable fibre.*) | *Conc.* :—Fibre immediately decolorised (sand-coloured), liquid colourless; on addition of water, original colour reappears.<br>*Dil.* :—Heated—fibre dirty rose, liquid colourless; on being rinsed with water the original colour is again produced. | *Conc.* :—Fibre light yellow, liquid colourless; on addition of water—fibre completely decolorised.<br>*Dil.* :—Fibre immediately pale yellowish-rose, liquid colourless; heatod—fibre completely decolorised. | *Conc.* :—Fibre dirty rose; liquid colourless.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre immediately sand-coloured.<br>*Dil.* :—Fibre immediately decolorised (flesh-coloured) liquid colourless; heated—liquid completely decolorised. | Same as dilute soda-lye. | Fibre yellowish in the cold: heated—fibre colourless. | No action. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

VIOLET DYES.

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 121.<br>Methyl Violet B. [A.] [B.] [By.] [C.] [M.]<br>Violet de Paris.<br>Violet Direct.<br>Violet de Methyl Aniline.<br>(*Animal and Vegetable fibre.*) | *Conc.* :—Fibre at first pale violet, then brown, and finally intensely yellow; liquid yellow; on addition of water—fibre at first green, then blue, and by rinsing, the original colour is restored.<br>*Dil.* :—Slowly warmed—fibre at first blue, then green; on boiling—fibre almost decolorised (light green), liquid faintly yellow. Fibre becomes pale violet on being rinsed. | *Conc.* :—Fibre immediately brown, then brownish-yellow; liquid the same. By protracted action—fibre greenish-olive to yellowish-green, liquid green. On addition of water—fibre bluish-green; the original colour is not restored on rinsing.<br>*Dil.* :—Fibre dark brown, then yellowish-brown; heated—fibre light yellowish-green. Original colour not restored on rinsing. | *Conc.* :—Fibre dark Bordeaux, then dark brown; liquid amber-yellow; heated—fibre intensely orange-yellow, liquid intensely yellow. On addition of water, same as concentrated hydrochloric acid.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Warmed—fibre almost decolorised.<br>*Dil.* :—Warmed—fibre pale lilac. | Heated—fibre lighter, liquid colourless. | Fibre at first green, then slowly almost decolorised, liquid yellowish-green. | Colouring matter extracted on boiling. | Boiling ammonium acetate solution extracts the dye somewhat readily. The solution becomes yellow on addition of concentrated hydrochloric acid. |
| 122.<br>Benzyl Violet.<br>Parisian Violet 6 B.<br>Methyl Violet 6 B.<br>Methyl Violet 6 B. Extra [A.] [C.] [M.]<br>Violet 5 B. [By.]<br>Violet 6 B. [By.]<br>(*Animal fibre.*) | *Conc.* :—Fibre dark Bordeaux, then brown, and finally orange-yellow; liquid amber-yellow; on addition of water—fibre green, then blue, and on rinsing, violet.<br>*Dil.* :—Fibre at first blue, then green, and after some time decolorised. | *Conc.* :—Fibre at first brown, then orange-yellow, liquid yellow; on more protracted action, fibre yellowish-olive to greenish-olive. The original colour is partially restored on rinsing.<br>*Dil.* :—Fibre at first brown, becoming gradually yellow, liquid colourless; heated—fibre green, then again light lemon-yellow. | *Conc.* :—Fibre dark Bordeaux-red, then brown, liquid faint amber-yellow; heated—fibre intensely orange-yellow. On addition of water—same as concentrated hydrochloric acid.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Warmed—fibre decolorised (very faint yellow). Rinsed with acidified water—colour partially restored.<br>*Dil.* :—Heated—fibre pale lilac, on standing a long time, colourless. | Heated—fibre brighter (pale lilac), liquid colourless. | On heating—fibre at first brown, then orange, liquid amber-yellow; finally—fibre decolorised. | Colouring matter slightly extracted on boiling. | Behaves with ammonium acetate solution in the same manner as methyl violet. Crystal violet exhibits the same reactions as benzyl violet. |
| 123.<br>Acid Violet 4 B N. [B.]<br>Acid Violet 6 B. [By.]<br>(*Animal fibre.*) | *Conc.* :—Fibre pale reddish-violet, then bright brown, liquid faint brownish tint; on addition of water—fibre blue, and when rinsed—violet.<br>*Dil.* :—Fibre greenish-blue; heated—lighter shade—bluish-green. After standing for a protracted period—decolorised. | *Conc.* :—Fibre at once reddish-brown, then brownish-orange; liquid brownish. On addition of water, the original colour is partially restored and the liquid becomes bluish; when rinsed, the original colour is completely restored.<br>*Dil.* :—Warmed—fibre at first green, then light lemon-yellow; liquid colourless. | *Conc.* :—Fibre at first Bordeaux, then reddish-brown; heated—lighter, liquid brownish. On addition of water, same as with concentrated hydrochloric acid.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Warmed—fibre decolorised, liquid colourless; when rinsed with acidified water, the original colour is partially restored.<br>*Dil.* :—Warmed—fibre almost decolorised, liquid colourless. | Hardly any action. | Warmed—fibre at first yellowish-olive, then brownish-yellow, liquid faint brownish. After remaining for a protracted period, the fibre is decolorised. | Very little action. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 124.<br>Mauveine Rosolan. [P.]<br>Chrom Violet<br>Obsolete names:—Aniline Purple, Indisine, Aniline Violet, Perkin's Violet, Purpurine.<br>(*Animal fibre.*) | *Conc.*:—Fibre at first bluish-violet, then blue; heated—liquid faint bluish tint; on addition of water—fibre as originally, liquid faint reddish-violet.<br>*Dil.*:—Heated—fibre redder, liquid faint reddish-violet; with excess of soda-lye, colourless. | *Conc.*:—Fibre immediately blue, becoming bluish-green to yellowish-green by degrees, liquid faint greenish colour. On addition of water—fibre lighter (light yellowish-green).<br>*Dil.*:—Fibre bluish-violet; heated—fibre brown, liquid colourless. | *Conc.*:—Fibre brownish-violet (discoloured); heated—fibre dirty olive; on addition of water, the original colour reappears, liquid adherent to the fibre bluish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Warmed—fibre violet-black; on addition of water, original colour partially restored.<br>*Dil.*:—Warmed—fibre somewhat bluer. | No action. | Heated—fibre almost decolorised (reddish-brown), liquid reddish. | Little action. | Chlorine slowly bleaches the colour. |
| 125.<br>Fast Acid Violet 10 B. [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre at first indigo blue, then green, and finally greenish-yellow; liquid faint yellowish tint. On addition of water, the original colour is restored after passing through the changes of colour in the reverse direction to that just mentioned.<br>*Dil.*:—Fibre green; heated—fibre light green, liquid yellowish. Fibre becomes blue on being rinsed, liquid treated with excess of soda-lye—blue. | *Conc.*:—Fibre immediately green, then straw-yellow; on addition of water, the original colour is restored.<br>*Dil.*:—Fibre immediately dark green, becoming by degrees greenish-yellow; warmed—fibre again dark green, liquid greenish. Original colour is not restored on rinsing the fibre. Liquid treated with excess of soda-lye—yellowish. | *Conc.*:—Fibre indigo-blue; heated—straw-yellow, liquid yellowish. On addition of water—fibre bright green, liquid yellow.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Warmed—fibre dark indigo-blue to blackish-blue; on addition of water, the original colour is restored.<br>*Dil.*:—Warmed—fibre blue, liquid bluish; acidified—faint yellow. | Boiled—fibre blue, liquid the same; acidified—faint yellow. | Heated—fibre intensely yellow, liquid yellow. | No action. | .. .. |
| 126.<br>Red Violet 4 R S. [B.]<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre redder, liquid faint reddish-violet. On addition of water—liquid bluish-red.<br>*Dil.*:—Heated—liquid intensely reddish-violet; with excess of soda-lye—colourless. | *Conc.*:—Fibre dark red, liquid dirty violet; on addition of water—fibre as originally, liquid reddish-violet.<br>*Dil.*:—Warmed—liquid intensely reddish-violet; boiled—fibre and liquid yellow. | *Conc.*:—Fibre dark red; heated—fibre reddish-brown, liquid brownish. On addition of water—fibre as originally, liquid bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Warmed—fibre dirty yellowish-brown, liquid colourless.<br>*Dil.*:—Fibre almost decolorised (dull brownish tint), liquid colourless. | Heated—same as dilute soda-lye. | Fibre not decolorised, even on boiling; liquid intensely reddish-violet. | No action. | .. .. |

Detection of Artificial and Natural Colouring Matters on the Fibre—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 127.<br>Fast Bluish Violet. [B ]<br>(*Animal fibre.*) | *Conc.* :—Fibre by degrees blue; heated—fibre greenish-blue, liquid colourless; on addition of water—fibre as originally.<br>*Dil.* :—No action. | *Conc.* :—Fibre immediately greenish-blue, then bluish-green; heated—fibre scarlet, liquid reddish, finally, fibre yellow.<br>*Dil.* :—Fibre bluer; heated—fibre brownish-red, then reddish-brown, liquid brownish. | *Conc.* :—Fibre becomes dark green by degrees; heated—fibre bluish-green, liquid the same; on addition of water—the original colour is restored, liquid reddish-violet.<br>*Dil.* :—No action. | *Conc.* :—Warmed—fibre somewhat bluer, liquid colourless; on addition of water—fibre as originally.<br>*Dil.* :—Fibre bluer, liquid faint violet. | Some of the dye extracted on boiling. | Warmed—fibre decolorised, liquid colourless. | No action. | .. .. |
| 128.<br>Victoria Violet. 4 B S. [M.]<br>(*Animal fibre.*) | *Conc.* :—Fibre becomes redder by degrees, and finally attains a bright reddish-violet colour, liquid bluish-rose; on addition of water—the original colour slowly reappears.<br>*Dil.* :—Heated—fibre at first reddish-violet, then bluish-red, liquid the same; on rinsing—fibre again reddish-violet. | *Conc.* :—Fibre at first reddish-violet, then red, and finally orange-red, liquid faint rose; on addition of water—fibre brownish-red.<br>*Dil.* :—Fibre reddish-violet; heated—fibre red, then orange, liquid of bluish-rose tint. | *Conc.* :—Fibre violet-blue; heated—fibre indigo-blue, liquid faint reddish-violet; on addition of water—fibre reddish-violet, liquid red.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Warmed—fibre dark reddish-violet, liquid colourless; on addition of water—fibre dark red.<br>*Dil.* :—Fibre dark brownish-red, liquid colourless. | Same as dilute soda-lye. | Fibre completely decolorised on warming, liquid colourless. | No action. | .. .. |

—A. R. L.

### *Estimation by Karcz's Method of Crystallised Sugar in Raw Products and Molasses.* Strohmer and Stift. Oesterr. Zeits. Zuckerind. 1895, 24, 41.

The authors allege that the suppositions advanced by Karcz in his glycerin-washing method (this Journal, 1894, 1210) are irrelevant. Crystallised glycerin is by no means anhydrous, but may contain as much as 5 per cent. of water; moreover, sugar is soluble therein, 100 grms. of anhydrous glycerin of sp. gr. 1·263 at 17·5° dissolving 3·947 grms. of sugar at 20°. The sugar dissolves very slowly at first, but it readily remains in solution, so that on cooling, supersaturation results. This solubility increases proportionately with the water-content of the glycerin; *e.g.*, the solubility of sugar in glycerin containing 8 per cent. of water, is $2\frac{1}{2}$ times that in glycerin, which contains only 1 per cent. After crystallised sugar polarising 100, has been washed with pure anhydrous glycerin, only 99·3—99·7 per cent. is found, and in general this lowering is dependent upon three conditions: the fineness of the grain of the sugar, the duration of the washing, and the degree of concentration of the glycerin. The latter is of some importance, for the purest commercial glycerins are not alike in quality, and for technical purposes perfectly anhydrous glycerin is not usually obtainable. When first products are treated by this method, low values to the extent of 1 per cent. are observed, whereas second products and masecuites give impossibly high results, for as shown by synthetical experiments with mixtures of known composition, and as demonstrated by Herzfeld, glycerin exerts a very strong desalting influence on sugar. This method was verified for certain products, when the glycerin was saturated, and supersaturated with sugar, as well as when treated with calcium chloride, &c., but no general prescription was possible. For these several reasons, Karcz's method is neither perfectly accurate, nor one to be recommended for commercial analysis. For the technical control of the factory, however, it can, if conducted with care and under uniform conditions, give reliable and comparable results.—J. L. B.

### *Kjeldahl's Method for the Determination of Nitrogen.* B. Dyer. Proc. Chem. Soc. 1895 [152], 104—106.

The best modification of the method, in the author's experience, for the analysis of feeding stuffs and fertilisers not containing nitrates, and applicable, as will be seen, to a large number of organic compounds, is the Kjeldahl-Gunning method modified, however, by the use of mercury. A suitable quantity of the material to be analysed, is mixed in a round-bottomed hard glass flask, with 20 c.c. of strong sulphuric acid and a drop of mercury, and warmed for a short time, when 10 grms. of potassium sulphate are added. The contents of the flask are then boiled until colourless. With many materials this result is attained within half an hour, and it is rarely deferred beyond an hour. The contents are washed into a distilling flask, mixed with excess of soda and a little potassium sulphide (to decompose mercury compounds), and the ammonia is then distilled off into standard acid, which is afterwards titrated in the usual way. No spray trap is necessary in distilling if the connection between the distilling flask and receiver be made by means of a long, block-tin tube, rising perpendicularly 15 or 20 in. from the neck of the flask. The author prefers not to use a condenser, but to drive the steam directly into the standard acid, which stands in a trough of cold water, the delivery tube terminating in a pear-shaped glass bulb, to prevent regurgitation of the acid. The use of mercury is not necessary, but materially expedites the process.

When nitrates are present, or nitro-compounds and certain other compounds referred to in the paper, Jodlbauer's modification is used. This consists in dissolving in the sulphuric acid used for oxidation, a small quantity (about 2 grms. for a single determination) of phenol or salicylic acid. The nitrogen in the nitrate or nitro-group then forms a nitro-compound with the sulphonated phenol or salicylic acid. In many cases it is highly important that the sulphuric acid containing the phenol or salicylic acid should be poured directly and suddenly on to the material contained in the flask, so as to submerge it immediately, and not to let it trickle from a pipette. If nitrates and ammonium salts are both present, loss of nitrogen occurs, unless this precaution is observed; this does not appear to be generally known, and probably often gives rise to errors. One or two grms. of zinc dust (as well as a drop of mercury) are dissolved in the contents of the flask while still cold. The process is then continued exactly as before.

The author finds that if zinc alone (without the use of phenol or salicylic acid) be used with aromatic nitro-compounds there is loss of nitrogen, as though it were necessary that more carbon should be present.

The Kjeldahl-Gunning method fails to furnish the calculated quantity of nitrogen in azobenzene or amidoazobenzene. Mere reduction by zinc suffices with amidoazobenzene, but in the case of azobenzene the complete Jodlbauer modification is necessary. With amido-azotoluene the correct amount was obtained by the Kjeldahl-Gunning process supplemented by reduction with zinc and with carbazol by the Kjeldahl-Gunning method alone.

Hydroxylamine hydrochloride, which contains 20·21 per cent. of nitrogen, yielded only 3 per cent. by the Kjeldahl-Gunning method; by reduction with zinc about 10 per cent. was obtained; by the Kjeldahl-Gunning-Jodlbauer method about 19 per cent.; by reduction with sugar and zinc less than 19 per cent. The Kjeldahl-Gunning-Jodlbauer method with the addition of sugar as well as zinc, however, gave the calculated quantity in each of three separate determinations. Acetaldoxime, by the Kjeldahl-Gunning method, gave somewhat low results, but with the addition of sugar and zinc furnished correct results. Naphthoquinone-oxime yields its full percentage by the Kjeldahl-Gunning method.

Potassium cyanide and ethyl cyanide both give nearly correct results by the Kjeldahl-Gunning method; no trace of hydrocyanic acid is evolved if the sulphuric acid used be strong. Potassium ferrocyanide also yields accurate results. Potassium ferricyanide, however, only gives sufficiently accurate results when reduced by the addition of sodium thiosulphate. Sodium nitroprusside failed with any modification of the method to yield all its nitrogen.

Phenylhydrazine derivatives cannot by any modification of the method tried by the author be made to give correct results; there is invariably loss of nitrogen, presumably liberated in the free state.

### *Kjeldahl's Method of Estimating Nitrogen.* O. Kellner, O. Böttcher, and G. Diesselhorst. Chem. Zeit. 1895, 19, 35.

Comparative nitrogen determinations were made in which the substance (horn meal, fish guano, and various meals) was decomposed by heating (1) With sulphuric acid containing 200 grms. of phosphoric anhydride per litre, and mercury; (2) With sulphuric acid and mercury.

In most cases in which phosphoric anhydride was employed the decomposition was complete in two hours, or at the most in three hours, whilst without phosphoric anhydride three hours' boiling was insufficient.

For the decomposition of mercury-ammonium compounds the author employs zinc dust (2—3 grms.) instead of potassium sulphide.—N. H. J. M.

### *Kjeldahl's Method for Estimating Nitrogen in Foods.* A. Bömer. Chem. Zeit. 1895, 19, 166—167.

The employment of sulphuric acid, containing phosphoric anhydride and mercury, is strongly recommended. Economy of time is effected, and the results are more certain.—N. H. J. M.

### *Method of Separating Quantitatively Coal-Tar Hydrocarbons from those of Petroleum.* R. Henriques. Chem. Zeit. 1895, 19, 958—959.

Instead of carbon bisulphide, coal-tar "benzol" is now almost universally employed for dissolving caoutchouc in the preparation of waterproofing materials, for which purpose it is more effective than petroleum "benzine," although dearer. In order to obtain a cheaper article, the two kinds are frequently mixed together, with apparently satisfactory results, and it is with the object of ascertaining the composition of the commercial article that this process is proposed. It consists in agitating the mixture under examination for a few minutes with twice its volume of sulphuric acid containing 5 per cent. of sulphur trioxide. The coal-tar hydrocarbons are entirely dissolved by the acid, leaving the "benzine" to be read off. Two sources of error are noticed: the first is the solubility of the aromatic constituents of benzine and the second the solvent action of the sulpho-acid mixture, but both are believed to lie within the usual limits of experimental error and to be without effect on the value of the process as a rapid means of accomplishing the object in view.—C. S.

### *Analysis and Valuation of Fish-Oil.* V. Vedrödi. Chem. Zeit. 1895, **19**, 600—601.

A SAMPLE of fish-oil, containing 9·15 per cent. of free acids and 27·8 per cent. of unsaponifiable matter, having been rejected as unsuitable for softening leather, a series of tests were made with commercial samples to ascertain the proportions of such substances usually present. An unquestionably suitable fish-oil from a Hungarian factory showed 1·36 per cent. unsaponifiable and 13·12 per cent. of free acid, whilst medicinal cod-liver oil contained 1·0 and 2·8 per cent. respectively. In commercial fish-oils the highest recorded numbers were 82 per cent. unsaponifiable (from Buda-Pest) and 53·8 per cent. of free acid (from Hamburg). The conclusion arrived at is that all fish-oils, even those used medicinally, contain free acids and resinous matter, in greater or less quantity, according to the commercial purity of the sample. The actual limits permissible in oils to be used for softening leather have yet to be found by trial. But the author is of opinion that the unsaponifiable matter should not exceed 3—4 per cent., and the free acid should be less than 15 per cent.—W. G. M.

### *Polarisation of Sugar.* Howeg. Deutsch. Zuckerind. 1895, **20**, 390.

ALTHOUGH the rotatory dispersion of sugar and of quartz bear a very close relation to each other, yet, if the half-shadow polariscope be employed without a section of a bichromate crystal, differences of some tenths occur in the readings of various observers. This probably arises according to varying ocular capacity, and can be overcome to a marked extent with the aid of the bichromate cell.
—J. L. B.

### *Estimation of Sugar.* G. Opperman. Apoth. Zeit. 1895, **10**, 216.

FOR that method of sugar estimation whereby the precipitated copper oxide is reduced with hydrogen, and weighed as copper, the author proposes the following alteration:—The copper oxide, after being filtered into a tube packed with asbestos, is well washed and dissolved in moderately strong nitric acid, avoiding a large excess. The copper is then electrolytically precipitated, washed, dried, and weighed. A couple of large Daniell's cells serve as the source of current.—J. L. B.

### *Examination of Linseed Oil and Linseed-Oil Varnish.* H. Amsel. Zeits. angew. Chem. 1895, 73.

OF all the tests usually employed in the examination of linseed oil and linseed-oil varnishes, only the Kottstorfer test can be satisfactorily worked. Filsinger proposed some time ago to examine these products by the polariscope, and since rosin oil and mineral oil, the first of which is strongly dextro-rotatory, are almost the only impurities to be looked for, any adulteration with rosin oil is easily detected, linseed oil and linseed-oil varnish being optically inactive. The likewise inactive mineral oils would, however, escape detection; and, moreover, the dark coloration, especially of many of the linseed-oil varnishes, will often prevent the application of this optical method. The author considers that the purity or otherwise of linseed-oil varnishes can only be determined by the estimation of their drying power and saponification number. Finally, also the nature of the mineral matter present and the substances extracted by alcohol may have to be considered. A coating of pure linseed oil upon glass, without a dryer, should be perfectly dry and hard in three days. A mixture of linseed-oil varnish with 5 per cent. of a dryer, similarly applied to glass, should be perfectly dry in 24 hours. A mixture of only 5 per cent. of rape oil delays the drying for eight days and more. Mineral oils, rosin oils, rosin, and resinates, which are largely employed in the manufacture of varnish, are all detected and estimated according to Köttstorfer's method by saponifying 2 grms. of the oil or varnish with 20 c.c. of half-normal alcoholic caustic potash. The saponification number thus obtained at once shows the presence of any of the above-named adulterants, their saponification numbers being either nil or very low. Moreover, on diluting the alcoholic soap solution obtained by Köttstorfer's test with water, milky emulsions are obtained if mineral or rosin oils are present. If the sample examined contain rosin, the latter is precipitated. The saponification number of pure linseed-oil varnishes varies from 190 to 195, that of linseed oil is 188.—C. O. W.

### *Examination of Linseed Oil and Linseed-Oil Varnish.* F. Filsinger. Zeits. angew. Chem. 1895, 159.

THE objections raised by Amsel (see previous abstract) against the polarimetric examination of linseed-oil varnishes are said to be groundless, as in working with a half-shade polarimeter, the coloration of the varnish solution does not interfere with the accuracy of the observations. It is true that mineral oils are not detected by means of this test, but their presence in a varnish would be indicated by the saponification test, and also be indicated by the great retardation of the drying power. To look for colza or rape oil in linseed oil and linseed-oil varnishes is scarcely worth while, for the simple reason that the former is always higher in price than the latter, and, moreover, is very detrimental to the drying power of linseed oil, so that nothing would be gained by such an adulteration. Regarding the presence of metallic resinates in linseed-oil varnishes, it is difficult to see, the author contends, why these should be objected to any more than litharge, manganese peroxide, or borate of manganese. The metallic resinates add very little to the weight of the varnish, and varnishes prepared with these resinates fulfil all practical requirements.--C. O. W.

### *The Ethereal Oils, their Adulterants and their Detection.* Schimmel and Co. Zeits. f. Anal. Chem. **33**, 756--761.

THE following products are employed in the adulteration of bergamot oil:—

1. The essence extracted from the rind of the small and fallen fruit by pulping, and diluting the pulp with water. This essence has a specific gravity of 0·889 and contains 23·5 per cent. of esters.

2. The essence distilled from the pressed fresh bergamot fruits. Sp. gr. 0·865; esters 12 per cent.

3. The essence distilled from the residue of the small, fallen fruit after the extraction of No. 1. Sp. gr. 0·868; esters 6·6 per cent.

The addition of any of these essences to pure expressed bergamot oil must lower the percentage of esters. The bergamot oil of commerce contains between 31 and 43 per cent. of esters.

For the estimation of the esters, Schimmel and Co. recommend the following saponification method:--1 to 2 grms. of the oil are heated on a water-bath, for from 1 to 2 hours, with 10--20 c.c. of alcoholic semi-normal potassium hydrate solution and then titrated. From the number of milligrms. of potassium hydrate used per grm. of oil—the saponification index,—the percentage of esters can be calculated from the following table:—

Table for the Calculation of the Percentage of Esters of the Formula $C_{10}H_{17}O.COCH_3$.

Linalyl, geranyl, and bornyl acetic esters corresponding to the saponification index (S.I.).

| S.I. | Per Cent. | S.I. | Per Cent. | S.I. | Per Cent. |
|---|---|---|---|---|---|
| 1 | 0·35 | 100 | 35·00 | 200 | 70·00 |
| 10 | 3·50 | 110 | 38·50 | 210 | 73·50 |
| 20 | 7·00 | 120 | 42·00 | 220 | 77·00 |
| 30 | 10·50 | 130 | 45·50 | 230 | 80·50 |
| 40 | 14·00 | 140 | 49·00 | 240 | 84·00 |
| 50 | 17·50 | 150 | 52·50 | 250 | 87·50 |
| 60 | 21·00 | 160 | 56·00 | 260 | 91·00 |
| 70 | 24·50 | 170 | 59·50 | 270 | 94·50 |
| 80 | 28·00 | 180 | 63·00 | 280 | 98·00 |
| 90 | 31·50 | 190 | 66·50 | 286 | 100·10 |

*Sweet orange oil* should not give a lower reading than + 96° in a 100-mm. tube, and bitter orange oil not less than + 92°.

*Geranium oil* contains, besides geraniol, its esters and especially tiglic acid geranyl ester. Butyric and valerianic acids are also present. The amount of esters varies in the different commercial samples, the richest being the Réunion oil with about 31 per cent.

To determine the alcoholic constituents of ethereal oils, the following method is recommended:—10 to 20 c.c. of the oil, with the addition of an equal volume of acetic anhydride and 1 to 2 grms. of sodium acetate, are heated on a water-bath in a flask fitted with an inverted condenser. After cooling, the oil is removed by means of a separating funnel, washed with water, and dried over anhydrous sodium sulphate. The saponification index of the dried product is then determined, and from this is calculated the amount of alcohols contained in the oil, allowance of course being made for the amount of esters originally present. This method does not yield good results with lavender oil, owing to the formation of terpenes, but it is of great service in the estimation of geraniol in other oils and also in the discrimination of the oils of spikenard and rosemary. These two latter oils contain only traces of esters, but oil of spikenard contains at least 30—40 per cent. of alcohols, whilst oil of rosemary only contains 13—15 per cent.

The following table shows the comparative physical properties and ester and geraniol percentages of several oils:—

| —— | Specific Gravity at 15° C. | Optical Activity in 100-mm. Tube. | Esters calculated as Tiglic Acid Geranyl Ester. | Saponification Index of the Acetylised Oil. | Geraniol. |
|---|---|---|---|---|---|
| | | | Per Cent. | | Per Cent. |
| Geraniol, chemically pure | 0·8835 | ±0° | .. | 287·2 | 100·4 |
| Palmarosa oil | 0·894 | −1° 55′ | 15·0 | 259·0 | 90·5 |
| Réunion oil | 0·890 | −9° 15′ | 31·3 | 241·0 | 84·3 |
| " | 0·891 | −9° | 31·1 | 242·0 | 84·6 |
| " | 0·893 | −8° 32′ | 33·3 | 243·0 | 84·9 |
| " | 0·891 | −8° 8′ | 32·5 | 229·0 | 80·0 |
| " | 0·[illegible]1 | −8° 57′ | 34·1 | 227·0 | 79·3 |
| African oil of geranium | 0·898 | −8° 45′ | 29·1 | 235·0 | 82·1 |
| Spanish " " | 0·898 | −8° 12′ | 23·7 | 233·5 | 81·5 |
| Author's preparation | 0·906 | −16° | 27·9 | 212·0 | 74·1 |

The finest qualities of lavender oil contain the highest percentages of esters, the authors distinguishing as fine oils those containing 30 per cent., and as finest, those with 36—40. The best oils are not yellowish, but slightly green. Colourless samples have been rectified and have thereby had their ester percentage and quality diminished.

Lign-aloe oil was found to be adulterated with 20 per cent. of cocoa-nut oil. Such an oil freezes to a buttery mass, and is not entirely soluble in alcohol. One part of pure lign-aloe oil should, if pure, give a clear solution in two parts of 70 per cent. alcohol.

Lign-aloe wood from Cayenne differs considerably from the Mexican wood, the former yielding an oil with a specific gravity of 0·873—0·877 and an optical activity of −16°, whilst the latter gives a distillate with sp. gr. 0·889 and optical activity −7° 33′.

Oil of orange flowers has a specific gravity of 0·876—0·872, and an optical activity of −0° 52′ to −0° 40′ in a 100-mm. tube, is soluble in 80 per cent. alcohol, contains a little free acetic acid, and gives a saponification index of 21. Adulteration with petitgrains oil, or oil of bergamot, increases the saponification index, and can thereby be detected.—J. G. W.

## ANALYTICAL AND SCIENTIFIC NOTES.

### *The Occurence of Hydrogen Peroxide on Surfaces covered with Dried Boiled Linseed Oil.* H. Noerdlinger. Pharm. C.-H. N.F. 1894, 15, 730.

When a surface upon which boiled linseed oil has been allowed to dry—*e.g.*, a piece of paper saturated with the oil—be moistened with an aqueous solution of potassium iodide, the reagent becomes yellow and ultimately brown from the separation of iodine. This reaction is stated to be due to hydrogen peroxide produced during the drying of the oil under the influence of light and air. The occurrence of hydrogen peroxide is not temporary, for the presence of this substance may be recognised for years after the oil has dried, if used either in the form of linseed-oil paints or varnishes.—B. B.

### *The Inversion of Cane Sugar in some Acid Syrups of the French Pharmacopœia.* Hérissey. J. Pharm. Chim. 1895, 6 Ser. 1, 358.

The author has investigated the inversion of cane sugar in the following acid syrups:—Citric acid, tartaric acid, "chlorhydrocalcium phosphate," "calciumlactophosphate," acid calcium phosphate, ferric chloride, quinine sulphate, and has found that in all cases considerable inversion had taken place.—J. L. B.

# New Books.

THE PROSPECTOR'S HANDBOOK. A Guide for the Prospector and Traveller in Search of Metal-bearing and other Valuable Minerals. By J. W. ANDERSON, M.A., F.R.G.S. Sixth Edition, thoroughly revised and much enlarged. London: Crosby Lockwood and Son. 1895. Price 3*s.* 6*d.*

IN his Preface the author thus explains briefly his purpose in writing this book:—"After traversing the mineral fields of New Zealand, New Caledonia, New Mexico, and Colorado, I feel fully convinced that some simple guide or handbook for the use of prospectors as well as travellers, is a desideratum." The work is of pocket-book size, and contains 152 pages of subject-matter, a glossary of terms used by prospectors, &c., and an alphabetical index. It is illustrated with 69 wood-cuts, and contains an Appendix with Tables of Weights and Measures, Weights of Various Rocks and Metallic Ores (lb. per cub. ft.), Specific Gravities of Metals, Ores, and Rocks, a Table of Natural Sines, and a Table of Melting Points of Metals, &c. The Chapters of the work are denoted as follows:—I. Prospecting. II. Rocks. III. Testing Minerals by the Blowpipe. IV. Character of Minerals. V. Metals and Metallic Ores. VI. Other Useful Minerals and Ores. VII. Composition of Various Rocks. VIII. Testing by the Wet Process. IX. Assay of Gold. X. Treatment of Ores. XI. Surveying.

L'INDUSTRIE CHIMIQUE. Encyclopédie de Chimie Industrielle. A. HALLER. Paris: Libraire J. B. Baillière et Fils, 19, rue Hautefeuille. London: H. Grevel and Co., 33, King Street, Covent Garden. 1895. Price 5 fr.

THIS little book, of small 8vo. size and strongly bound in cloth, is a reprint of the report on the International Exhibition of Chicago of 1893, and is made by the author at the request of the Committee on Chemical and Pharmaceutical Products, Paints, Perfumery, and Soaps. In the introduction, extending from page 7 to page 56, statistics of considerable value are given, among them, a Table of Imports and Exports of Chemical Products, between the years 1877 and 1893, for England, Germany, and other Countries. The text covers 287 pages, and is concluded by an alphabetical index. The following subjects are treated of:—I. Acids, Alkalis, and Salts, with recent improvements, &c. II. Chemical and Pharmaceutical Products. Products little known or recently discovered. III. Artificial Colouring Matters. IV. Essential Oils and Raw Materials for Perfumery.

SAVONS ET BOUGIES. Encyclopédie de Chimie Industrielle. J. Lefévre. D. ès Sciences. Prof. à l'École des Sciences de Nantes. Paris: Libraire J. B. Baillière et Fils, 19, rue Hautefeuille. London: H. Grevel and Co., 33, King Street, Covent Garden. 1895. Price 5 fr.

THIS small 8vo. volume, one of the same series as the preceding—L'Industrie Chimique—and similarly bound, is devoted to the subject of Soaps and Candles. It contains, besides the Preface and an introduction treating of the Composition and Properties of Fatty Bodies, 402 pages of matter in which the following subjects are treated of in suitable detail:—PART I.—SOAPS. 1. Composition and Properties. 2. Raw Materials, Fats, and Oils. 3. Caustic Lyes. 4. Tests and Valuation of Fats and Oils. 5. Alkalimetry, &c. 6. Principles of Soap Manufacture. 7. Marbled Marseilles Soaps. 8. White Marseilles Soaps. 9. Hard Soaps. 10. Various Soaps. 11. Toilet Soaps (Hot Process). 12. Various Toilet Soaps. 13. Soft Soaps. 14. Industrial and Medical Soaps. 15. Adulteration and Valuation of Soaps. PART II.—CANDLES. 1. Melting the Tallows. 2. Manufacture of Candles. 3. Adulterations and Tests of Tallows. 4. Extraction of Solid Fatty Acids. 5. Purification of Solid Fatty Acids. 6. Moulding of Stearin Candles. 7. Varieties of Candles. 8. Glycerin. The text is illustrated with 116 wood engravings, and the work concludes with an alphabetical index of subject-matter.

A FIRST BOOK OF ELECTRICITY AND MAGNETISM, FOR THE USE OF ELEMENTARY SCIENCE AND ENGINEERING STUDENTS AND GENERAL READERS. By W. PERREN MAYCOCK, Lecturer on Electricity at the Croydon County Polytechnic, &c. Second Edition. London: 2, White Hart Street, Paternoster Square. 1895. Price 2*s.* 6*d.*

CROWN 8vo. volume, strongly bound in cloth, and containing Prefaces to the first and second editions, Table of Contents, list of illustrations numbering 107, and text filling 216 pages. Next follows a Series of Questions; List of Apparatus for Illustration, with prices; and an Alphabetical Index. The little work is divided into three parts. Part I. Magnetism; II. Electrokinetics; and III. Electrostatics. The reason for writing the book, as stated in the preface, is that students and others desiring to use a standard text-book frequently, need "an easy introduction to such text-book," free from ambiguities, and in the clearest possible language.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate, und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1894. Erstes Halbjahr. Zweite Hälfte. Mit in der Text gedruckten Illustrationen. 1895. Berlin, S. W.: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstr. 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

THE second issue for the first half-year of 1894 of Dr. Jacobsen's Repertory of Chemical Technology. It contains reports of the progress of the following branches of chemical industry:—I. Foodstuffs. II. Paper. III. Photography. IV. Residuals, Manures, Disinfection, and Sanitation. Soaps. Explosives and Matches. Preparation and Purification of Chemicals. Chemical Analysis. Machinery, Apparatus, Electrotechnology and Thermotechnology. Appendix. Adulteration of Trade Products, &c. New Books. This number contains 198 pages of subject-matter, and is profusely illustrated with woodcuts.

JAHRES-RUNDSCHAU ÜBER DIE CHEMISCHE INDUSTRIE UND DEREN WIRTHSCHAFTLICHE VERHÄLTNISSE FÜR DAS JAHR 1894. Ein übersichtlich geordnete Bericht über die Fortschritte der Chemischen Gross- und Klein-Industrie, so wie über analytische Methoden. II. Jahrgang, unter Mitwirkung von Fachmännern, herausgegeben von Dr. ADOLF BENDER, Fabrikschemiker und Docent an der Humboldt-Akademie. Vienna, Pest, Leipsic: A. Hartleben's Verlag. London: H. Grevel and Co., 33, King Street, Covent Garden. 1895. Price 18*s.* complete, or 6*s.* each for Parts I. and II. separately, and 3*s.* each for Parts III. and IV.

THIS Annual Report or Jahresbericht of Chemical Technology is issued in four Parts or Volumes (Abtheilungen), each entire in itself, and each furnished with an alphabetical index of subject-matter and names of authors, &c. The volumes are of 8vo size, and are enclosed in the usual paper covers.

THE FIRST PART treats of technological progress in the following branches:—1. Fuel and Heating. 2. Metallurgy. 3. Metallurgy of Iron. 4. Metallurgy of other Metals. 5. Acids, Bases, Salts, &c. 6. Earthenware. 7. Cements, Artificial Stone, and Building Materials. 8. Glass. 9. Manures. 10. Apparatus and Machinery. It is illustrated with 32 Woodcuts, and contains 180 pages of subject-matter.

The Second Part.—1. Starches and the Starch Industry. 2. Beet- and Cane-Sugar Industry; also other Sweetening Agents. 3. Milk, Butter, and Cheese. 4. Foodstuffs. 5. Water. 6. Spirits. 7. Beer. 8. Wine. 9. Sanitation, Medicaments, and Disinfectants. It is illustrated with 35 Woodcuts, and contains 202 pages of subject-matter.

The Third Part.—1. Industry of the Coal-Tar Colours. 2. Dyeing. 3. Calico Printing. 4. Tanning. 5. Paper Manufacture. This volume is compiled by Dr. A. Buntrock, of Charlottenburg. It is illustrated with 19 Woodcuts, and contains 116 pages of subject-matter.

The Fourth Part.—1. Industry of the Ethereal Oils, Resins, India-rubber, Lakes, and Varnishes. 2. Fats and Oils, Soaps, Fatty Acids, Glycerin, Lanolin, &c. 3. Illuminating Gas, Petroleum, and Paraffin Industries. 4. Explosives, Gunpowder, and Matches. 5. Photography. 6. Adhesive Gums and Pastes, &c. Part IV. is illustrated with five Woodcuts, and contains 106 pages of subject-matter.

# Prizes.

### Prizes for Chemical Research.

Amongst the recent published list of prizes to be offered for competition in 1896 by the French Society for the Encouragement of National Industries are some which have interest to chemists, from the fact that they are open to competitors of all nations. A thousand francs is offered in the chemical section for the utilisation of waste products. The best paper on the culture of the vine in France and the influence of the different processes in connection with the vintage will obtain 2,000 frs., and a similar sum is offered for the best study on the chemical composition of the soil in one of the agricultural districts of France. A stipulation of the competition is that all the papers must be written in French.—*Chemist and Druggist.*

# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

*From the Board of Trade Journal.*

### Germany.

*Alteration in the Customs Tariff.*

A decree, signed by the German Emperor, May 18, and published in the *Deutscher Reichs-Anzeiger* of the 29th May, makes the following alterations in the Tariff Law and Customs tariff of Germany :—

The tariff published in the proclamation aforesaid is altered as follows :—

1. In No. 5, part *a* is to include the following :—
   (1.) Ether of all kinds, except sulphuric ether :
      (*a.*) In casks, 100 kilogs., 125 marks.
      (*b.*) In flasks, jugs, or other receptacles, 100 kilogs., 180 marks.
   (2.) Sulphuric ether, chloroform, collodion; etheric oils, except those included under *c* and *m*; essences, extracts, tinctures, and waters, containing alcohol or ether, for use in industry and medicine; varnishes of all kinds, except oil-varnish; painters' colours, washing colours, and coloured crayons; Indian ink; boxes of paints and Indian ink; lead pencils; red and other coloured pencils; drawing chalk, 100 kilogs, 20 marks.
2. In No. 26 :—
   (*a.*) The following is to replace 26 *b* :—Comestible oils, as :—olive, poppy, ground-nut, beech-nut, sunflower-seed, cotton-seed oils, in casks, 100 kilogs., 10 marks.
      *Note.*—Cotton-seed oil in casks, officially denaturalised, 100 kilogs., 4 marks.
   (*b.*) In 26 *c* the comma after "linseed oil" and the words "cotton-seed oil" are to be omitted.
3. No. 31 (*e*) is to include the following :—
   (*e* 1.) Liquid perfumes containing alcohol or ether; including washes for the head, mouth, and teeth, containing alcohol or ether, 100 kilogs., 300 marks.
   (*e* 2.) Perfumes, not elsewhere specified, 100 kilogs., 100 marks.

This law is to come into force on July 1st, 1895.

### Russia.

*Classification of Articles in Customs Tariff.*

*Note.*—Poud = 36 lb. avoirdupois. Russian pound = 9 lb. avoirdupois. Gold rouble = 3*s.* 2*d.*

Oxide of zinc, chemically pure, prepared by pharmaceutical process, and not used as white paint for industrial purposes, to be cleared under section 112. Duty, 1 rouble 50 copecks gold per poud, gross.

### United States.

*Customs Decisions.*

Lincrusta-walton, a well-known article made of paper, powdered wood pulp, and oxidised linseed oil, with a small percentage of gum and resin, is assessed with a duty at 20 per cent. under either paragraph 310 or 313 of the Act of August 28, 1894.

### British Honduras.

*Amendment of Customs Tariff.*

A communication, dated the 13th May, has been received at the Board of Trade from the Colonial Office, transmitting copy of an Ordinance of the Legislative Council of British Honduras, relating to the Customs duties leviable on certain imported articles, which was passed on the 30th April last. The following is a copy of the ordinance in question :—

Nothwithstanding anything contained in section 3 of "the Tariff Ordinance of 1895," mineral oil of 130° flash-test and upwards, shall pay 3 cents duty per gallon only, while mineral oil with lower flash-test than 130° shall continue subject to a duty of 6 cents as heretofore.

Notwithstanding anything in the said section contained, manure and fertilisers shall be admitted free.

It shall be lawful for the collector of Customs, subject to such conditions as he may deem necessary, to remit the duty on any mineral oil which is intended to be exclusively used as fuel for any steam-boat or engine.

## *GENERAL TRADE NOTES.*

### The New Chief Inspector of Alkali Works.

By effluxion of time, the necessity has arisen of appointing a new chief inspector under the Alkali, &c. Works Act to fill the vacancy created by the retirement of Mr. A. E. Fletcher from the post he has so honourably filled since his appointment in 1884. Under these circumstances we feel sure it will be with pleasurable feelings that the members of the alkali industry will learn that the President of the Local Government Board has elected Mr. R. Forbes Carpenter, of Bent Terrace, Prestwich, to fill the vacancy. Mr. Carpenter has long been an able district inspector under the Act, as well as being Chairman of the Manchester Section of the Society of Chemical Industry, and we wish him every success in the pursuance of the more exalted career to which he has deservedly been called. Mr. Fletcher was the last of the inspectors remaining in office out of the five that were originally appointed in 1863. —*Chemical Trade Journal.*

### SAUERBECK'S TABLES.

Mr. Augustus Sauerbeck's chart of the average prices of general commodities in England, a new issue of which has just been made (Effingham Wilson), again demonstrates that the period of decline is not yet at an end, or was not so in 1894. Mr. Sauerbeck takes 45 representative, or principal, commodities, and compares their prices with the average of the ten years 1867–77, which is adopted as "100." As they rise or fall against those prices the index number goes above or below this 100, and since 1873 the course of prices has been almost uninterruptedly downward. From 1888 to 1891 the average was about 70, or 30 per cent. below the standard of 100; and in 1894 it was under 64, or 36 per cent. below. Taking particular articles in illustration, we find that the average price of tea was 11$\frac{1}{4}$*d.* per lb. in the ten years adopted for standard of comparison. That price, in other words, together with the "average import price," was 100 in the index number. In 1894 tea fell to 4$\frac{1}{2}$*d.* per lb., which brings the number to 47, or a fall of 53 per cent. Scotch pig iron has fallen 38 per cent.; Straits tin, 35 per cent.; cotton (middling upland), 58 per cent.; and petroleum 69 per cent. English wheat is 59 per cent. down, prime beef only 20 per cent., and mutton only 13 per cent.; but in no instance, except that of coffee, which has risen 17 per cent., is the price now higher than it was five and twenty years ago.—*Standard.*

### THE PETROLEUM, ASPHALT, AND BITUMEN OF THE EAST.

The *Revue d'Orient*, of Buda-Pesth, for April 23, gives the following particulars regarding the petroleum, asphalt, and bitumen of the countries of Eastern Europe and of Asia.

The petroleum of Galicia has been worked for at least 35 years. The first systematic development of this industry took place in the Bobka district. In 1861 the first well, 14 metres deep, supplied 6,000 kilos. of oil per hour. In 1883 this district supplied per day 550 barrels of raw petroleum, from a surface of 1,500 metres long and 350 to 500 metres broad.

In certain places a reddish oil is found, which can be burned in a raw state in ordinary lamps. The oil of the bored wells is very fluid, but the surface oil, which comes from shallow wells, is sometimes a little viscous.

Moreover, Galicia produces a certain amount of ozokerit. The chief centre of the industry is Boryslaw, in a valley surrounded with hills on the northern slope of the Carpathians, 360 metres above the sea. At Truskowicz there is a deposit of native sulphur mixed with clayey schist, ozokerit, and petroleum. The ozokerit presents itself under the form of veins of variable thickness, some being several millimetres and others several decimetres thick; the upper beds, which form the richest portion of the deposit, occupy an area of about 21 hectares, but a less productive zone extends the total superfices to about 60 hectares.

The petroleum lands of Roumania constitute the great hope of the future for petroleum, whether we regard the extension of the ground already worked, or the discovery of new petroliferous regions.

In the neighbourhood of the Okna, on the further side of the Eastern Carpathians, in the valley of Trotush, an affluent of the Sereth, some 30 wells are dug in a clayey soil, producing salt and petroleum. In some of these petroleum is found in considerable quantities. At Slanick, opposite Okna, ozokerit has been found.

On the confines, too, of the territories of Grochezti and Hirka, several wells have been dug, in which petroleum is found at a depth of 40 metres.

But it is in the Moniezti district, north of Okna, that the most considerable workings of mineral oil are concentrated. The petroleum wells, to the number of a hundred, are concentrated to the north of the village, and the ground worked may cover a circular surface of from 15 to 16 kilometres in diameter.

The petroleum of Teskani is beyond contradiction the purest in all Moldavia, its composition and density approaching that of naphtha. It weighs only from 0·76 grm. to 0·79 grm., whilst that of Moniezti weighs from 0·84 grm. to 0·87 grm.

In continuing our progress along the eastern slope of the Carpathians, to the south of Teskani, we meet at Modreni with new beds of worked petroliferous clays. The petroleum is here obtained from some thirty wells, the depth of which varies from 35 to 45 metres. The Modreni petroleum is the best which Wallachia produces, and can bear comparison with the most accredited yield of Pennsylvania.

Sarrata is a commune situated to the north of Buséo, and is one of the markets of Wallachia, which, after the district of Plojesti, yields the greatest quantity of petroleum, but of a very poor quality, the oils being extremely charged with tar.

At Plojesti, the petroleum wells, to the number of a hundred, and all of them active, are bored in the clay. It is the same at Baïkoi and Tsinta, where the same salt-bearing clay occurs, with beds below of white lamellated gypsum.

To the north of Matitza, the petroliferous clays of Poceurezza are considered as the cradle of the petroleum industry of Roumania.

Finally, beds of petroleum are met with at Campina, 60 kilos. to the north of Bucharest, on the high road to Brassó (Cronstadt).

The basin of Sélénitza, in Albania, includes a bed of solid bitumen, which is in some places three metres thick. This bitumen is, according to Coquand, petroleum which has reached the extreme limit of exhaustion, reduced into a solid substance, incapable of spontaneous decomposition, and of the generation of new secondary products. Under analysis, the maltha of Sélénitza yields the following results:—Oil of petroleum, 43 per cent.; coal that can be turned into coke, 43 per cent.; residue, 14 per cent.

In passing from the camp at Sélénitza to the Vojutza, we pass hills which contain deposits of bitumen. The plain which separates the mountainous region from the river is sprinkled with fragments of bitumen which the water has dragged down with it, some of which, in the great floods, is carried to the shores of the Adriatic.

It is on the banks of the Vojutza, on a level with the blue clays, that the remarkable phenomena of the air volcanoes make their appearance. M. Coquand was able to study two in full activity very close to one another. The more majestic of the two was placed above a bed of gravel, in the form of a very flattened cone, surmounted by a regular crater of more than a metre in diameter, which was filled with a liquid and transparent water. At intermittent periods, varying from 50 to 55 seconds, the water in the crater was violently shaken by an escape of gas, which broke the surface in the form of great bubbles. Each emission, which overflowed the walls of the crater, ran down over the sides of the cone, the thickness and circumference of which were thus being steadily increased, and then was lost in the quiet waters of a bay formed by the Vojutza.

The old cast-up matter, which lies at a short distance from the crater, becomes as thick as printers' ink, and is able to bear the weight of objects upon it; a man's foot would gradually sink in it if it were left there long enough.

In the island of Zante, the petroleum is found in clays lying under marshy ground, and attempts have been made to sound the depth of these beds. In one case they went down 150 m., and tapped the petroleum bed at 48 m., producing at once about half a ton. Another boring went down 150 m. without getting beyond the blue clay and without any result; a third at 21 m. supplied 5,000 litres within seven hours, and then became absolutely sterile.

The mineral oils of Chiéri are very heavy and of inferior quality, which is easily to be accounted for. The disengagement of inflammable gas for centuries has deprived them of their lighter qualities. It is even reasonable to conjecture that this spontaneous distillation will gradually lead to their impoverishment and complete exhaustion, when they will be finally transformed into solid bitumen, as has already happened in the beds of the Dead Sea and of Sélénitza.

The asphalt beds of Russia are found to the west of the great curve of the Volga, on the right bank, a little above the town of Sizran, and along an extent of 20 kiloms. There are known three beds of them, the lowest of which is the best; this contains from 24 to 36 per cent. of bitumen, the point of fusion of which is much higher than that of the French and Swiss bitumens.

The asphalt diggings have been worked since 1874. They are worked in quarries open to the sky, and they serve to manufacture asphalt putty in three factories, the most important of which is in the town of Sizran. The free bitumen necessary to this manufacture is extracted from bituminous sandstone in the district of Sizran, 80 kiloms. to the east of the beds of asphalt.

The phenomenon of mud volcanoes is produced on a grand scale in the eastern part of the Crimea, near Kertch, and in the neighbouring peninsula of Taman. These volcanoes, considered as phenomena of suppressed volcanic activity, are very numerous, and occur all of them in a region almost parallel to the axis of the Caucasus. Some are active, others inactive, that is to say, in the condition of cones of dried mud.

The bitumen commonly called Judean bitumen exists in the calcareous cretaceous rocks of the valley of the Jordan and of the banks of the Dead Sea. In this region, in particular, it is tolerably abundant, since it leads to an oozing or trickling in a glutinous form, which hardens into a solid resinous mass.

The localities in which it is found in following the western shore of the Dead Sea, and in mounting to the sources of the Jordan, are those of Wady Sebbeh, Wady Mahawat, Nebi-Musa, Hasbeya. The stratum in Wady Sebbeh, which is of slight importance, is formed by dolomitic chalks impregnated with bitumen; the torrent has worn a passage through the chalk, and fragments of asphalt are frequently found in the bed of the torrent, torn by the waters from the bituminous chalk they have crossed. The Wady Mahawat stratum is situated not far from the salt beds of Djébel Usdom. The bitumen there strongly impregnates the cretaceous chalk. It runs out of the fissures, sometimes drooping in the form actual stalactites. The stratum of Nebi Musa, the most extensive of all, presents itself at the surface in the form of large bluish stains, which correspond to bituminous chalks of a rich black in the fissure. The proportion of bitumen differs from 13·55 to 25 per cent. The bitumen burns very easily. The Hasbeya stratum is situated at the northern extremity of the basin of the Jordan. The bituminous chalk is less rich than at Nebi-Musa, perhaps 10 per cent. But at a depth of 60 metres a bed is found containing particularly rich asphalt, 72 per cent. bitumen and volatile substances, and 14 per cent. coal.

The Judean bitumen floats in fragments or in masses of more or less bulk on the Dead Sea, and is particularly thrown up on the western shore and on the banks of the Lisan, where the arabs pick it up among the gravel. It makes its appearance in a liquid or viscous state and is solidified by the volatilisation of the naphtha with which it is penetrated. Whether it rises from the depths of the lake or is oozed forth by its shores, it is at least certain that it presents itself exactly in the same form as that of the strata or beds of the valley of the Jordan.

In conclusion it may be remarked that M. Jaccard seems not to have known of the beds of asphalt in Hungary, in the county of Bihar, at Felsö-Derna, Mezö-Telegd, and Tataros; the works are carried on by two joint stock companies employing about 1,230 workmen.—*Board of Trade Journal.*

### Note from Baku.

*Chem. Zeit.* 1895, **19**, 681—682.

The Department of Commerce and Manufactures has postponed *sine die* the meeting called by members of the Russian Petroleum Syndicate to settle the differences between the large and small refiners, with a view to the parties arriving at some understanding. It is proposed that the smaller refiners shall receive from the large firms for each pood of kerosene 1½ poods of crude naphtha, and for the rectified product 4½, for distillate 3 kopecks, in addition to which the group will have a share, amounting to 25 per cent., in the net profits. The profits on residuum will also be included. Any refiner wishing to discontinue his works will receive 2 kopecks for every pood of his assessed proportion of production, and will likewise participate in the aforesaid advantages. A similar arrangement is in contemplation for the Russian trade, each man's share to be in the same proportion to the whole as in the case of the foreign export trade.

It is stated that in experiments made by Messrs. H. Funk and Co., of London, with a mixture of Russian and light American oils in proportions yielding a product approximating to the quality of Pennsylvania oil, the specific gravity increased after eight hours' burning from 0·801 to 0·8094, the illuminating power decreasing in the same period from 18 to 16½ normal candles—results identical with those from American Standard White. The possibility of supplying Baku oil mixed with light fractions to give a burning oil of lower flashing point is thus foreshadowed.

The statutes of a projected company for exploiting the naphtha lands of the Amoor have been submitted to the Ministry of Finance for approval. The oil territory extends from the river Amoor over the Baikal mountains, the richest indications appearing near Shunka.

Copper ore and naphtha have been discovered in the hills near Sachalin, and it is reported from Wladikawkas that a second company boring for naphtha at Grossni has struck a spouting well.—C. S.

### Uses of Monazite in Germany.

In compliance with department instructions asking for information as to the use of monazite, the United States Consul-General in Frankfort reports as follows:—

Monazite—known in American mineralogy as "Eremit," and variously elsewhere as "Mengit" or "Edwardsit"—is a brown or reddish mineral which was originally found at Miask, in the Ural, but has since been discovered in Norway, Brazil, and, still more recently, in the United States, notably in North Carolina. It is a natural phosphate of the protoxides of cerium and lanthanum, and contains about 28 per cent. of phosphoric acid, 24 to 27 per cent. of protoxide of cerium, 37 to 40 per cent. of protoxide of lanthanum, and generally traces of lime, magnesia, and the oxides of tin. It is infusible before the blowpipe, but is soluble in hydrochloric acid, and upon these two qualities depends its value for the latest industrial purpose to which it has been applied in Germany—the manufacture of hoods for incandescent gas-burners.

Until quite recently the principal use of monazite has been for the production of cerium, lanthanum, and their various chemical derivatives.

Cerium, a grey metal of lamellar structure and high specific gravity, costs, in this country, 190 dols. per kilogram (2·2046 pounds), and its principal derivatives are the acetate, carbonate, chloride, nitrate, oxalate, sulphate, and the hydrated and anhydrous oxides of cerium. These products vary in value from 2·70 dols. per ounce for the anhydrous oxide, to the carbonate, nitrate, and pure oxide of cerium at 1·31 dols.; the salicylate, at 2·18 dols.; and the oxalate, at 41 cents per pound, respectively.

Lanthanum costs, as pure metal, 6·80 dols. for 20 grains; the chloride, 2·70 dols. per ounce; the anhydrous oxide, 3·40 dols.; and the sulphate, nitrate, and hydrated oxide of lanthanum, 2·70 dols. per ounce, respectively. These values are here given to show that both metals and most of their compounds are so expensive that their use must be relatively limited.

The most recent and important application of monazite, which has greatly stimulated the demand for it, is its use as an impregnating material for the hood, or mantle, of the incandescent gas-burner invented by Dr. Auer, of Vienna.

Thus far Germany has obtained its supply of monazite from Norway and Brazil, the value of the imported mineral being governed by the percentage of available monazite contained, which varies from 1½ to 6 per cent. If the mineral from the United States is equal or superior to this there would seem to be a good opportunity for its introduction for this purpose.

The Incandescent Gas-Light Company, No. 5 Molkenmarkt, Berlin, uses monazite in considerable quantity, but has thus far obtained its supply from Norway and Brazil.—*United States Consular Reports.*

### RUSSIAN PETROLEUM.

Recent advices state that the petroleum fields of the Amoor and the district around Lake Baikal, in Central Asia, are extremely rich. The expectation is that the oil from these fields will be exported to China, Japan, &c., *viâ* Vladivostock, and that they will cut out the American oil in those markets. It is expected that the Baikal oil will be cheaper and more plentiful even than that from the Baku district.—*Ironmonger.*

### EXPORTATION OF IRON ORE FROM LULEA.

In a despatch to the Foreign Office, dated May 13 last, Mr. M. S. Constable, Her Majesty's Consul at Stockholm, reports that during the year 1894, 518,614 tons of iron ore were exported from the port of Lulea, as compared with 259,826 tons and 138,381 tons for the years 1893 and 1892. Last year the ore was distributed in the following proportions :—

| | Tons. |
|---|---|
| To furnaces in Sweden | 939 |
| To England | 77,374 |
| To France | 2,148 |
| To Finland | 85 |
| To Germany | 438,068 |

It will thus be seen that Germany absorbs by far the largest proportion of the entire quantity exported.

The chief reason for this is that the Thomas method for treating iron ores is more largely applied in Germany than elsewhere, and that therefore the Germans are able to utilise the very cheap Gellivara ores notwithstanding the somewhat large quantity of phosphorus they contain.

The Gellivara ores are at present sorted into six qualities according to the percentage of phosphorus which they hold.

| | | | | | |
|---|---|---|---|---|---|
| Quality | "A" | contains a maximum of | 0·05 | per cent. | phosphorus. |
| „ | "B" | „ „ | 0·1 | „ | „ |
| „ | "C" | „ „ | 0·6 | „ | „ |
| „ | "D" | „ „ | 0·8 | „ | „ |
| „ | "E" | „ „ | 1·2 | „ | „ |
| „ | "S.A." | „ „ | 0·05 | „ | „ |

None of the ores contain much sulphur, the average being about 0·06 per cent.

The ore that has been up to the present time shipped to England has been almost exclusively that containing the minimum of phosphorus, viz., Class "A."—*Board of Trade Journal.*

### AUSTRALIAN COBALT AND OTHER MINERALS.

In New South Wales deposits of cobalt have been found at Bungonia, Carcoar, and Port Macquarie, but the market for the metal being limited, no attempt has yet been made to produce it on a large scale. Tellurium has been discovered at Bingara and in other parts of the northern districts, though up to the present only in such minute quantities as would not repay the cost of production. It has been found also, in association with bismuth, at Captain's Flat. At Berridale, in the Snowy River district, a lode has been tested for wolfram, a compound of tungstate of iron and manganese, which has been found also in the New England district. Zinc is found in the colony, usually in association with silver, lead, and copper, but it has not been profitably produced. Deposits of various pigments have been discovered near Mudgee and Dubbo, and in the Orange district, where a fair quantity of the raw material, consisting principally of purple oxide and yellow ochre, has been produced. Chromite is found in the northern portion of the colony, in the Clarence and Tamworth districts, and also near Young. It is usually associated with serpentine, but so far very little has been accomplished in the direction of developing these valuable deposits. Graphite of moderate quality has been discovered at Undercliffe, in the New England district, from a lode 6 ft. wide.—*Engineering and Mining Journal.*

### MINERAL PRODUCTION OF CANADA, 1894.

The mineral production of Canada during 1894, as noted in our issue of April 4th, shows an increase in value of $1,650,000 over that of 1893. The following table gives the full mineral production and values during 1894, from a preliminary statistical table prepared by Mr. Elfric Drew Ingall for the Geological Survey of Canada. The figures are in metric tons of 2,204·6 lb., except where otherwise stated. The figures for 1893 are given for comparison :—

*Mineral Production of Canada.*

| — | 1893. | | 1894. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| METALLIC: | | Dols. | | Dols. |
| Copper (*a*) | 3.679 | 875,864 | 3,847 | 805,760 |
| Gold, kilos. (*b*) | 1,092 | 976,603 | 1,648 | 954,451 |
| Iron ore (*c*) | 113,128 | 298,018 | 99,782 | 226,611 |
| Iron ore, chromic | .. | .. | 2,009 | 36,946 |
| Lead (*d*) | 968 | 78,996 | 2,628 | 158,262 |
| Nickel, kilos. (*e*) | 1,806,669 | 2,071,151 | 2,225,975 | 2,061,120 |
| Platinum | .. | 1,800 | .. | 1,000 |
| Silver, kilos. (*f*) | 13,000 | 321,423 | 20,202 | 409,239 |
| Total | .. | 4,623,855 | .. | 4,653,389 |
| NON-METALLIC: | | | | |
| Arsenic | .. | .. | 64 | 420 |
| Asbestos | 5,743 | 310,156 | 6,935 | 420,825 |
| Coal | 3,481,383 | 8,423,759 | 3,495,599 | 8,417,320 |
| Coke (*g*) | 55,409 | 161,790 | 52,404 | 147,861 |
| Fireclay | 490 | 700 | 219 | 515 |
| Feldspar | 522 | 4,525 | .. | .. |
| Grindstones | 4,173 | 38,379 | 3,408 | 32,717 |
| Gypsum, exports | 195,668 | 196,150 | 203,300 | 202,031 |
| Limestone, flux | 25,217 | 27,519 | 31,848 | 34,347 |
| Lithographic stone | .. | .. | 163 | 30,000 |
| Manganese ore | 193 | 14,578 | 67 | 4,180 |
| *Mica (*h*) | .. | 69,622 | .. | 50,000 |
| Mineral water, gallons | 725,096 | 108,347 | 511,460 | 95,040 |
| *Moulding sand | 4,291 | 9,460 | 2,799 | 6,148 |
| Natural gas (*i*) | .. | 376,233 | .. | 313,754 |

* Estimated.

*a*. Copper contents of ore, matte, &c., 10½c. per lb. in 1893, and 9½c. per lb. in 1894.

*b*. Nova Scotia and Ontario gold at $19·50, Quebec at $18, and British Columbia and Yukon at $17 per oz.

*c*. Of this quantity, in 1893, 112,539 metric tons were converted into pig iron, producing 50,754 metric tons, valued at $790,283, and in 1894, 98,766 tons were converted into pig iron, producing 45,275 tons, valued at the furnaces at $646,447.

*d*. Lead contents of ore, &c., in 1893 at 3$\frac{7}{10}$c., in 1894 at 3¼c. per lb.

*e*. Nickel contents of ore, matte, &c., in 1893 at 52c., in 1894 at 42c. per lb.

*f*. Silver contents of ore, &c., in 1893 at 769c., in 1894 at 63c. per oz.

*g*. Oven coke, all the production of Nova Scotia.

*h*. Exports, plus quantity sold to Canadian electrical and stove manufacturers.

*i*. Gross returns from sale of gas.

*Mineral Production of Canada*—cont.

| | 1893. | | 1894. | |
|---|---|---|---|---|
| | Quantity. | Value. | Quantity. | Value. |
| | | Dols. | | Dols. |
| Ochres | 971 | 17,710 | 1,018 | 11,120 |
| Petroleum (*a*), bbls. | 798,406 | 834,334 | 829,104 | 835,322 |
| Phosphate | 7,467 | 70,912 | (*b*) 6,613 | 43,910 |
| Precious stones | .. | 1,500 | .. | 1,500 |
| Pyrites | 53,108 | 175,626 | 36,765 | 121,581 |
| Quartz | 91 | 500 | .. | .. |
| Salt | 56,539 | 194,015 | 51,890 | 170,687 |
| Soapstone | 640 | 1,920 | 831 | 1,640 |
| Whiting, bbls. | .. | .. | 500 | 750 |
| STRUCTURAL MATERIALS: | | | | |
| Bricks, thousands | 290,000 | 1,800,000 | .. | *1,800,000 |
| *Building stone, cub. yds. | 219,747 | 609,827 | .. | 1,100,000 |
| Cement, bbls. | 158,597 | 194,015 | 107,327 | 140,659 |
| Flagstone, sq. ft. | 40,500 | 3,487 | 152,700 | 5,298 |
| Granite | 20,431 | 94,393 | 14,901 | 109,936 |
| *Lime, bushels | 6,750,000 | 900,000 | .. | 900,000 |
| Marble | 535 | 5,100 | .. | .. |
| Pottery | .. | 213,186 | .. | 113,874 |
| Roofing cement | 863 | 5,141 | 513 | 1,978 |
| Sand and gravels, exports | 298,569 | 121,795 | 294,523 | 86,940 |
| Sewer pipe | .. | 350,000 | .. | 250,325 |
| Slate | 6,452 | 90,825 | .. | 75,550 |
| Terra cotta (*c*) | .. | 55,704 | .. | 65,600 |
| Tiles (thousands) | 19,000 | 200,000 | .. | 200,000 |
| Total non-metallic | .. | 15,786,909 | .. | 15,821,858 |
| Total metallic | .. | 4,623,855 | .. | 4,653,389 |
| Estimated value of other products. | .. | 1,111,742 | .. | 294,744 |
| Total | .. | 21,522,506 | .. | 20,709,991 |

* Estimated.

*a*. Calculated from inspection returns, at 100 galls. crude to 38 refined oil, and computed in 1893 at $1·04½, and in 1894 at $1·00¾ per bbl. of 35 imp. galls. The barrel of refined oil is assumed to contain 42 imp. galls.

*b*. Railway shipments at average price of $6 per ton.

*c*. In 1893 includes porous fireproof terra cotta; in 1894 porous fireproof terra cotta and other structural and ornamental forms.

The value of the products since 1886 has been as follows: 1892, $19,500,000; 1891, $20,500,000; 1890, $18,000,000; 1889, $14,500,000; 1888, $13,500,000; 1887, $12,250,000; 1886, $12,000,000.—*Ibid.*

### METALLIFEROUS MINING IN NEW ZEALAND.

Although it has been ascertained that New Zealand is rich in many of the useful metals, mining operations in that colony have been confined principally to gold and silver. In explanation of this, the New Zealand Minister of Mines says it is owing, "in a great measure, to the difficulties there are to contend with, not only in getting machinery and appliances on the ground, but also in getting men with sufficient capital to open out and work the mines. The attention of those persons who put their money into mining is generally directed to gold only."

The country in which the metalliferous ores are found is of an extremely rough and broken character, difficult of access, and at a considerable distance from the nearest settlements, thereby largely increasing the cost of working.

*Antimony.*—The only ores at present worked are antimony and manganese. The former is obtained principally from Endeavour Inlet, Queen Charlotte Sound, but until recently the heavy expense of producing crude antimony led to considerable losses on the part of the miners, resulting in failure after failure, until a process was invented with a view to lessening the cost of production. This process has been in use some few months. Should it prove permanently successful, it will, we are officially told, "overcome one of the greatest difficulties in the way of the production of antimony from its ore that has been experienced in all the countries of the world where this metal is obtained." The details of the process have not been fully described, but one of its features is the vastly diminished quantity of fuel used. It is said that the introduction of the process has enabled New Zealand antimony to be placed on the British market, with a fair margin of profit, even at the low prices lately ruling.

*Manganese.*—These deposits are mostly at too great a distance from the nearest port of shipment to admit of being worked at a profit, although the mineral is abundant in many places. Where the mines are near the coast, where vessels can be loaded, they are successfully worked.

*Cinnabar.*—Traces of cinnabar, in the shape of small rounded pellets, have been found in various localities, but, so far, no lodes have been discovered, although prospecting operations have been carried on for some time. The pellets are found among the gravel wash-dirt of a small creek. About 75 lbs. of cinnabar have been obtained by washing the drift, and it is anticipated that sooner or later the mineral will be traced into the solid country.

*Scheelite* in considerable quantities is found is some parts of the Middle Island—New Zealand comprises three large islands—but at present no efforts have been made to secure any quantity for shipment, although it could be placed on the British market at a fair profit.

*Coal* of good quality is plentiful, but the annual output is limited, amounting to only 691,548 tons in 1893. In the official returns 153 mines are mentioned, but most of these are simply small pits or open cuttings. The local consumption is limited to lignite or brown coal. The bituminous coal, which is found only in the Middle Island, is raised principally for use by ocean-going steamers. The possibilities of an export trade in New Zealand coal are at present somewhat remote. In 1893 the colony imported 113,122 tons from New South Wales, 2,939 tons from Queensland, and 1,385 tons from Victoria. A portion of this was re-exported, and nearly half used for the supply of steam vessels. The utter impossibility of placing the coal at a sufficiently low price at present in foreign markets prevents any rapid development of the coal-mining industry. China and Japan can each place coal in the Eastern markets on more favourable terms than can New Zealand. The average wages of the coal miners has been estimated at 119*l.* 7*s.* 1*d.* per head per annum.

*Platinum*, in its metallic state, has been found among the gravel drifts, but not, so far, *in situ*.

*Tin* is plentiful, both in the alluvial drifts and in lodes, taking in both the form of blackish-brown pellets, those from the lodes containing a large percentage of wolgram.

*Copper* has been met with in several localities, but no effort has been made to utilise the deposits, some of which are of a rich character. The principal lead ores are galena and cerusite. They are generally found in combination with gold, silver, zinc, copper, antimony, &c. Zinc and nickel ore have also been found.

*Chrome Ore* in large quantities was formerly shipped to Europe. It occurs in the form of chromite or oxide of chrome. The lodes are in a magnesium rock formation, dunite, closely resembling serpentine. The ore has a submetallic lustre, and is of brownish-black colour, and sometimes slightly magnetic. Although the lodes were discovered several years ago, they have not been worked for a considerable period.—*Ibid.*

## MINERAL PRODUCTION OF THE UNITED STATES, 1893 AND 1894.

Compiled for *The Mineral Industry*, Vol. III.

By Richard P. Rothwell, editor of *The Engineering and Mining Journal.*

| No. | Products. | Customary Measures. | 1893. Quantity. Customary Measures. | 1893. Quantity. Metric Tons. | 1893. Value at Place of Production. | 1894. Quantity. Customary Measures. | 1894. Quantity. Metric Tons. | 1894. Value at Place of Production. |
|---|---|---|---|---|---|---|---|---|
| | NON-METALLIC. | | | | | | | |
| | Abrasives— | | | | Dols. | | | Dols. |
| 1 | Corundum and emery | Short Tons | 1,747 | 1,585 | 140,589 | 1,220 | 1,106 | 109,500 |
| 2 | Garnet | „ | 1,520 | 1,379 | 55,800 | 1,000 | 907 | 35,000 |
| 3 | Grindstones | „ | 45,340 | 41,133 | 345,920 | 37,400 | 33,922 | 335,800 |
| 4 | Millstones | „ | 155 | 141 | 2,359 | 297 | 269 | 4,447 |
| 5 | Tripoli and infusorial earth | „ | 1,351 | 1,226 | 25,625 | 1,802 | 1,634 | 36,687 |
| 6 | Whetstones | „ | 1,903 | 1,726 | 89,550 | 1,735 | 1,574 | 84,450 |
| 7 | Alum | „ | 96,000 | 87,093 | 2,880,000 | 72,000 | 65,304 | 2,160,000 |
| 8 | Antimony ore | „ | 850 | 771 | 41,000 | 165 | 150 | 9,075 |
| | Asbestos and Talc— | | | | | | | |
| 9 | Asbestos | „ | 120 | 109 | 6,000 | 250 | 227 | 3,750 |
| 10 | Fibrous talc | „ | 36,500 | 33,113 | 337,625 | 39,600 | 35,917 | 396,000 |
| 11 | Talc and soapstone | „ | 20,100 | 18,235 | 366,825 | 21,044 | 19,087 | 401,892 |
| 12 | Asphalt | „ | 3,490 | 3,166 | 68,682 | 4,198 | 4,080 | 75,654 |
| 13 | Bituminous rock | „ | 31,404 | 28,489 | 114,752 | 34,199 | 25,018 | 148,120 |
| 14 | Barytes | „ | 26,632 | 24,161 | 133,160 | 23,758 | 21,548 | 95,032 |
| 15 | Bauxite | Long Tons | 19,041 | 10,896 | 55,205 | 10,732 | 10,908 | 42,928 |
| 16 | Borax | Pounds | 9,199,000 | 4,173 | 689,925 | 13,140,589 | 5,962 | 919,841 |
| 17 | Bromine | „ | 348,399 | 158 | 87,400 | 379,444 | 172 | 98,655 |
| 18 | Cement, natural hydraulic | Bbls., 300 lbs. | 7,445,950 | 913,677 | 5,010,958 | 7,895,259 | 1,074,179 | 4,397,407 |
| 19 | Cement, Portland | „ | 673,989 | 91,715 | 1,052,173 | 738,196 | 100,352 | 1,080,644 |
| 20 | Clay, refractory | Short Tons | 3,214,989 | 2,916,591 | 4,822,483 | 3,375,738 | 3,061,794 | 4,050,885 |
| 21 | Clay, kaolin | „ | 30,183 | 27,382 | 205,667 | 24,552 | 22,246 | 185,169 |
| 22 | Coal, anthracite | „ | 47,355,387 | 42,960,116 | 74,605,885 | 52,010,433 | 47,183,345 | 80,879,404 |
| 23 | Coal, bituminous | „ | *a*128,826,364 | 116,869,397 | 123,899,415 | *a*117,950,348 | 106,953,311 | 103,842,467 |
| 24 | Coke | „ | 8,939,961 | 8,104,202 | 14,706,544 | 8,495,295 | 7,706,846 | 12,654,558 |
| 25 | Cobalt oxide | Pounds | 3,894 | 2 | 5,452 | 6,550 | 3 | 8,843 |
| 26 | Copperas | Short Tons | 17,862 | 16,204 | 134,520 | 14,897 | 13,511 | 164,100 |
| 27 | Copper sulphate | Pounds | 54,000,000 | 24,492 | 1,822,500 | *e*60,000,000 | 27,215 | 2,016,000 |
| 28 | Chrome ore | Long Tons | 1,629 | 1,636 | 16,000 | 2,653 | 2,697 | 35,125 |
| 29 | Feldspar | „ | 17,000 | 17,274 | 85,000 | 23,280 | 23,655 | 116,400 |
| 30 | Fluorspar | Short Tons | 9,700 | 8,800 | 63,070 | 9,000 | 8,165 | 64,000 |
| 31 | Graphite | Pounds | 882,912 | 400 | 39,731 | 770,846 | 349 | 34,689 |
| 32 | Graphite, amorphous | Short Tons | 1,691 | 1,534 | 8,996 | 165 | 150 | 1,252 |
| 33 | Gypsum | „ | 330,231 | 299,682 | 927,615 | 287,517 | 279,437 | 849,925 |
| 34 | Lime | Bbls., 200 lbs. | *e*60,000,000 | 5,443,164 | 30,000,000 | *e*56,750,000 | 5,104,355 | 28,375,000 |
| 35 | Magnesite | Short Tons | 1,143 | 1,037 | 8,000 | 1,370 | 1,243 | 4,864 |
| 36 | Manganese ore | Long Tons | 9,150 | 9,297 | 60,000 | 11,735 | 11,924 | 74,890 |
| 37 | Mica, ground | Pounds | 679,000 | 308 | 29,522 | 829,500 | 377 | 35,957 |
| 38 | Mica, sheet | „ | 6,500 | 3 | 5,478 | 9,900 | 4 | 11,103 |
| 39 | Monazite | „ | 130,000 | 59 | 7,600 | 750,000 | 340 | 45,000 |

(*a*) Including brown coal, lignite, and anthracite, mined elsewhere than in Pennsylvania. (*e*) Estimated.

THE MINERAL PRODUCTION OF THE UNITED STATES, 1893 AND 1894—*continued.*

| No. | Products. | Customary Measures. | 1893. | | | 1894. | | |
|---|---|---|---|---|---|---|---|---|
| | | | Quantity. | | Value at Place of Production. | Quantity. | | Value at Place of Production. |
| | | | Customary Measures. | Metric Tons. | | Customary Measures. | Metric Tons. | |
| | NON-METALLIC—*continued.* | | | | Dols. | | | Dols. |
| 40 | Natural gas | .. | .. | .. | 14,000,000 | .. | .. | 11,000,000 |
| 41 | Paints, mineral | Short Tons | 44,709 | 40,559 | 726,160 | 38,801 | 34,201 | 662,262 |
| 42 | Paints, vermilion | " | 37 | 34 | 40,000 | 41 | 37 | 45,600 |
| 43 | Paints, white lead | " | 88,500 | 80,286 | 9,469,500 | 87,242 | 78,155 | 8,445,174 |
| 44 | Paints, zinc oxide | " | 25,000 | 22,679 | 1,875,000 | 22,814 | 22,172 | 1,711,275 |
| 45 | Petroleum (crude) | Bbls., 42 galls. | 50,349,228 | 6,978,403 | 32,223,505 | 48,527,336 | 6,725,490 | 40,762,962 |
| 46 | Phosphate rock | Long Tons | 981,340 | 997,140 | 3,434,690 | 952,155 | 967,485 | 2,856,465 |
| 47 | Marls | " | 200,000 | 203,814 | 540,000 | 225,000 | 228,622 | 607,500 |
| 48 | Precious stones | .. | .. | .. | 200,000 | .. | .. | 250,000 |
| 49 | Pyrites | Long Tons | 95,000 | 95,526 | 285,000 | 107,462 | 109,192 | 466,466 |
| 50 | Salt, evaporated | Bbls., 280 lbs. | 9,703,419 | 1,232,392 | 4,945,583 | 9,161,053 | 1,163,508 | 4,608,275 |
| 51 | Salt, rock | " | 1,935,642 | 245,838 | 678,064 | 2,341,922 | 297,438 | 788,681 |
| 52 | Silica, sand and quartz | Long Tons | 300,000 | 304,814 | 330,824 | 315,531 | 320,610 | 347,951 |
| 53 | Slate, roofing | Squares | 803,887 | 237,014 | 2,956,895 | 693,944 | 204,656 | 2,551,259 |
| 54 | Slate, other manufactures | Square feet | 4,138,920 | .. | 475,681 | 5,099,791 | .. | 499,578 |
| 55 | Soda, natural | Short tons | 2,500 | 2,268 | 12,500 | .. | .. | .. |
| 56 | Soda, natural sulphate | " | 90 | 82 | 450 | .. | .. | .. |
| 57 | Stone, limestone (flux) | Long tons | 3,750,000 | 3,810,375 | 2,250,000 | 3,544,393 | 3,602,290 | 2,126,636 |
| 58 | Stone, marble | Cubic feet | 5,639,681 | 429,399 | 2,087,758 | 5,681,766 | 433,093 | 2,177,280 |
| 59 | Stone, onyx | " | 2,175 | 166 | 28,750 | 1,450 | 110 | 29,000 |
| 60 | Other building stones | .. | .. | .. | *e*38,000,000 | .. | .. | *e*30,900,000 |
| | Total non-metals | .. | .. | .. | 377,476,784 | .. | .. | 353,670,787 |
| | METALS. | | | | | | | |
| 61 | Aluminium | Pounds | *a*312,000 | 142 | 202,800 | 817,600 | 371 | 490,560 |
| 62 | Antimony | Short tons | 350 | 318 | 63,000 | 220 | 205 | 39,200 |
| 63 | Copper | Pounds | 327,255,788 | 148,441 | 35,179,997 | 353,504,314 | 110,483 | 33,540,489 |
| 64 | Gold | Troy ounces | 1,739,323 | *75,764 | 35,955,000 | 1,923,619 | *72,732 | 39,761,205 |
| 65 | Iron, pig | Long tons | 7,043,384 | 7,156,782 | 93,888,309 | 6,657,388 | 6,764,572 | 71,966,364 |
| 66 | Lead, value at New York | Short tons | 166,678 | 152,080 | 12,434,178 | 160,867 | 145,906 | 10,585.048 |
| 67 | Nickel, fine | Pounds | 25,893 | *11,745 | 12,429 | .. | .. | .. |
| 68 | Quicksilver | Flasks, 76½ lbs. | 30,164 | 1,046 | 1,108,527 | 30,410 | 1,056 | 1,095,810 |
| 69 | Silver, commercial value | Troy ounces | 60,500,000 | *1,881,550 | 47,311,000 | 49,846,875 | *1,550,238 | 31,403,531 |
| 70 | Zinc, spelter | Short tons | 76,255 | 69,178 | 6,214,782 | 74,000 | 67,135 | 5,209,882 |
| | Total metals | .. | .. | .. | 232,370,022 | .. | .. | 194,092,119 |
| | Estimated products unspecified | .. | .. | .. | 6,000,000 | .. | .. | 5,500,000 |
| | Grand total | .. | .. | .. | 615,846,806 | .. | .. | 553,372,902 |

(*a*) Including brown coal, lignite, and anthracite, mined elsewhere than in Pennsylvania. (*e*) Estimated. * Kilograms.

—*Ibid.*

### Progress in the Starch Industry.

*Hanow. Chem. Zeit.* 1895, **19**, 708—709.

Owing to the plentiful potato crop in 1893 the price of starch fell to the lowest recorded point, and only recovered in the summer of last year, when the probable deficiency of potatoes in Germany and maize in America became known. The exports of starch and starch products from the former country during 1894 amounted to 50,130 metric tons, an increase of 8,000 metric tons over the previous year, four-fifths of the difference going to the credit of potato meal and starch, and only the remaining fifth due to an increase in starch sugar and syrup. As the German industry is not in a very flourishing condition, the fact that no important or costly alterations or novelties were introduced in the past year needs no explanation.

Gaudet (La Féculerie, 1894, No. 1, 7) introduced an apparatus for the continuous exhaustion of starch. It consists of a series of movable sieves, arranged in steps, and separated by channels wherein the pulp is stirred up, the washing water increasing in richness of starch at every stage.

It is reported that in France the scum starch in the settling-pan is washed with water at 30°—40° C., with the idea of dissolving the substances enveloping the starch grain.

Several plans have been proposed for the utilisation of the potato pulp as fodder. One is to place the pulp in a pit and allow the liquid portion to drain off. Most of the micro-organisms are said to be removed in this manner, leaving innocuous fodder. In Colcord's box-silos, perforated metal pipes at the bottom of the box communicate with others outside for the admission of air and removal of drainings. At the works of Büttner and Meyer, of Küstrin, the pulp is treated with milk of lime, pressed, and mixed with molasses in the proportion of 1 to 4, producing a useful fodder, which may either be used as it is or dried in a kind of oven by means of hot gases aided by strong draught. The finest particles drying first are carried off in the air current and collected, to be subsequently re-mixed with the bulk after the latter is dried and ground.—C. S.

### The Sugar Industry in Austria-Hungary.

According to the *Moniteur Officiel du Commerce*, the first manufactory of beetroot sugar was established in 1830 at Dobrowitz in Bohemia. In 1863–64 the Empire possessed 136 manufactories, producing 1,040,000 quintals of sugar extracted from 8,103,000 quintals of beetroots. In 1873–74 the number was 257 establishments, which turned out 2,420,000 quintals of sugar from 13,750,000 quintals of beetroots. Since then the number of manufactories has diminished, but the production continues to increase. In 1883–84 there were 230 establishments; 41,845,000 quintals of beetroots in use, giving 4,700,000 quintals of sugar. In 1887 the number of manufactories sank to 203; since then there has been a reaction, and in 1893-94, 236 manufactories have produced 8,300,000 quintals of sugar from 65,000,000 quintals of beetroots. In the same year Germany produced 13,800,000 quintals of sugar. The value of the exports of sugar from Austro-Hungary was 97,000,000 florins in 1893–94 as against 71,000,000 in 1893–94, and 83,000,000 in 1891–92.

To this forced production, stimulated by bounties, must be attributed the various crises through which the sugar industry has passed. A fresh crisis is arising from the same cause. By increasing the bounties to sugar manufacturers, the production has been much increased, but the consumption cannot be developed in the same degree, as the duties are too heavy in proportion to the value of the article. A tax, which at one time represented 30 per cent. of the sale price, may now be set down as 70 per cent. of the same. In Belgium the consumption duty is 45 francs for raw sugar worth only 22 francs. In Austro-Hungary the basis of the tax is 11 florins per 100 kilogs. for beetroot and other raw sugars, whatever may be their degree of finish. In Hungary there is, in addition to the tax on the production, a consumption tax of 6 florins per quintal.

The law of the 20th June 1888 grants, by way of export bounty, for every 100 kilogs.:—

1 florin 50, if the degree of polarisation is from 88 to 93 per cent.

1 florin 60, if the degree of polarisation is from 93 to 99½ per cent.

2 florins 30, if the degree of polarisation is above 99½ per cent.

But the total amount of bounties is limited; it cannot exceed 5 millions of florins.—*Board of Trade Journal.*

### The Sugar Industry in Argentina.

According to the last report of the French Minister at Buenos Ayres, the sugar industry of Argentina has developed considerably since 1855. The total production has risen in 40 years from 400,000 to 76,600,000 kilogs., as seen in the following table:—

| Years. | Total Amount produced. | Of which the Province of Tucuman. |
|---|---|---|
| | Kilogs. | |
| 1855 | 400,000 | Five-sixths of the whole. |
| 1857 | 720,000 | Almost the whole. |
| 1872 | 1,400,000 | „ |
| 1881 | 9,000,000 | „ |
| 1887 | 24,000,000 | „ |
| 1889 | 49,321,600 | „ |
| 1891 | 46,366,155 | 40,217,242 kilogs. |
| 1892 | 57,696,913 | (No returns.) |
| 1893 | 53,000,000 | 48,000,000. |
| 1894 | 76,600,000 | 65,000,000. |

In the current year the production, unless unforeseen accidents should occur to the plantations, can, it is said, easily reach 85,000,000 kilogs., from the 42,500 hectares of cane in actual cultivation, and even attain a much higher figure, since, under ordinary circumstances and reckoning only 30 tons to the hectare, it is possible to obtain from 7 to 7½ per cent. of sugar, which would represent a total of 95,625,000 kilogs. The province of Tucuman is the great centre of the sugar industry. In 1894, this province alone contained 35,000 hectares of cane, of which 8,000 consisted of plants of one year's growth, and 27,000 of plants of more than one year's growth. After deducting 10 per cent. for new plantations, &c., the product was upwards of 70,000,000 kilogs. of sugar, or an average of 2,200 kilogs. to the hectare. This is a poor result, since a hectare, with an ordinary yield of 40 tons and rendering 7 per cent. of saccharine, should yield at least 2,800 kilogs. In other districts, and in the provinces of Jujuy, Chaco, and elsewhere, the yield in a good year is 45 tons of cane, with an average 8 per cent. of saccharine, representing 3,600 kilogs. of sugar. When Jujuy, Chaco, and the other provinces have factories like those already established at Tucuman, and the cane can be made to yield 8½ to 9 per cent. of sugar, one hectare will produce 4,000 kilogs.—*Ibid.*

### Gutta-Percha from Leaves.

There is now a prospect that the supply of gutta-percha will become permanent. The old native method of cutting down a tree to get the gum, and thus killing the goose that laid the golden eggs, is giving place to that of plucking the leaves and extracting the gum from them. This plan has been put in practice by M. Hourant, at Sarawak, with success. The gum from the leaves is not only purer, but there is more of it. An adult tree of 25 to 30 years' growth only yields one catty of gum when the tree is sacrificed, whereas two pluckings of the leaf yield as much without injuring the tree. Moreover, the saplings from the roots of trees already cut down are useful in yielding leaves.—*Chemical Trade Journal.*

### PUMICE IN COLD-AIR STORES.

Pumice stone is being used in New Zealand as a substitute for charcoal as an insulator. There are large deposits of it, and a particular variety has been discovered at Rangiriri, near Auckland, and is now being obtained, and will quite revolutionise the old system. Large and expensive machinery has been erected. Rotary furnaces have been built to render the pumice absolutely free from moisture, and from 10 to 25 per cent. lighter than charcoal. This calcined pumice is now being extensively used by meat purveyors, brewers, maltsters, millers, and others. They find it is far lighter, cleaner, free from organic matter, and is much better in every way than charcoal as an insulator, and above all it cannot fire. The New Zealand Government has watched the development of this industry, and only recently they gave instructions for the prepared pumice to be subjected to severe tests to prove its qualities as an insulator. It fulfilled all and more than was required of it, and strong recommendations were made by the inspector in its favour. —*Ibid.*

### THE GERMAN EAST AFRICAN SODA DEPOSITS.

Apotheker Hermann Peters, of Nuremburg, contributes to the *Pharmaceutische Zeitung* an interesting article on the soda deposits of German East Africa, which were first explored and accurately described by the author's brother, the well-known Dr. Carl Peters, now German Imperial Commissary in East Africa. Mr. Peters calls attention to the statement in Pliny (Book XXXVI., Ch. 66) that the Phœnicians obtained the saltpetre which they used in their glass manufacture from the land of Ophir. The identity of the classical Ophir with Central East Africa has been much discussed of late years, and Mr. Peter's statement may be regarded as so much additional evidence in favour of the contention that "Ophir" actually covered some portion of the East African Hinterland. In several parts of German East Africa there are huge deposits of natural carbonate of sodium, the product of which is an important trading article in those parts, especially in Masai-land. The commercial salt is nearly all dug out at the western side of Mount Kilima-Njaro, where there is a sodium lake about 12½ miles long by 2½ miles wide. The water of this lake is soft, of a reddish-yellow colour, and has a temperature of about 50° C. The shores are covered with a salt-crust and abound in hot alkaline springs. According to Mr. Peters, the German colonial carbonate of sodium is quite free from sulphuric acid and contains only traces of chlorine and iron. An analysis of the samples by Professor Kämmerer gave the following results:—

| — | Actually present. | Tested for |
|---|---|---|
| $Na_2O$ .......................... | 41·36 | 41·51 |
| $H_2O$ .......................... | 20·74 | 20·62 |
| $CO_2$.......................... | 37·93 | 37·89 |
| | 100·93 | 100·02 |

From this analysis Professor Kämmerer calculates the formula of the natural salt as—

$$4Na_3H(CO_3)_2, Na_2CO_3, 10H_2O.$$

At present the deposits are exploited by the natives only, which causes the brothers Peters to sigh for the realisation of the projected railway through German East Africa from the coast to the Victoria Nyanza, which would make the deposits available for the German glass and soap industry.—*Chemist and Druggist.*

### FRIEDRICHSHALL WATER.

A new spring has been opened at Friedrichshall. The old spring, which has been continuously worked for upwards of 50 years, and was referred to by Baron Liebig as "a treasure of Nature," has of late given indications that the combination of saline deposits which gave it its value was becoming exhausted. Geologists were of opinion that this was simply due to the dissolving action of the water upon that portion of the vein of deposits which fed the spring, and that the same vein could as easily be struck and worked by another shaft. Borings were accordingly made, and a new spring found, with the satisfactory result that the water drawn therefrom proves to be practically identical with that originally yielded by the old Friedrichshall spring. An analysis of the water from the new spring, by Dr. B. Fischer, of Breslau, compared with one made by Liebig in 1846, shows that the two waters are practically identical. We give the two averages below:—

| — | Parts in 1,000. | |
|---|---|---|
| | Fischer, 1894. | Liebig, 1846. |
| Sulphate of soda .................. | 5·9461 | 6·0560 |
| „ magnesia ............ | 5·9624 | 5·1502 |
| „ lime.................. | 0·7408 | 1·3456 |
| „ potash.............. | 0·1707 | 0·1982 |
| Chloride of sodium................ | 7·3112 | 7·9560 |
| „ magnesium........... | 4·7135 | 3·9390 |
| Bromide of magnesium........... | 0·0072 | 0·1140 |
| Carbonate of soda................ | 0·3163 | 0·0000 |
| „ magnesia ........... | 0·0113 | 0·5198 |
| „ lime ................ | 0·2193 | 0·0117 |
| Carbonic acid.................... | 0·2338 | 0·4020 |
| Silicic acid........................ | 0·0012 | Traces |
| Oxide of iron..................... | Traces | „ |
| Alumina.......................... | „ | „ |
| Total ................ | 25·6443 | 25·6955 |

The medicinal value of the Friedrichshall water is due to the combination of the sulphates and chlorides of sodium and magnesium.—*Ibid.*

### THE VALUATION OF MANURES.

The Highland and Agricultural Society once more issues its useful scale of unit values for the determination of a fair price for fertilisers. The classification adopted is as follows:—

"Fish guano.—Finely ground, and containing not more than 3 per cent. oil. Frey-Bentos guano.—(*a.*) Meat meal, free from horn, yielding over 11 per cent. nitrogen. (*b.*) Mixed scrap, yielding 6 to 7 per cent. nitrogen and 30 to 40 per cent. phosphates. Bone meal.—(*a.*) 90 per cent. passing ⅛-in. sieve. (*b.*) Coarser. Genuine bone meal contains 45 per cent. to 55 per cent. phosphates and from 3½ per cent. to 4½ per cent. nitrogen. The better qualities contain little or no fat. Steamed bone flour.—Ground to flour, and containing about 60 per cent. phosphates and about 2 per cent. nitrogen. Dissolved bones.—Must be pure—*i.e.*, containing nothing but natural bones and sulphuric acid. Mixtures.—To be valued according to the unit values (as given below) of the ingredients of which they are guaranteed and also found to be composed, with an addition of from 5 to 10 per cent., according to the fineness of their manufacture. Thomas slag and ground phosphates.—Fineness of grinding is of paramount importance. The coarsest kind used should be so finely ground that 80 per cent. passes through a sieve of 10,000 holes per square inch.

The following table gives the unit values for the present season, which are compulsory on all local analytical associations receiving grants from the Highland Society, and are based on the present *retail* prices at port. When these units are multiplied by the percentages in the analysis of a manure, they will produce a value representing very nearly the cash price at which one single ton may be bought in fine serviceable condition. Larger purchases may be made on more favourable terms.

UNIT VALUES FOR SEASON 1895.

| Items to be Valued. | Guanos. | | Scrap Manures. | | | Bone Manures. | | | | Super-phosphates. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Icaboe. | Peruvian (Riddled). | Fish Guano. | Frey-Bentos Guano. | | Bone Meal. | | Steamed Bone Flour. | Dissolved or Vitriolated Bones. | |
| Classes. | Genuine. | Genuine. | | *a.* | *b.* | *a.* | *b.* | | | |
| | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* | *s. d.* |
| Phosphates, dissolved .... | .. | .. | .. | .. | .. | .. | .. | .. | 3 0 | 1 11 |
| „ undissolved.. | 2 3 | 2 3 | 1 4 | 1 6 | 1 4 | 1 2 | 1 0 | 1 4 | 1 6 | .. |
| Nitrogen ................ | 21 0 | 21 0 | 13 6 | 15 6 | 13 6 | 11 0 | 10 0 | 12 0 | 14 0 | .. |
| Or ammonia............ | 17 3 | 17 3 | 11 1 | 12 9 | 11 1 | 9 0 | 8 3 | 9 10 | 11 6 | .. |
| Potash .................. | .. | 3 6 | .. | .. | .. | .. | .. | .. | .. | .. |
| Price per ton March 1895: From................ | 250 0 | 200 0 | 105 0 | 150 0 | 120 0 | 105 0 | 100 0 | 105 0 | 105 0 | 25 °/ₒ=48*s.* |
| To.................... | 270 0 | 280 0 | 140 0 | 190 0 | 140 0 | 110 0 | 105 0 | 110 0 | 120 0 | 36 °/ₒ=69*s.* |

The following examples show the method of applying the above units :—

Take the analysis of the manure, and look for the following substances :

Phosphates dissolved (or soluble phosphate).
Phosphates undissolved (or insoluble phosphate).
Nitrogen.
Potash.
No other items but these are to be valued.

Should the analysis or the guarantee not be expressed in that way, the chemist or the seller should be asked to state the quantities in these terms.

Suppose the manure is bone meal :—

There are two classes of bones, according to their fineness. An ordinary bone meal will fall under Class (*a*), and it will contain about 50 per cent. phosphate and 4½ per cent nitrogen. The units for bones, Class (*a*), are 1*s.* 2*d.* for insoluble phosphate, and 11*s.* for nitrogen. Therefore the value is—

| | £ | *s.* | *d.* | |
|---|---|---|---|---|
| Insoluble phosphate, 50 times 1*s.* 2*d.*, equal to ........................ | 2 | 18 | 4 | |
| Nitrogen, 4 times 11*s.*, equal to....... | 2 | 4 | 0 | |
| Say | 5 | 2 | 0 | per ton. |

Suppose the manure is dissolved or vitriolated bones :—

It must be guaranteed " pure."

The units in the schedule are 3*s.* for soluble phosphate, 1*s.* 6*d.* for insoluble phosphate, and 14*s.* for nitrogen.

The analysis will be about 15 per cent. soluble phosphate, 20 per cent. insoluble phosphate, and 2½ per cent. nitrogen. In that case the value would be—

| | £ | *s.* | *d.* | |
|---|---|---|---|---|
| Soluble phosphate, 15 times 3*s.*, equal to ................................ | 2 | 5 | 0 | |
| Insoluble phosphate, 20 times 1*s.* 6*d.*, equal to ......................... | 1 | 10 | 0 | |
| Nitrogen, 2½ times 14*s.*, equal to ..... | 1 | 15 | 0 | |
| Say | 5 | 10 | 0 | per ton. |

Suppose the manure is a superphosphate, say an ordinary superphosphate, with 27 per cent. soluble phosphate and 3 per cent. insoluble phosphate. It is valued thus :—

Soluble phosphate, 27 times 1*s.* 11*d.*, equal to, say 2*l.* 12*s.* per ton.
Insoluble phosphate is not valued in a superphosphate.

The units have reference solely to the commercial values of manures, and not to their agricultural values.

Thus, in stating soluble phosphate in dissolved bones at 3*s.* per unit, and that in superphosphate at 1*s.* 11*d.*, it is meant that these are the prices per unit at which soluble phosphate can be bought in these two manures; but it does not mean that the soluble phosphate in the one is 1*s.* 1*d.* per unit better as a manure than that in the other. It is probably no better.—*Chemical Trade Journal.*

### POSSIBILITIES OF ESTABLISHING INDUSTRIES.

*B. Lach. Chem. Zeit.* 1895, **19**, 185—186.

*Italy.*—This country, with an annual consumption of about 1,200 tons of ceresin, has no factory for the production of this article since the closing of the works at Treviso through lack of capital. The import duty on the manufactured article is 8 lire, whereas ozokerite, paraffin scale, and decolorising powder only pay 50 centesimi; and, as labour is cheap, the conditions for the development of this industry are favourable. Mineral oil refineries would pay well, provided—as is probable—a reduction in the high import duty on crude oil could be obtained. Attention is also directed to the manufacture of margarine in the large towns, to the resin and rosin-oil industries—raw material being cheap, and existing production inferior in quality and quantity—and caoutchouc.

As all coal has to be imported, the employment of water-gas, petroleum residue, &c. as fuel would yield profitable results.

In *France* there is only one establishment near Paris producing ceresin, and this, favoured by a protective duty of 30 francs, does a profitable trade.

*Austro-Hungary* possesses but one aniline colour works. Hungary, with a plentiful coal supply and a beneficent administration anxious to assist industrial development, offers a fine field for new industries. Official statistics for 1893 show that there were imported : stearin products, nearly 1½ million florins; soaps, nearly 1 million florins; medicinal articles, almost as much; lacquered goods, nearly 800,000 florins; aniline colours, 699,500 florins; in addition to matches and combustibles, perfumes, sulphuric acid, carbolic acid, salts of copper, glycerin, ultramarine, glue, starch, and blacking, in quantities ranging in value between half a million and 160,000 florins. For want of manufacturing facilities, Hungary exports some half million florins' worth of fats which might be profitably utilised in soap and candle making. At present there are only two candle factories in the country. Lacquer and perfumery goods, as well as resin, also merit attention, and in the matter of medicinal articles the hearty co-operation of the administration could be relied on.

*Bosnia and Herzgovina* are referred to as promising countries, with Governments favourably inclined to new industries.

In *Roumania, Servia, and Bulgaria*, stearin works are absent, and ceresin is obtained from abroad in spite of the high duty (200 francs in gold per 100 kilos.). The petroleum refiners, who are also candle makers, are allowed to import the necessary amount of stearin free of duty, and avail themselves of the privilege to the extent of making candles of stearin alone.

*Russia* is favourably mentioned in regard to facilities for industrial development, and the refining of glycerin is cited as a profitable pursuit, there being only one establishment in the country, and a differential duty of four roubles per pood in favour of the crude article. Hydrochloric and sulphuric acids would be worth making, since English $H_2SO_4$ of $65\frac{1}{2}°$ Bé. pays $8\frac{1}{2}$ roubles per 100 kilos., whereas sulphur is only liable to a small impost. In addition to the foregoing the demand for colours, medicinal articles, and refined sugar is said to be unlimited, and to afford ample scope for the establishment of manufactories.—C. S.

### German Wine and its Adulterations.

*Zeits. für Anal. Chem.* **33**, 629—713.

At meetings held in 1894 of the German Commission for the preparation of wine statistics, it was decided that:—

(1.) White wine which contains less than four parts per 1,000 of total acid, including at the most 0·6 per 1,000 of volatile acid, and also less than 3·25 per 1,000 of fixed acid, should contain not less than 1·7 grms. per 100 c.c. of extract, otherwise it is to be regarded as diluted.

(2.) The standard extract for red wines should be 1·6 grms. per 100 c.c., not 1·5 grms., while the residue after deducting the total acid should be 1·1 grms. instead of 1·0.

It was also decided that the addition of glycerin is indicated if, with more than $\frac{1}{2}$ grm. of glycerin per 100 c.c. of wine, (1) the residual extract, after deducting the non-volatile acid, consists of more than $\frac{2}{3}$ glycerin, or (2) if with a proportion of glycerin to alcohol of more than 1 : 100 the total extract is less than 1·8 grms. per 100 c.c., or the residue after subtracting the glycerin amounts to less than 1 grm. per 100 c.c.

It was decided that the following modification of the method of estimating glycerin, which had been suggested by Kulisch, should be recommended:—The residue after evaporation on a water-bath is treated with 15 c.c. alcohol and then $22\frac{1}{2}$ c.c. of ether added in three separate portions. For the final washing 2 c.c. of alcohol and 3 c.c. of ether are employed.

It was recommended, on the proposition of Kulisch, that in the taking of must samples two drops of ethereal mustard oil should be added per half flask or three drops per whole flask to stop fermentation. The mustard oil is easily driven off again by heat, leaving the must ready for fermentation by yeast.

Seventy-eight pages of analytical results of must and wine of the 1893 vintage—1892 and 1893, in the case of Alsace-Lorraine—from 17 wine-producing districts accompany the report and include analyses, giving a general idea of the average composition of the products of the respective districts, besides those of musts and wines which are of abnormal constitution. A summary of the analytical results is also given, in addition to the following remarks:—Prussian wine district.—Boric acid was present in all the musts examined; no nitric acid was detected in any of the wines, which in the great majority of cases possessed no optical activity. The grapes in the majority of cases had been gathered in a moderately ripe condition, especially in Rheingau, where must of an abnormally high specific gravity occurred in several vintages. The year's results confirm those of previous years with regard to the different results given by the musts of large and small vineyards, the former yielding a greater extract and ash than the latter.—J. G. W.

## BOARD OF TRADE RETURNS.

### Summary of Imports.

| Articles. | Month ending 31st May. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,503,982 | 1,572,963 |
| Chemicals and dyestuffs | 490,991 | 552,282 |
| Oils | 544,970 | 704,954 |
| Raw materials for non-textile industries. | 3,642,386 | 3,471,679 |
| Total value of all imports | 34,134,060 | 34,752,086 |

### Summary of Exports.

| Articles. | Month ending 31st May. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,417,432 | 2,460,717 |
| Chemicals and medicines | 711,093 | 808,410 |
| Miscellaneous articles | 2,567,465 | 2,830,800 |
| Total value of all exports | 17,484,212 | 18,344,744 |

### Imports of Metals for Month ending 31st May.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Copper:— | | | | | |
| Ore | Tons | 3,815 | 2,948 | 31,174 | 21,384 |
| Regulus | „ | 6,939 | 5,118 | 187,943 | 135,958 |
| Unwrought | „ | 4,648 | 3,029 | 191,897 | 127,857 |
| Iron:— | | | | | |
| Ore | „ | 351,285 | 379,278 | 239,134 | 260,428 |
| Bolt, bar, &c. | „ | 6,957 | 4,168 | 69,232 | 32,841 |
| Steel, unwrought | „ | 457 | 751 | 4,414 | 7,086 |
| Lead, pig and sheet | „ | 11,227 | 16,338 | 102,745 | 159,808 |
| Pyrites | „ | 49,575 | 48,752 | 85,328 | 80,126 |
| Quicksilver | Lb. | 303,206 | 844,570 | 24,238 | 78,695 |
| Silver ore | Value £ | .. | .. | 160,656 | 147,420 |
| Tin | Cwt. | 64,675 | 74,465 | 224,113 | 236,815 |
| Zinc | Tons | 3,766 | 6,142 | 59,890 | 91,009 |
| Other articles | Value £ | .. | .. | 123,218 | 193,536 |
| Total value of metals | | .. | .. | 1,503,982 | 1,572,963 |

## IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST MAY.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Bark, Peruvian .. | Cwt. | 7,896 | 2,901 | 14,910 | 5,155 |
| Bristles.......... | Lb. | 250,986 | 448,482 | 34,823 | 61,995 |
| Caoutchouc...... | Cwt. | 32,335 | 26,893 | 353,809 | 282,517 |
| Gum :— | | | | | |
| Arabic.......... | „ | 3,641 | 5,242 | 12,792 | 9,543 |
| Lac, &c. ....... | „ | 14,778 | 11,894 | 80,842 | 73,809 |
| Gutta-percha .... | „ | 4,185 | 4,792 | 43,376 | 51,153 |
| Hides, raw :— | | | | | |
| Dry............ | „ | 36,619 | 52,659 | 85,617 | 120,373 |
| Wet........... | „ | 44,138 | 100,930 | 94,741 | 203,487 |
| Ivory............ | „ | 466 | 719 | 21,884 | 30,552 |
| Manure :— | | | | | |
| Guano......... | Tons | 1,343 | 6,409 | 8,782 | 56,778 |
| Bones.......... | „ | 7,495 | 4,403 | 35,383 | 18,488 |
| Nitrate of soda... | „ | 14,264 | 18,934 | 137,307 | 153,562 |
| Phosphate of lime | „ | 38,905 | 25,978 | 71,864 | 46,279 |
| Paraffin.......... | Cwt. | 50,760 | 48,575 | 53,440 | 50,957 |
| Linen rags....... | Tons | 1,677 | 2,197 | 13,830 | 19,834 |
| Esparto.......... | „ | 15,256 | 16,083 | 66,590 | 69,396 |
| Pulp of wood .... | „ | 22,615 | 20,989 | 112,881 | 130,261 |
| Rosin............ | Cwt. | 151,556 | 111,618 | 34,495 | 25,536 |
| Tallow and stearin | „ | 117,012 | 135,782 | 152,534 | 161,894 |
| Tar.............. | Barrels | 6,590 | 262 | 3,697 | 98 |
| Wood :— | | | | | |
| Hewn ......... | Loads | 207,591 | 227,295 | 355,648 | 408,996 |
| Sawn .......... | „ | 395,022 | 243,312 | 880,058 | 553,712 |
| Staves ......... | „ | 9,855 | 9,057 | 45,472 | 58,363 |
| Mahogany ..... | Tons | 3,901 | 3,877 | 32,573 | 27,791 |
| Other articles.... | Value £ | .. | .. | 895,008 | 851,152 |
| Total value ....... | | .. | .. | 3,642,386 | 3,471,679 |

Besides the above, drugs to the value of 84,048*l.* were imported, as against 72,200*l.* in May 1894.

## IMPORTS OF OILS FOR MONTH ENDING 31ST MAY.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Cocoa-nut......... | Cwt. | 19,153 | 58,714 | 22,644 | 70,495 |
| Olive ............. | Tuns | 1,855 | 904 | 65,922 | 33,607 |
| Palm ............. | Cwt. | 114,096 | 120,598 | 116,917 | 126,224 |
| Petroleum ........ | Gall. | 12,026,671 | 13,554,281 | 157,090 | 309,782 |
| Seed ............. | Tons | 2,490 | 3,127 | 55,282 | 60,090 |
| Train, &c. ........ | Tuns | 1,927 | 1,708 | 30,519 | 27,918 |
| Turpentine ....... | Cwt. | 791 | 10,271 | 700 | 10,982 |
| Other articles .. | Value £ | .. | .. | 95,896 | 65,856 |
| Total value of oils ... | | .. | .. | 544,970 | 704,954 |

## EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST MAY.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Brass............ | Cwt. | 11,732 | 9,235 | 41,136 | 34,661 |
| Copper :— | | | | | |
| Unwrought ..... | „ | 37,180 | 51,426 | 82,672 | 112,597 |
| Wrought......... | „ | 23,082 | 28,305 | 64,803 | 72,798 |
| Mixed metal .... | „ | 17,209 | 34,973 | 37,996 | 70,109 |
| Hardware ..... | Value £ | .. | .. | 155,157 | 145,319 |
| Implements....... | „ | .. | .. | 103,718 | 100,352 |
| Iron and steel..... | Tons | 238,914 | 265,663 | 1,646,516 | 1,693,380 |
| Lead ............. | „ | 6,265 | 6,124 | 63,571 | 65,840 |
| Plated wares... | Value £ | .. | .. | 22,088 | 24,144 |
| Telegraph wires | „ | .. | .. | 90,077 | 26,942 |
| Tin ............... | Cwt. | 7,760 | 10,671 | 29,504 | 36,020 |
| Zinc .............. | „ | 12,810 | 19,666 | 8,919 | 12,059 |
| Other articles .. | Value £ | .. | .. | 71,275 | 66,496 |
| Total value ......... | | .. | .. | 2,417,432 | 2,460,717 |

## EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST MAY.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Gunpowder...... | Lb. | 721,100 | 463,200 | 18,864 | 11,691 |
| Military stores.. | Value £ | .. | .. | 129,878 | 204,260 |
| Candles.......... | Lb. | 1,395,500 | 2,098,800 | 24,237 | 35,188 |
| Caoutchouc ..... | Value £ | .. | .. | 88,883 | 85,582 |
| Cement.......... | Tons | 48,120 | 40,572 | 81,256 | 64,858 |
| Products of coal | Value £ | .. | .. | 112,866 | 180,713 |
| Earthenware ... | „ | .. | .. | 132,987 | 158,715 |
| Stoneware ...... | „ | .. | .. | 14,006 | 14,124 |
| Glass :— | | | | | |
| Plate........... | Sq. Ft. | 140,951 | 137,931 | 7,039 | 8,009 |
| Flint........... | Cwt. | 7,415 | 8,080 | 17,369 | 17,627 |
| Bottles......... | „ | 60,041 | 54,220 | 28,473 | 25,532 |
| Other kinds.... | „ | 14,187 | 23,122 | 11,063 | 18,156 |
| Leather :— | | | | | |
| Unwrought .... | „ | 12,255 | 18,741 | 106,972 | 138,098 |
| Wrought ..... | Value £ | .. | .. | 18,737 | 20,811 |
| Seed oil.......... | Tons | 5,645 | 5,539 | 119,139 | 111,613 |
| Floorcloth ..... | Sq. Yds. | 1,609,400 | 1,906,200 | 58,085 | 70,031 |
| Painters' materials | Val. £ | .. | .. | 137,058 | 144,480 |
| Paper ........... | Cwt. | 83,647 | 82,854 | 128,924 | 125,233 |
| Rags............. | Tons | 5,157 | 4,672 | 28,402 | 29,335 |
| Soap............. | Cwt. | 51,913 | 60,878 | 57,118 | 63,505 |
| Total valuo .......... | | .. | .. | 2,567,465 | 2,830,800 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST MAY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 8,558 | 22,126 | 8,485 | 15,645 |
| Bark (tanners', &c.) „ | 26,917 | 35,454 | 9,449 | 13,976 |
| Brimstone........ „ | 49,052 | 72,185 | 11,728 | 13,396 |
| Chemicals...... Value £ | .. | .. | 132,673 | 116,401 |
| Cochineal ........ Cwt. | 197 | 242 | 1,048 | 1,429 |
| Cutch and gambier Tons | 2,547 | 1,836 | 61,656 | 42,063 |
| Dyes :— | | | | |
| Alizarin ...... Value £ | .. | .. | 25,838 | 25,463 |
| Aniline and other „ | .. | .. | 20,353 | 30,915 |
| Indigo ........... Cwt. | 1,914 | 4,337 | 33,054 | 59,194 |
| Nitrate of potash . „ | 15,882 | 22,302 | 14,785 | 20,465 |
| Valonia........... Tons | 1,311 | 3,130 | 16,717 | 34,725 |
| Other articles... Value £ | .. | .. | 155,205 | 178,610 |
| Total value of chemicals | .. | .. | 490,991 | 552,282 |

### EXPORTS OF DRUGS AND CHEMICALS FOR MONTH ENDING 31ST MAY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 461,062 | 617,580 | 129,657 | 152,688 |
| Bleaching materials „ | 119,662 | 140,901 | 47,306 | 51,008 |
| Chemical manures. Tons | 20,137 | 25,787 | 156,767 | 168,101 |
| Medicines....... Value £ | .. | .. | 85,555 | 82,658 |
| Other articles ... „ | .. | .. | 291,808 | 353,955 |
| Total value .......... | .. | .. | 711,093 | 808,410 |

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### APPLICATIONS.

10,031. W. P. Thompson.—From The Actien Maschinenbau-Anstalt. Improved apparatus for drying superphosphate and other substances. May 21.

10,428. Tangyes, Lim., and W. Johnson. Improvements in apparatus for compressing air or gases. May 27.

10,571. E. Theisen. Improved method of and apparatus for evaporating, condensing, and cooling fluids. May 28.

10,625. H. B. Watson and J. S. Watson. Improvements in or relating to evaporating apparatus applicable for obtaining fresh from salt water or analogous purposes. Complete Specification. May 29.

10,658. H. A. Becker. An improved scrubber for laboratory vessels, applicable also for other purposes. May 29.

10,905. B. L. de Ridder. Improvements in apparatus for sampling gases for analysis. June 1.

10,917. W. von Baranoff. Improvements in means for subjecting liquids to the action of gases, especially adapted for use in manufacturing alkaline carbonates from alkaline sulphides, but applicable also to other operations where liquids and gases are to be brought into intimate contact. June 1.

11,015. A. Dauber. Improvements in continuous-working recuperative gas-furnaces. Complete Specification. June 4.

11,039. J. Humes. Improvements in gas compressors. June 4.

11,088. H. H. Lake.—From P. I. Buaas. Apparatus for sterilising milk and other liquids. June 5.

11,405. C. Pottier. An improved basket or packing-case for carboys of acid and the like. June 11.

11,450. B. H. Thwaite and T. J. Denny. Improved rotating agitator for corrosive solutions and gases. June 12.

11,513. J. Maynes and C. L. Watchurst. Apparatus for the separation of gases. June 13.

### COMPLETE SPECIFICATIONS ACCEPTED.*

1894.

11,226. D. B. Morrison. Improvements in apparatus for heating, evaporating, or condensing. May 29.

11,354. J. Wilkinson. Improvements in furnaces applicable to metallurgical, chemical, and other purposes. June 19.

11,960. G. W. Brown and W. R. Skinner. Improvements in apparatus for evaporating and condensing, and for heating feed-water for steam boilers. May 29.

13,857. G. Fletcher. Improvements in multiple-effect and other vessels for evaporating liquid. June 12.

14,431. W. W. Pilkington. Improvements in gas generators or producers, and furnaces and appliances for smelting glass, for melting and heating metals, alkalis, and other substances, and for heating steam-generators and for like purposes. June 5.

14,553. N. Teissier and G. L. A. Negre. Improvements in the manufacture of retorts of refractory material. June 12.

14,766. H. L. Doulton and L. E. Sanceau. Improvements in condensers used for the condensation of acid fumes. June 5.

14,767. H. L. Doulton and L. E. Sauceau. Improvements in filling of towers used in the purification of acid and for such like purposes. June 5.

15,150. B. Dawson. Improvements in gas-producers. June 12.

1895.

7113. J. Bryson, J. Jones, and W. Fraser. *See* Class III.

## II.—FUEL, GAS, AND LIGHT.

### Applications.

10,129. H. Reeser, jun. Improvements in the manufacture of mantles or luminous bodies for incandescent gas lamps and in compounds for use in such manufacture. May 22.

10,145. A. Guéguen. Improvements in gas retorts. Complete Specification. May 22.

10,229. A. G. Glasgow and J. A. Norcross. An improved method of working plant for producing carburetted water-gas. May 23.

10,265. T. Hawkins and E. E. Carr. A new chemical compound gas brick or cake to be used for motive power and heating and fuel purposes and accumulators attached. May 24.

10,278. O. Imray.—From E. Grey. Improved method and appliances for the manufacture of gases for illuminating and heating purposes from liquid hydrocarbons. May 24.

10,307. A. R. Newman and J. M. Somerville. Improvements in and in connection with the manufacture of illuminating gas. May 24.

10,356. J. T. Key and W. S. Key. An improved system for the manufacture of coke, the construction of coke ovens, and the recovery of by-products from same. May 27.

10,414. W. P. Gibbons and G. B. A. Gibbons. Improvements in apparatus for charging gas retorts. May 27.

10,477. J. H. Ladd. Improvements relating to the manufacture of gas, and to apparatus therefor. May 27.

10,697. W. Fiddes. Improvements in apparatus for discharging gas retorts. May 30.

10,947. H. Riché. Improvements relating to the manufacture of gas and to apparatus therefor. June 1.

11,039. J. Humes. *See* Class I.

11,082. G. Haycraft. Improvements in machines or presses for use in the manufacture of artificial fuel or briquettes. June 5.

11,119. J. Henderson. Improved device or means for charging gas retorts and similar vessels. June 6.

11,333. F. C. Yeo.—From A. E. Tavernier. Improvements in the manufacture of artificial fuel. June 10.

11,438. C. K. Marr. Improved briquette fuel. June 12.

11,503. J. Bowing. Improvements in coking processes. June 13.

11,577. R. G. Shadbolt and J. W. Broadhead. Improvements in the method of and means for enriching coal gas. June 14.

### Complete Specifications Accepted.

1894.

11,801. J. Calderwood and J. Hodges. Improvements in treating paraffin scale. May 1.

13,385. B. H. Thwaite. An improved process for generating combustible gas and in apparatus therefor. June 5.

13,758. F. Mayer. Improvements in apparatus for manufacturing gas. May 29.

13,841. A. Scott and P. McLean. Improvements in and relating to fire-clay and metal retorts for the manufacture of gas from coal, oil, tar, or other material. June 19.

15,066. J. David. Manufacture of variegated candles and apparatus therefor. June 12.

16,149. H. Drehschmidt. A process for obtaining cyanogen or its compounds from the gases resulting from the dry distillation of substances of organic origin. June 19.

1895.

1487. A. G. Glasgow. Improvements in apparatus for the manufacture of water-gas. June 19.

7113. J. Bryson, J. Jones, and W. Fraser. *See* Class III.

7517. H. Simon. Improvements in and connected with the manufacture of gas. June 19.

8334. F. Kuhn. A new or improved process for preparing by the aid of gaseous mixtures, liquefied gas by compression. June 5.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

### Complete Specification Accepted.

1895.

7113. J. Bryson, J. Jones, and W. Fraser. Improvements in or relating to retorts for the distillation of shale and other bituminous substances, or for the calcining of ironstone, lime, or other substances, also applicable to gas-producers. May 29.

## IV.—COLOURING MATTERS AND DYES.

### Applications.

10,470. C. D. Abel.—From A. Fischesser and Co. Manufacture of new colouring matters. May 27.

10,473. H. Loesner. Process for producing *o*-nitrobenzylic chloride, *o*-nitrobenzylic alcohol, and its derivatives from *o*-nitrotoluol. May 27.

10,668. H. H. Lake.—From Farb. Mulheim. Improvements in the manufacture of colouring matters. May 29.

10,669. H. H. Lake.—From Farb. Mulheim. Improvements in and relating to the manufacture of colouring matters. May 29.

10,670. H. H. Lake.—From Farb. Mulheim. Improvements in the manufacture of colouring matters. May 29.

10,676. J. Y. Johnson.—From The Chemische Fabrik vormals Goldenberg, Geromont, and Co. A process for obtaining the lactyl derivatives of methyl-aniline, ethyl-aniline, para-anisidine, and bara-phenetidine. May 29.

11,011. R. Cambier and A. V. Brochet. Process for the direct preparation of salts of methylamine. June 4.

11,228. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of new azo dyestuffs. June 7.

11,276. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of dyestuffs suitable for dyeing cotton. June 8.

11,329. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of violet and blue colouring matters. June 10.

### Complete Specifications Accepted.

1894.

14,056. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of azo colouring matters, derivatives of the 1.4-α-naphthol-sulphonic acid from corresponding azo colouring matters of naphthionic acid. June 12.

14,135. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of α-naphthol-monosulphonic acid 1.4 from α-naphtholcarbonate. May 29.

14,137. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of blue gallocyanin colouring matters. May 29.

14,600. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Production of methylglyoxalidine CHN. June 5.

14,983. J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of new colouring matters derived from muscarine. May 29.

15,067. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of *α*-naphthylamine sulphonic acid. June 5.

15,205. T. R. Shillito.—From J. R. Geigy and Co. Production of green and blue dyes or colouring matters. May 22.

15,621. H. E. Newton.—From The Farbenfabriken vormals F. Fayer and Co. The manufacture or production of dyestuffs, and materials therefor. June 5.

15,859. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture of new dyes of the rhodamine series, and intermediate products and leuco-compounds related thereto. June 19.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

10,918. F. Raschig. A process for washing crude wool. Complete Specification. June 1.

10,988. J. H. Lenton and R. B. Caldicott. Improvements in the manufacture of textile fabrics, and in apparatus therefor. Complete Specification. June 4.

11,335. L. Rousseau. Improved means applicable for use in the removal of dark spots from scoured wool or from worsted or woollen goods. Date Complete Specification filed June 10. Date claimed May 16, 1895, being date of application in France.

11,546. B. J. B. Mills.—From V. Crépet. A new or improved process for the decoration or ornamentation of tissues. June 13.

11,661. F. J. Abbott, jun. Improvements in treating wool for destroying and removing therefrom burs and other vegetable and foreign substances. Complete Specification. June 15.

### Complete Specification Accepted.

1895.

8650. C. K. Mills.—From Fresca Bros. Improvements in the manufacture of silk thread. June 5.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

10,004. C. M. White.—From T. B. Bowers, United States. A new or improved machine for washing or dyeing wool, cotton, rags, waste, or the like. Complete Specification. May 21.

10,424. R. W. E. McIvor and J. Chester. Improvements in the mode of bleaching rhea ramie, china grass, and other vegetable fibres and undyed fabrics made from vegetable fibres. May 27.

10,716. F. Stehle. *See* Class XIX.

11,087. H. H. Lake.—From H. Schweitzer and E. N. Dickerson. An improved process of printing on aniline black. Complete Specification. June 5.

### Complete Specifications Accepted.

1894.

14,092. F. Barraclough. Improvements in apparatus for dyeing and otherwise treating yarns. May 29.

14,334. M. Cockroft and S. J. Pegg. Improvements in or appertaining to dyeing machines. June 19.

14,374. B. Walsh. Improvements in kiers or vessels for bleaching textile fabrics. June 12.

14,565. J. Booth and L. Thornley. Improvements in apparatus for dyeing, veneering, and washing hat bodies. June 5.

15,433. H. Wylie and J. Morton. Improvements in dyeing certain colours on cotton yarns and fabrics. June 19.

1895.

9624. E. Bush. Improvements in or connected with machinery for varnishing or otherwise coating paper or other flexible material. June 19.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

10,128. N. Bassett and W. von Baranoff. Improvements in and connected with the manufacture of caustic alkalis and alkaline carbonates. May 22.

10,236. S. Trivick. Improvements in and relating to the manufacture of cyanides. May 23.

10,427. W. von Baranoff. Improvements in the manufacture of carbonic acid gas from sulphates. May 27.

10,442. W. P. Thompson.—From J. Finlay and E. W. Derry. Improvements in the manufacture of cyanides and other cyanogen compounds. May 27.

10,476. J. Raschen and J. Brock. Improvements in the manufacture of cyanides and ferrocyanides from sulphocyanides and the recovery of by-products. May 27.

10,713. R. Main and W. Donald. Improvements in treating chlorides for the production of chlorine and alkalis or alkaline earths and the recovery of by-products. May 30.

10,736. M. N. d'Andria. Improvements in and connected with the manufacture of magnesia and calcium carbonate. May 30.

10,931. O. Imray.—From Goerlich and Wichmann. Process for decomposing sulphuretted hydrogen and obtaining ammonia, compounds of ammonia, oxysulphides, sulphides, and sulphur. June 1.

10,956. J. Raschen and J. Brock. Improvements in the manufacture of cyanides and ferrocyanides from sulphocyanides and the recovery of by-products. June 1.

11,095. C. F. Claus. *See* Class X.

11,680. W. P. Thompson. *See* Class X.

### Complete Specifications Accepted.

1894.

8305. H. W. Crowther, E. C. Rossiter, J. J. Hood, and G. S. Albright. Improvements in the manufacture of ferrocyanides of potassium and sodium from their sulphocyanides, and apparatus relating thereto. May 29.

11,233. A. Crossley. An improved process and apparatus for the manufacture of zinc oxides, sulphates, and sulphides, from zinc ashes, zinc blende, carbonate of zinc, and other ores of a complex nature, such as ores containing lead, zinc, silver, copper, manganese, iron, or other metals in combination. May 29.

14,154. G. S. Albright and J. J. Hood. Improvements in the manufacture of sulphocyanides. May 29.

14,985. W. L. Wise.—From Solvay and Co. Improvements in or relating to the manufacture or treatment of bicarbonate of soda. June 12.

14,986. W. L. Wise.—From E. Solvay. Improvements in or relating to the manufacture of bleaching powder and other hypochlorites. June 12.

14,987. W. L. Wise.—From Solvay and Co. Improvements in or relating to the separation of caustic alkalis from the liquors obtained by the electrolysis of alkaline salts. June 12.

16,149. H. Drehschmidt. *See* Class II.

16,529. G. Kraemer. Manufacture of potassium cyanide and yellow prussiate of potash from carbazol and its alcohol alkali compounds. June 19.

1895.

2466. W. Garroway. Improvements in the manufacture of sulphuric, nitric, and nitrous acid, and of sulphate of soda, oxide of iron, and alumina. June 12.

7193. A. Le Chatelier. Improvements in the production of blocks of salt. June 5.

9555. W. von Baranoff. Improvements in and connected with the manufacture of alkaline carbonates. June 19.

9558. M. W. Beyliikgy. Process of manufacturing alkaline bichromates. June 19.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

10,911. E. Böhm. A process and apparatus for the production of plaques and similar articles from glass. June 1.

10,985. W. H. Meigh and R. Meigh. Improved kiln for use in firing pottery ware. June 4.

11,595. J. L. Rawbon and The British and Foreign Patent Syndicate. Improved composition for use in the plastic arts. June 14.

### Complete Specifications Accepted.

1894.

13,290. H. B. Barlow.—From J. J. Power. Apparatus for blowing and moulding in glass. June 19.

14,875. J. C. Bailey. Improved methods of preparing "transfers" for use in decorating pottery ware. June 12.

1895.

8558. C. H. Tondeur. An improved method of and apparatus for the manufacture of glass for skylights and the like. June 5.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

10,089. J. Patchett. Time precipitation process of mortar analysis. May 22.

10,090. J. Patchett. Measure process of mortar analysis. May 22.

10,207. S. G. Bird and J. Wright. Improvements in the manufacture of cement concretes. May 23.

10,352. G. A. Shaw, T. Kay, and Kay Bros., Lim. Improvements in the manufacture of plaster of Paris. May 27.

10,468. A. Roberts. A new or improved substitute for tiles for the coverings of walls, ceilings, and other suitable places. May 27.

10,744. J. F. de Navarro. Improvements in apparatus for treating cement-making materials. Complete Specification. May 30.

11,267. W. Slark. Improvements in the manufacture of cement. June 8.

11,459. F. H. Brooke. Improvements in the manufacture of "silica" bricks. June 12.

11,543. A. McLean. Improvements relating to artificial lithographic stones. June 13.

11,586. H. L. Doulton and A. J. Smith. Improvements in the manufacture of tiles. June 14.

11,622. G. de Bruyn. Improvements in the manufacture of artificial stone. June 14.

11,688. A. W. Lundberg, J. O. Hallgren, and V. F. L. Smidth. Improvements in kilns for burning Portland cement, Roman cement, or other hydraulic cements or lime. June 15.

### Complete Specifications Accepted.

1894.

13,029. S. J. Beaman and J. Deas. Improvements in furnaces for burning sludge, slurry, and like materials. May 29.

15,156. J. Roy. Improvements in or relating to the construction of fireproof floors or the like. June 19.

1895.

7542. G. T. Jenkins. Improvements in artificial stone. June 5.

## X.—METALLURGY, MINING, Etc.

### Applications.

9944. E. B. Parnell. Improvements in the extraction of metals from ores and apparatus therefor. May 20.

10,399. J. J. Christmas. An improved process for the treatment of gold-bearing antimony ores. May 27.

10,447. L. Falero and H. Lumley. Improvements in the manufacture of sodium and like metals, and in apparatus therefor. May 27.

10,671. J. C. Bull and R. E. M. Lagerwall. Improvements in the manufacture of metal alloys. May 29.

10,717. J. W. Hall. Improvements in the treatment of complex ores and substances containing zinc and lead with or without other metals. May 30.

10,865. W. J. Clapp and J. F. Wake. Improvements in furnaces and apparatus for and in the method of manufacturing and purifying the waste products from blast and other furnaces, cupolas, and for other purposes. June 1.

10,927. J. A. Mays. Process of and apparatus for recovering metals from sulphide ores. June 1.

11,072. E. Fischer, E. Klein, and F. Mahlstedt. Improved method of extraction of precious metals from their ores. Complete Specification. June 5.

11,095. C. F. Claus. Improvements in the treatment of refractory complex sulphide ores. June 5.

11,097. A. E. Westwood. Improvements in moulds for casting metals and metallic alloys. June 5.

11,101. G. G. M. Hardingham. From C. Raleigh. An improved method of treating tailings and similar residues with a view to the extraction of the precious metals. June 5.

11,144. J. Berger. Improvements in alloys or compositions of metals and other matters. June 6.

11,190. G. H. Llewellyn. Extraction of manganese from spiegel-slag and utilisation of by-products. June 7.

11,478. J. Y. Johnson.—From L. Peletan and F. Clerici. Improvements in apparatus for the electrolytical separation of precious metals from their ores or other materials containing them. Complete Specification. June 12.

11,680. W. P. Thompson. Improvements in or relating to the manufacture of alkaline metals. June 15.

### Complete Specifications Accepted.

1894.

8306. C. T. J. Vautin. An improved process for the extraction of metals from oxides and sulphides. May 1.

11,307. C. Hoepfner. An improved method or process for the treatment of the ores of nickel and cobalt. June 12.

11,724. C. Hoepfner. Improvements in the treatment of calamine and similar minerals for the extraction of zinc. April 24.

15,761. R. Biewend. Process for treating sulphurous zinc ores in blast furnaces by the addition of ferriferrous substances. June 5.

16,003A. H. Ellis and B. G. Coleby. A new alloy applicable for umbrella fittings, parts of bicycles, and for other uses where a non-corrodible, strong, and light metal is required. June 12.

23,006. L. C. Daumas. An improved process for the extraction of gold from its ores and apparatus employed therefor. June 19.

1895.

7575. J. Johnson.—From N. McConnell. Improvements in the manufacture of alloys of iron or steel with nickel. June 5.

8047. A. Reichwald.—From F. Krupp and Co. Method of or process for improving or perfecting steel armour plates and other steel articles. June 12.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

9937. S. Hammacher. Improvements in the manufacture of active material for secondary batteries. Complete Specification. May 20.

9981. A. E. Old. The application of the motor-generator for purposes of electrolysis. May 21.

10,134. G. G. M. Hardingham.—From R. Langhans. Improved means applicable for use in the decomposition of substances susceptible to electrolytic treatment. May 22.

10,445. H. C. F. Störmer. Improvements in apparatus for electrolysis of alkali salts with quicksilver as cathode. Complete Specification. Filed May 27. Date applied for November 26, 1894, being date of application in Norway.

10,448. L. Falero and H. Lumley. Improvements in secondary or storage batteries. May 27.

10,792. W. Elliott. An improved dry battery for electrical purposes, and material for packing same. May 31.

10,836. C. Payen. Improvements in storage batteries. Complete Specification. May 31.

10,929. E. Hermite, E. J. Paterson, and C. F. Cooper. Improvements in apparatus for electrolysing chloride solutions. Complete Specification. June 1.

10,930. E. Hermite, E. J. Paterson, and C. F. Cooper. Improvements in apparatus for electrolysing chloride solutions. Complete Specification. June 1.

10,951. E. Freund. Improvements in secondary batteries. June 1.

11,016. H. Blackman. Improvements in electrolytic decompositions, and especially in the electrolytic production of bleaching agents and their uses, and in electrodes and apparatus therefor. Complete Specification. June 4.

11,032. T. Eremin. Improvements in secondary batteries or accumulators. June 4.

11,222. D. G. FitzGerald. Improvements in voltaic batteries. June 7.

11,298. E. Jordis. An improved method or process for obtaining metals or metallic alloys by electrolysis. June 8.

11,659. J. T. Niblett. Improvements in elements for secondary batteries. June 15.

### Complete Specifications Accepted.

1894.

5537. R. Heathfield and W. S. Rawson. Electrical deposition of zinc and alloys of zinc, and apparatus therefor. June 19.

7205. A. F. B. Gomess. A new or improved process for the electro-deposition of aluminium and aluminium alloys. June 19.

10,032. E. Gautier. Improvements in and connected with electrolysis, and in apparatus connected thereto. May 29.

10,463. J. M. Moffat. Improvements in cells or boxes of electric batteries. June 5.

1895.

4610. W. A. Boese. Improvements in or relating to secondary batteries or electric accumulators. June 19.

8226. J. von der Poppenburg. Improvements in and relating to electric batteries. May 29.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

11,367. P. F. Desgrandchamps. Poly-chrome soap. June 11.

11,411. M. H. Wilson. Improvements in soap. Complete Specification. June 11.

11,606. A. F. Beyer and A. G. Beyer. Improvements in power presses for soap. Complete Specification. June 14.

### Complete Specifications Accepted.

1895.

5743. F. E. Coulter. Washing compound, and method of preparing the same. May 1.

6717. W. Ford and C. P. Maher. Soap. June 5.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

9957. H. Seward. An improved pigment. May 20.

10,715. J. H. R. Paterson. Improvements in treating gutta-percha or its compounds for the manufacture of golf balls and other goods. May 30.

10,900. S. Kleemann. New or improved pigments or colours and processes of manufacturing the same. June 1.

11,379. T. Coppock, jun. Improved varnish or lacquer applicable to mixing with the bronze powder colours, painters' colours, and for varnishing purposes. June 11.

### Complete Specifications Accepted.

#### 1894.

14,375. I. Frankenburg. Improvements in stoves for vulcanising and deodorising india-rubber waterproof garments. June 19.

22,100. A. J. Boult.—From G. Philippe. Improvements in or relating to damp-proof paints or the like. June 12.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

9953. C. Heitemeyer. A new or improved process of and apparatus for liming, bateing, or tanning hides and skins. Complete Specification. May 20.

11,037. A. Seymour-Jones. Improvements in machines for treating hides and skins. Complete Specification. June 4.

13,596. J. P. O'Donnell. — From J. A. Schweitzer. Improvements in the manufacture of artificial whalebone from parchmentised skin. May 29.

5924. S. L. Evans. A new or improved tanning process. May 29.

## XV.—AGRICULTURE and MANURES, Etc.

### Application.

11,460. F. Nobbe and L. Hiltner. Improvements relating to the inoculation of soil for the cultivation of leguminous plants. June 12.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Application.

10,846. C. V. van Geeteruyen. Pneumatic apparatus for extracting water from starch paste and transforming it into dry and solid cakes. May 31.

### Complete Specifications Accepted.

#### 1894.

15,772. L. Fulda. Improvements in or connected with the manufacture of confectionery. June 5.

#### 1895.

791. E. A. Loesch. An improved composition for stiffening and glossing linen and the like.

4803. J. Soltau. An improved process for removing the gum or glutinous matter from textile fibres. June 5.

7997. G. D. Hart and C. L. Hart. Improvements in the manufacture of ferment leavens. May 29.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

10,363. J. Edge. Izal ale. May 27.

10,700. F. W. Fletcher. An improved tonic wine. May 30.

10,762. E. Simonsen. An improved process for the treatment or inversion of materials containing cellulose for the production of spirit. May 30.

11,154. T. D. Lichtenstein. The manufacture and production of caramelized materials especially intended for use in the manufacture or treatment of beers, spirits, vinegar, aërated water, and other liquids or beverages. Complete Specification. June 6.

11,155. T. D. Lichtenstein. Improvements in the manufacture or treatment of beers, spirits, vinegar, aërated waters, and other liquids or beverages. Complete Specification. June 6.

### Complete Specifications Accepted.

#### 1894.

13,153. E. Hermite, E. J. Paterson, and C. F. Cooper. An improvement in the purification of alcohol spirits and the like. June 5.

13,364. C. Rach. Apparatus for the preparation of wort. June 12.

#### 1895.

6207. C. L. Hart. Improvements in the manufacture of diastassic ferments.

7997. G. D. Hart and C. L. Hart. *See* Class XVI.

8319. E. Heinemann. A process and apparatus for infusion and extraction of hops. June 5.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

11,613. J. H. Hooker. An improved alimentary liquid June 14.

#### *B.—Sanitary Chemistry.*

10,238. P. Jensen.—From J. C. Anderson. Improvements in and relating to a method of and apparatus for the treatment of garbage and other refuse matter. Complete Specification. May 23.

10,891. C. A. Burghardt. Improvements in and in the production of compositions adapted to be used in the treatment of sewage and other foul waters. June 1.

11,527. J J. Hood and A. G. Salamon. An improved means for treating sewage and the like. June 13.

### Complete Specifications Accepted.

#### *A.—Chemistry of Foods.*

#### 1894.

13,587. T. H. L. Bake and H. A. Leverett. Improvements in apparatus for preserving animal and vegetable food and other substances. June 19.

13,712. R. G. Nash. Improvements in or relating to the sterilisation and preservation of milk. June 19.

14,015. H. J. N. Berge. Treatment of potable waters by alkalinisation and subsequent neutralisation with a view to their sterilisation and purification. May 29.

14,433. P. A. Noll. Process for manufacturing a compote from jelly. May 29.

15,168. B. Biggs. Improvements in preserving extracts from lemons and the like. June 19.

#### 1895.

7988. T. B. Percy. An improved product for use in the preparation of articles of food. June 12.

8044. G. Gaetner. Process for reducing the proportion of caseine contained in milk. June 5.

### *B.—Sanitary Chemistry.*

1894.

12,893. H. E. Newton.—From The Pinhoe Patent Refuse Destructor Co. Improvements in apparatus for destroying garbage and house refuse. June 12.

11,927. C. Jones. Improvements in the method or process of treating and utilising town refuse. June 5.

### *C.—Disinfectants.*

1894.

15,361. J. Y. Johnson.—From F. von Heyden. Improvements in the manufacture of antiseptic agents. June 19.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

9936. R. F. English. An improved composition for enamelling or glazing paper, cardboard, and the like. May 20.

9987. T. C. Cadwgan and The O. S. Kelly Co. An improved process for preparing paper stock. Complete Specification. May 21.

10,716. F. Stehle. Process for bleaching paper-pulp. May 30.

11,261. C. T. Fox. Improvements in the manufacture of waterproof paper. Complete Specification. June 8.

11,546. B. J. B. Mills.—From V. Crépet. *See* Class V.

### Complete Specification Accepted.

1894.

11,264. J. Hargreaves and T. R. Hewlett. Improvements in or applicable to paper-making. June 12.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

10,946. H. H. Lake.—From The Fabriques de Produits Chimiques de Thann et de Mulhouse. Improvements in the manufacture of artificial musk. June 1.

10,955. C. Fahlberg. Improved process of manufacturing saccharine. June 1.

11,217. O. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Process for the extraction of perfumes having alcoholic function from natural essences. June 7.

11,287. O. Imray.—From Goerlich and Wichmann and Co. Manufacture of rhodan of sulphocyanide salts from nitrates, bisulphide of carbon, and sulphuretted hydrogen. June 8.

11,288. I. Roos. Manufacture of citrates, tartrates, and amygdalates of para-anisidine and para-phenetidine. Complete Specification. June 8.

11,635. R. Haddan.—From A. H. Gouts and E I. Marc. An improved process for extracting volatile matters, and especially those of vegetable tar. Complete Specification. June 14.

### Complete Specifications Accepted.

1894.

12,504. A. Hommel. An improved process for the production of purified, sterilised, liquid hæmoglobin. May 29.

15,348. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of acid derivatives of alkylic salts of paramidophenyl carbonic acid. June 19.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Applications.

10,492. H. W. Searle. Improvements in or connected with the production of photographs. May 28.

10,657. J. Pain. *See* Class XXII.

10,749. P. Jensen.—From M. Anderson. Improvements in and relating to method of and apparatus for the production of coloured photographs. Complete Specification. May 30.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

10,467. H. V. Keeson. Improvements in fuses for projectiles. May 27.

10,657. J. Pain. Improvements in compounds for use in pyrotechny and photography. May 29.

11,424. S. R. Divine. Improvements in blasting compounds. Complete Specification. June 11.

### Complete Specification Accepted.

1894.

13,506. H. H. Lake. — From The Dynamet Actien Gesellschaft vormals A. Nobel and Co. Improvements relating to the manufacture of explosives. May 29.

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# THE JOURNAL
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## A MONTHLY RECORD
FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 7.—Vol. XIV.]

JULY 31, 1895.

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## NOTICES.

The Society's Office will be closed from September 1st to September 16th next, and the General Secretary will feel obliged if those members who have changes of address for the August or September numbers to communicate will send them in either before the former date or after the latter.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l.*, instead of 15*l.* as heretofore, after the 1st January 1895.

### ANNUAL GENERAL MEETING.

In consequence of the General Election, the Annual General Meeting was postponed from July 17th to July 31st, as announced on the cover of the June issue. A full account of the proceedings, the President's address, and the visits to works and excursion will appear in the August issue.

### COLLECTIVE INDEX.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
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### BANKERS' ORDERS.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed.

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The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* C. F. Cross, B. Blount, S. Hall, F. Napier Sutton, and F. G. Adair Roberts.

*Meeting held Monday, June 17th, 1895.*

MR. B. E. R. NEWLANDS IN THE CHAIR.

## SOME REACTIONS OF AMMONIUM SALTS.

BY WATSON SMITH.

I HAVE read with considerable interest the abstract of a paper on the above subject by W. R. E. Hodgkinson and N. E. Bellairs, R.A., in the Proc. Chem. Soc., 1895 [152], 114. (This Journal, 1895, 571.)

Amongst other things, these authors state that they chose, for the purpose of their experiments on the action of some metals on so-called ammonium salts, "such salts of oxy-acids as may be melted in a comparatively dry state without appreciable decomposition."

"So far," they go on to say, "they have only examined the nitrate and sulphate." "These salts," they state, "were dried and carefully melted, and the metal in foil or thin sheet, introduced."

But ammonium sulphate will not melt. One equivalent of ammonia is expelled on heating, and ammonium hydrogen sulphate or "bisulphate of ammonia," is left, and it is this bisulphate or acid sulphate which fuses (viz. $NH_4HSO_4$). The case is different with the nitrate, this salt melting with but slight alteration, at about 153° C. (This Journal, 1892, 868.) The melting point of ammonium hydrogen sulphate is about 146° C. Thus, though the temperature may be maintained in the cases of both fused salts employed, something below 160° C. yet the intrinsic characters of the two salts themselves are sufficiently different to make it difficult to compare their several actions upon metals, the ammonium nitrate being, in the main, the normal salt, whilst the fused sulphate must of necessity be chiefly, if not wholly, the acid sulphate. $NH_4HSO_4$. With regard to the phenomena observed, when the fused salts act upon the pieces of foil of the metals introduced, since I have been studying some reactions of sulphate and other salts of ammonium during the last two or three years, it may be interesting to note how these salts will behave when heated alone. As regards work already done on the subject, *see* Gmelin's Handbook, Vol. II., 462. I find in my note-book a record of experiments as follows:—

1. *December 21st*, 1893.—3 grms. of ammonium sulphate were heated at 200° C. for 4 hours, when it was found that 0·03 per cent. of $SO_3$ had been lost as $SO_2$. Of course a considerable amount of ammonia had been evolved. Another quantity of 3 grms. of ammonium sulphate was taken and again heated for 4 hours at 200° C., the first experiment being repeated, and the ammonia evolved being also determined.

Ammonia evolved = [*]5·6 per cent.
Sulphur Trioxide = 0·044 per cent. lost as $SO_2$.

*January 13th*, 1894.—3 grms. of ammonium sulphate were heated to 250° C. for 22 hours.

In this time ammonia evolved = 7·7 per cent.
sulphur Trioxide = 0·074 per cent. lost as $SO_2$.

In some other similar experiments, whilst even a somewhat higher temperature was employed, and more ammonia evolved in the periods over which the action extended, yet no sulphurous oxide could be detected in the products evolved. I gather from this that the manner of heating up the salt, whether it be rapidly raised to the ultimate temperature or slowly, plays some part in the conditions under which, within certain limits, sulphites are formed and evolved.

That the conditions under which metallic foils are placed, whether introduced into a fused normal salt like ammonium nitrate or into an acid salt like fused ammonium sulphate (more or less bisulphate of ammonium), are, to say the least, somewhat different, may be gathered from an experiment I tried, and which is dated 31st January 1894. Some ammonium sulphate which had been heated until it lost only 19 per cent. of its one equivalent of ammonia, was dissolved in water, and into the solution some zinc dust was sprinkled. Hydrogen was freely evolved. When gossamer zinc, such as is used in precipitating gold in the MacArthur Forrest process, was placed in the solution, hydrogen was also evolved on slightly warming. Neither solution of pure ammonium nitrate, nor of normal ammonium sulphate, can produce such a result.

The ready solubility of silver in fused "ammonium sulphate" or rather ammonium hydrogen sulphate is thus easily explained. Now, the authors state that in their study of the reactions described, they took care to maintain the temperature of the fused salts below 160°. I believe I can positively say that bisulphate of ammonium ($NH_4HSO_4$), at or below 160° C., would not decompose. If, however, the fused salt consisted of a mixture of $NH_4HSO_4$ and $(NH_4)_2SO_4$, then $NH_3$ would escape more or less, according as more or less normal sulphate were present in the mixture, and my belief is that metals present would be modified in their action on the fused or semi fused salts and *vice versâ*, according as more or less normal sulphate were present.

I think that the authors may have been trying their experiments as far as sulphate of ammonium is concerned, in two ways (1) using metal mixed with pure normal sulphate of ammonium, and (2) using metal in contact with pure ammonium hydrogen sulphate. But method (1) would soon lead to acidity of the mass, through expulsion of $NH_3$ and formation of some $NH_4HSO_4$. It is easy to prepare, almost chemically, pure ammonium hydrogen sulphate by gradually heating the normal sulphate up to about 300° to 320° C. in a platinum dish (porcelain or glass would be attacked); and finally raising the temperature for a short period almost to dull redness. Ammonia is first evolved, as the temperature rises it becomes mixed with ammonium sulphites, finally ammonia, sulphurous oxide, water and nitrogen escape, and what is left behind on cooling is almost pure $NH_4HSO_4$. At the higher temperature, the ammonium molecule and that of sulphur trioxide tend to mutual decomposition, nitrogen, sulphur dioxide and water being formed. However, the bisulphate at this high temperature decomposes normal sulphite, or even a trace thereof, and so it comes about that a pure bisulphate remains as a residue. Indeed, at so high a temperature as say 130–150° C. or thereabouts, if dry ammoniacal gas be passed into fused ammonium hydrogen sulphate it acts upon it as a reducing agent somewhat as follows:—

$$3(NH_4HSO_4) + NH_3 = 2NH_3 + 3SO_2 + 6H_2O + 2N.$$

On this subject I have some records that may be of interest.

---

[*] In all percentages of ammonia the amounts are referred to 100 parts of the one equivalent of $NH_3$, which unites with $NH_4HSO_4$ to form $(NH_4)_2SO_4$.

April 9th, 1894.—Some ammonium bisulphate ($NH_4HSO_4$) was heated in a glass bulb apparatus to 450° C. (determined by a Chorley and Baly's thermometer), and the gases evolved were conducted into a tube over a pneumatic trough. It was found that nitrogen at this temperature was pretty freely evolved, along with $SO_2$, and after heating for a considerable time, the residue in the bulb was allowed to cool, and was then examined. It was found to have been largely converted into ammonium sulphites.

April 11th.—Another quantity of bisulphate was similarly heated to 400° C. A less quantity of nitrogen together with some $SO_2$, was evolved.

April 12th.—Another and similar quantity of $NH_4HSO_4$, similarly heated to 350°—360° C., was found to yield little or no nitrogen.

It was concluded that nitrogen gas only begins to be perceptibly evolved from $NH_4HSO_4$, on heating to temperatures between 360 and 400° C., but that it is freely evolved at 450° C. After heating for about an hour at this temperature, the residue in the bulb was examined for sulphites. It was found to contain 26·5 per cent. of $SO_2$. $(NH_4)_2SO_3$ contains 64·6 and $NH_4HSO_3$ 55·2 per cent. of $SO_2$. There is no doubt that at the temperature named, the glass of the containing vessels employed was acted upon, and consequently may be considered to have taken part in the reaction to a small extent. By heating ammonium bisulphate to 450° C., and maintaining it at that temperature, and collecting the gas evolved over alkaline water in a pneumatic trough, very fairly pure nitrogen gas could be prepared. [What the complete mechanism of the reaction is at temperatures below 360°, when the evolution of nitrogen becomes imperceptible, and yet sulphurous acid is formed, I am not yet prepared to say.]

The practical attempt was now made to answer the question: *Does bisulphate of ammonium ($NH_4HSO_4$) suffer reduction at high temperatures in contact with free, dry ammonia?*

Dry ammonia was passed through fused $NH_4HSO_4$ at about 300° C. under partial vacuum. The ammonia was absorbed to a certain extent. After passing a certain amount of the gas, the supply was cut off, and the residue being maintained at 300° C., air was aspirated through the semi-fused mass. It was then found that the ammonia which had been absorbed, was again given off, and in fair abundance. After maintaining at 300° for about half-an-hour, the temperature was dropped to 245° C., when it was found that ammonia was still evolved, and evolved with a fair amount of freedom. It would seem then that in presence of an atmosphere of ammonia, ammonia is absorbed by $NH_4HSO_4$, at a temperature at which, however, it is at once given up again, if that atmosphere be removed or be replaced by one of an inert gas.

April 18th.—Some more $NH_4HSO_4$ was now heated to from 310° to 320° C. and $NH_3$ was passed through it for about an hour. For the first four or five minutes the ammonia was almost entirely absorbed. About the end of the hour, the bisulphate had become distinctly thicker than before, from formation of normal sulphate. After the experiment, the salt was found to have become almost solid. On heating, ammonia was abundantly evolved, and at a much lower temperature than 310° C., just as in the former experiment. On testing some of the residue at the end of the period of ammonia absorption, it was found that about 30 per cent. of unchanged bisulphate remained, this was calculated from an alkalimetric titration of the acidity of the residue.

April 19th.—The experiment was repeated at 350°—360° C. Ammonia seemed fully absorbed during the first 4—5 minutes, but after that period a large proportion seemed to pass over unabsorbed. About 45·8 per cent. of unchanged, $NH_4HSO_4$ remained (51·7 per cent. of normal sulphate), this was the limit of capacity for 350—360° C. then. Now the singular observation was made in all three of the preceding experiments, that at their close, on opening the vessel and allowing the semi-fused residue to cool down, the mere removal of the atmosphere of ammonia by diffusion or otherwise, was quite sufficient to cause an abundant evolution of ammonia to take place from the cooling mass at various stages of temperature still exalted, but considerably below that at which the gas was readily absorbed in the first instance, under the conditions named.

April 20th.—Experiment now repeated at 410°—420° C. Ammonia even now slightly absorbed. To the extent of leaving about 85·6 per cent. of unchanged bisulphate. (The bisulphate used in these experiments contained 98·5 per cent. of real $NH_4HSO_4$).

April 23rd.—Experiment of April 19th, repeated with same result, viz., 51·7 per cent. normal sulphate formed. On blowing out all ammonia from the apparatus, washing the connecting tubes, and then re connecting with standard sulphuric acid, and lowering the temperature to 300° C., and keeping at that temperature for 7 hours, and then at 320°—340° C for 3 hours, until no more ammonia was evolved, it was found that about 51 per cent. of the formerly absorbed ammonia was again driven off, at a lower temperature accordingly, than that at which it had been absorbed.

April 27th.—In another experiment it was found that after absorbing ammonia at 350—360° C. (51·7 per cent. of normal sulphate being formed), on cooling down as low as 200°—210° C., ammonia was very perceptibly evolved from the mass.

April 21st.—Ammonium bisulphate heated up to about 420° C. Ammonia absorbed, but only to the extent of forming about 12·9 per cent. of normal sulphate. If the ammonia be passed through slowly, decomposition occurs at the temperature named (420° C.), *i.e.*, reduction of sulphate to sulphite with production of nitrogen gas. The sulphite is of course instantly decomposed by the highly-heated and fused bisulphate, and $SO_2$ passes over. If the rapidity of evolution of ammonia be increased, escaping $NH_3$ unites (along with $H_2O$) with sulphur dioxide in the tubes leading from the apparatus, and forms white fumes of $NH_4HSO_3$.

In employing ammonium sulphate or ammonium hydrogen sulphate then, in experiments at exalted temperatures with metals, the reactions which may ensue must of necessity be of a more complicated nature than would appear at first sight. For example, Messrs. Hodgkinson and Bellairs state that nickel and cobalt act like copper at a little below 160° on ammonium sulphate, but more sublimate of sulphite results, and "the amount of hydrogen is very small. Now in the light of my experiments at much higher temperatures, in which the hydrogen of free ammonia evidently reduces the $SO_3$ molecule to $SO_2$ in $NH_4HSO_4$, it seems very probable that "the amount of hydrogen *is* very small," because the nascent hydrogen liberated by the nickel and cobalt at or near 160° C., will have reduced $SO_3$ to $SO_2$, and so given rise to formation of sulphite and water.

When Messrs. Hodgkinson and Bellairs say "the ammonium group seems to be displaced and broken up by metals at temperatures just below those at which the salts undergo resolution, if heated alone,"—I entirely fail to comprehend how this applies in the case of "ammonium sulphate," and for this reason. The authors say that in their experiments "the salts were dried and carefully melted" before the introduction of the metals. Now normal ammonium sulphate as such will not melt. Ammonium hydrogen sulphate will melt at about 146° C., but its decomposition point lies, as we have seen, tolerably high, certainly higher than 160° C. by a great deal. If, however, the normal sulphate be referred to, then the evolution of ammonia during the action of the metal, has little connection with the experiment, for I have also proved that ammonia readily separates from finely powdered ammonium sulphate *at a temperature of* 160° *C.* Then again, where Messrs. Hodgkinson and Bellairs state in some of their experiments with metals and ammonium sulphate, that little hydrogen, or none, escapes, whilst sulphurous oxide alone or as sulphite, does, is to me confusing, since it seems exceedingly probable that hydrogen so soon as liberated *in status nascendi*, would at once react upon a $SO_3$ molecule of the sulphate reducing it to $SO_2$, and hence would not be in evidence, though it was originally liberated, but be in fact actually in part or wholly represented by the sulphite sublimed.

My remarks so far have been directed to ammonium sulphates, but with regard to the nitrate I may mention that so far as evolution of ammonia is concerned in the experiments of Messrs. Hodgkinson and Bellairs, there is nothing extraordinary, for Veley has shown (Phil. Trans. Royal Soc., 1888, 257—95), that on heating ammonium nitrate alone at temperatures somewhat below that "at which it undergoes resolution," ammonia is set free, as is also nitric acid. (See this Journal, 1893, 10.) If, then, a metal vulnerable to nitric acid be present, it is a matter of small surprise that that metal is attacked, and so soon as the trace of nitric acid has thus done duty and been removed from the free state, it is natural that the slight dissociation shall be again set up, with separation of a little more ammonia, and formation of more metallic nitrate and so on. In the one case then the action is pretty much that of nitric acid on the metal employed with collateral evolution of ammonia, and not that of ammonium nitrate; and it will be no matter of surprise that, as Messrs. Hodgkinson and Bellairs say, "it is doubtful whether any hydrogen escapes." I should say, "more than doubtful." In the other case it is a matter of the action of an unstable alkaline bisulphate on the respective metals, at a temperature at which any nascent hydrogen developed, would probably be at once consumed in reducing $SO_3$ to $SO_2$ with formation of $H_2O$ and sulphites.

* * *

## CAPTAIN M. NADIEIN'S COMPOUND SIPHON.

BY N. W. TCHAYKOVSKY.

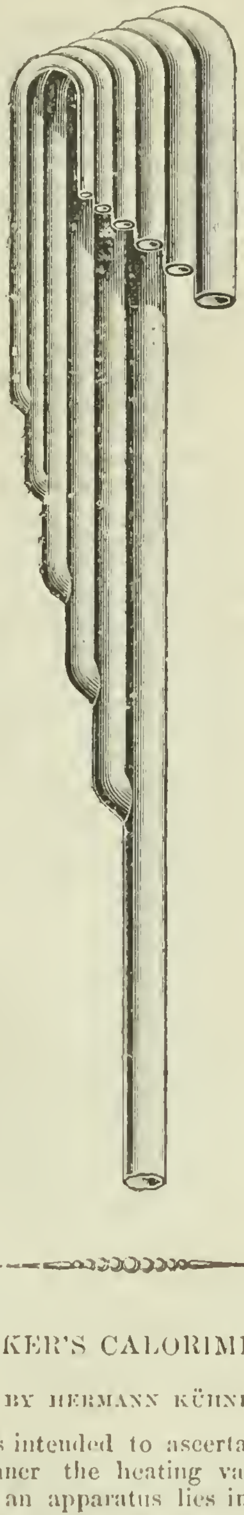
This siphon, of somewhat original shape, consists of a system of single siphons, or bent pipes of increasing bore, which fall one into the other, all terminating in the lower part of the thickest one. As soon as the smallest pipe is filled with fluid, and it works, the whole system is brought into action. The explanation of this lies in the fact that whilst the liquid from the smallest pipe passes down through the lower portion of the second pipe it carries down part of the air contained therein, thus rarefying it and causing the liquid to be sucked through the second pipe. In this way a very small constant supply of fluid is required to keep the appliance periodically and automatically at work. In the case of a compound siphon beginning with the smallest pipe of $\frac{1}{4}$ in. diameter, a supply through $\frac{1}{8}$—$\frac{3}{16}$ in. pipe is sufficient therefore, whilst if the smallest pipe be of $\frac{1}{8}$ in. diameter, a supply of $\frac{1}{16}$—$\frac{3}{32}$ in. will make it work. On the other hand, the force of the flush and the speed of the discharge do not depend on the rate of supply, but on the section of the largest pipe. A siphon terminating in a pipe of 1 in. diameter empties a $2\frac{1}{2}$-gall. basin in 8 seconds, whilst in the case of the largest pipe being of $1\frac{1}{4}$ in. diameter, a $3\frac{1}{2}$-gall. basin is discharged in less than 5 seconds.

The action is automatic, and the intervals between the successive discharges may be minutely regulated, that is to say, it may be brought into action every two minutes, five minutes, ten minutes, every half hour, or every hour—according to the requirements of the case. Such regulation would depend on a combination of pipes of certain sizes, with a suitable rate of supply of the liquid into the basin to be discharged.

Whilst discharging the contents of a vessel much quicker than a single siphon of the same section, and with much greater force, this siphon serves a much more important purpose than merely emptying vessels, since, in discharging liquid, it is capable of sucking in and mixing with itself a considerable amount of air through the overflow pipe (if used) as well as through the short ends of the smaller pipes at the end of each discharge, whilst the larger pipes are still at work. This action, in the first place, removes the foul air from the basin (as in the case of a urinal, and, secondly, in mixing fresh air with impure liquid it assists the chemical action of the oxygen upon the organic matter.

It will be understood from the above that this siphon may be arranged either for automatic emptying or flushing purposes, as the case may be. It is proposed at present to work by its means all sorts of urinals in large dwellings and buildings, such as hospitals, schools, hotels, barracks, railway stations, &c., in order to get rid entirely with the smell of rottening urine with either excessive waste of water, use of disinfecting chemicals, or attendance.

It has been suggested to me by Mr. Watson Smith that perhaps this siphon could be employed with advantage, instead of the usual "tumblers," for spreading water over the perforated tops of the absorbing towers, in the condensation and manufacture of hydrochloric acid, several siphons being used, and their basins being filled from the over-head water cistern (and consequently emptied), at different periods.



* * *

## JUNKER'S CALORIMETER.

BY HERMANN KÜHNE.

This instrument is intended to ascertain in a very simple and reliable manner the heating value of gases. The necessity of such an apparatus lies in the extraordinary extension of the use of hydrocarbons in place of solid fuel.

Twenty years ago the only extensive use of illuminating gas was for lighting purposes. In granting charters to the gas companies the Legislature therefore only took care that the public should be supplied with gas of a certain lighting power, generally known as "16 candle-power" gas. We still retain this perfectly obsolete and useless standard, while using the gas more and more for purposes where the candle-power affords no indication of its value, viz., for heating and for power.

Many years ago the late Sir Wm. Siemens gave it as his opinion that it was only a question of time, that the terrible waste of fuel going on by burning it in ill-constructed grates, stoves, and furnaces would cease, and that the only rational method of using gaseous fuel would be generally adopted. That prophecy has already gone far towards fulfilment, even in directions of which he had then no knowledge. There is no longer any question that the gas engine gives an infinitely better return in motive power than the steam engine; and in our time where inventions are no longer accidents, but the results of a set purpose, the present practical difficulties of building gas engines of large motive power will soon be removed. Thousands of large factories already rely for their motive power on the gas engine, besides gas-driven boats and ships, tramways, motor cars, and even tricycles. The gas stove in the kitchen, and for heating rooms is a firmly-established institution, gas producers replace stokers, and innumerable other uses of gas have been found in almost every one of which it is the heating power, but not the lighting value of the gas that is coming into request. Even upon the very domain of lighting, the heating power is encroaching, as the new departure, the incandescent gas light depends for its effect, not on the candle-power but on the heating power of the gas.

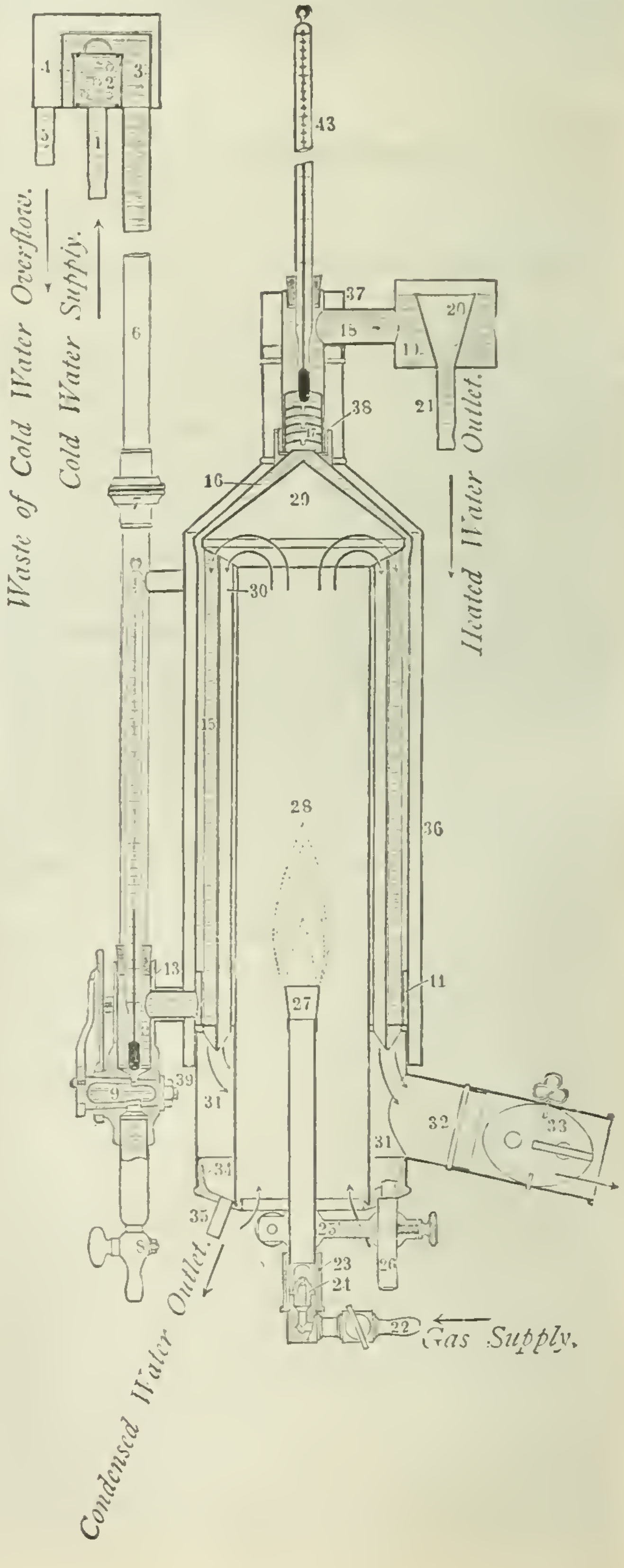
Is is therefore nothing less than an anachronism, that the public should still have to be content with buying their gas on the basis of a standard that is perfectly useless to them. To make matters worse, science has put into the hands of the gas companies ready means of producing gas of a very poor quality, and enriching it to the statutory candle-power by the addition of suitable cheap hydrocarbons. Of the many instances how this is done I will only mention the recent proposal of Professor Vivian B. Lewes, to send through the mains a 12 candle-power gas, and to enrich it up to 16 candle-power or more at the consumer's meter by means of acetylene. This plan would, no doubt, be to the interest of the gas companies, but if it were intended to charge the same price for this enriched gas, the amount of money to be paid for such gas for all heating and power purposes would at once increase about 25 per cent. Acetylene has about 14 times the lighting power but only double the heating power of ordinary coal gas. While, therefore, a small quantity of acetylene would be sufficient to raise the lighting power of 12-candle gas to 16 candles, the heating value would hardly be increased to any appreciable extent by the process. The gas company in adopting this course would remain strictly within their legal rights, but the gas engines, gas stoves, incandescent lights, &c., would at once become extravagantly wasteful. This state of things has already had serious commercial consequences. Gas-engine makers sell their engines on a guarantee that the same shall use no more than so many cubic feet of 16 candle-power gas per horse-power per hour. Trials at the works bear out this guarantee, but when the engine is used at the buyer's works, it requires perhaps 20 per cent. more gas, which when tested with the photometer however still shows the statutory 16 candles. There may be a suspicion that the heating value of the gas at the buyer's place is not so high as at the builder's, but how is this to be proved? A complete analysis of the gas requires a skilled chemist and a suitably fitted laboratory, which are not at hand everywhere, and even where they are, it would take half a day to finish the analysis, and during that time the composition of the gas may already have considerably altered.

The foregoing remarks will show conclusively that the present mode of using gas imperatively demands an instrument which will enable any intelligent man to ascertain the heating value of gas in an expeditious and reliable manner.

It is claimed for Junker's calorimeter that it perfectly fulfils these conditions.

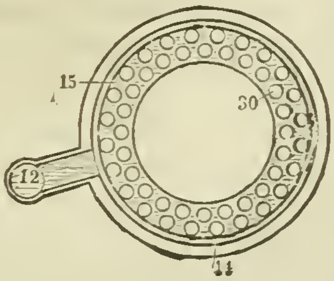
As will be seen from the sectional drawing, the calorimeter consists of a combustion chamber surrounded by a water-jacket, this water-jacket being traversed by a great many tubes. To prevent loss by radiation, the water-jacket is surrounded by a closed annular air-space in which the air cannot circulate. The whole apparatus is constructed of copper of great conductivity, and as thin as is compatible with strength. The water enters the water-jacket at the bottom, and leaves it at the top, while the hot combustion gases of the flame of the gas that is on trial enter the tubes at the top and leave them at the bottom. There is, therefore, not only a very large surface of thin copper between the gases and the water, but the two move in opposite directions, during which process all the heat generated by the flame is transferred to the water, and the waste gases leave the apparatus approximately at atmospheric temperature. The gas to be burned is first passed through a meter, and then, to ensure constant pressure, through a pressure regulator. The source of heat in relation to the unit of time is thus rendered stationary; and in order to make the absorbing quantity of heat also stationary two overflows are provided at the calorimeter, making the head of the water

Fig. 1.



and the rate of flow of the same constant. The temperatures of the water entering and leaving the apparatus can be read at the respective thermometers; as shown before, the quantities of heat and water passed through the apparatus are constant. As soon as the flame is lighted the temperature of the exit thermometer will rise to a certain point and will very nearly remain there. All data for ascertaining the heat given out by the flame are therefore available.

Fig. 2.



1. *Cold water inlet.*
2. *Strainer.*
3. *Overflow to calorimeter.*
4. *Upper container.*
5. *Waste overflow.*
6 *and* 7. *Fall pipe and joint.*
8. *Drain cock.*
9. *Adjustment cock.*
12. *Cold water thermometer.*
13. *Air jacket.*
14. *Perforated spreading ring.*
15 *and* 16. *Water jacket.*
17. *Baffle plates with cross slots.*
18. *Lower overflow.*
19. *Lower container.*
20. *Hot water overflow.*
21. *Hot water nipple.*
22. *Gas nipple.*
23. *Air supply regulator.*
24. *Gas nozzle.*
25. *Clamp for burner.*
26. *Burner holder.*
27. *Burning cap.*
28. *Combustion chamber.*
29. *Roof of combustion chamber.*
30. *Cooling tubes.*
31. *Receiver for combustion gases.*
32. *Outlet for combustion gases.*
33. *Throttle for combustion gases.*
34. *Brass base ring.*
35. *Condensed water outlet.*
36, 37, *and* 38. *Air jacket.*
39. *Test hole in air jacket.*
43. *Hot water thermometer.*

The two principal standard units of heat are the caloric and the British thermal unit, representing the amount of heat required to raise the temperature of 1 kilo. (1 litre) of water 1° C., or of 1 lb. of water 1° F. respectively.

All we have, therefore, to do is to measure simultaneously the quantity of gas burned and the quantity of water passed, and the difference in temperature between the entering and leaving water. For the present experiments I am using Centigrade thermometers and a two-litre measure glass. The meter shows $\frac{1}{10}$ of a cub. ft. per revolution of the large hand; the circumference being divided into 100 parts, we can read $\frac{1}{1000}$′ accurately. The water supply is so regulated that the overflow is working freely, and the water-admission cock is set to allow two litres of water to pass in about a minute and a half.

The calorimeter is now ready to take the reading.

The cold water has as a rule a sufficiently constant temperature that we note it only once; it is now 17·2° C. As soon as the large index of the meter passes zero, I note the state of the meter and at the same time transfer the hot-water tube from the funnel into the measure glass, and while that is being filled I note the temperature of the hot water at say 10 intervals, to draw the average.

The temperatures are 43·8
43·5
43·5
44·2
44·1
43·9
43·8
43·7
43·8
43·7
———
438·0
———

Average, 43·8.

The measure glass is now filled; I turn the gas out and find from the readings of the meter at the beginning and the end of the experiment that we have burned 0·35 cub. ft., by means of which we have raised the temperature of the two litres of water 26·6° C., viz. 43·8° − 17·2°.

We have now only to make a very short calculation by inserting the data given by the experiment into the formula—

$$H = \frac{W \cdot T}{G},$$

where H is the calorific value of 1 cub. ft. of gas in calories,

W the quantity in litres of the water heated,

T the difference in temperature between the two thermometers in degrees C., and

G the quantity in cubic feet of gas used.

We therefore find—

$$H = \frac{2 \cdot 26{\cdot}6}{0{\cdot}35} = 152{\cdot}3 \text{ calories},$$

or multiplied by the known factor 3·96828 we get 604·4 B.T.U.

I mentioned before that the effect of the cooling water is such that the waste gases leave the calorimeter at about atmospheric temperature. All hydrocarbons when burned form, however, a considerable quantity of water, which in all industrial processes escapes with the waste gases as steam. The latent heat of this steam is therefore not utilised when firing a stove or driving an engine with gas; in the above result, however, the latent heat *is* included, because in the copper tubes the steam is condensed, and its heat is transferred to the circulating water and measured with the rest. To find, therefore, the heating value of a gas which is available in practice, allowance must be made for the latent heat; the calorimeter gives a ready means to determine its quantity. The condensed water runs down the tubes, which are cut off obliquely to allow the drops to fall off easily, and is collected in the lower part of the apparatus, from where it runs through the little tube into a measure glass. In condensing, steam gives off an average of 0·6 calorie for every c.c. of water formed. I therefore place a measure glass graduated in cubic cent. under the little tube, and measure the quantity of water generated by burning, say, 1 cub. ft. of gas. In this case also we begin the measurement only after the apparatus has adopted a state of stagnancy, *i.e.*, after the delivery of condensed water from the little tube has become constant. We may then fairly assume that the inner surfaces of the instrument are uniformly wet, and that they will be in the same state when we remove the measure glass.

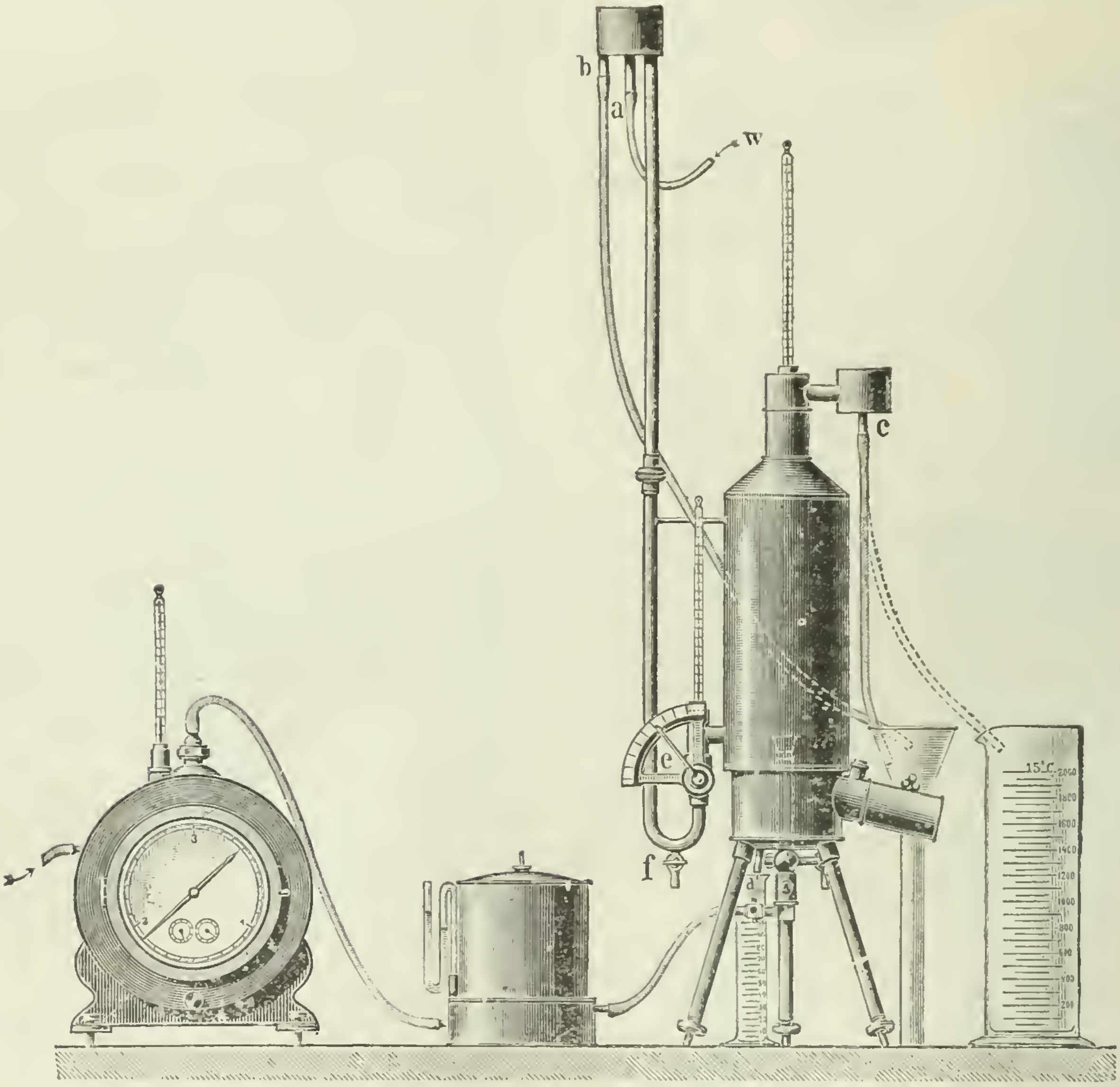
From burning 1 cub. ft. of gas we have collected 27·25 c.c. of condensed water, and must therefore deduct 16·35 calories from the gross value found above, which gives us the nett calorific value of the gas tested as 135·95 calories per cub. ft.

During the last year I have made a very long series of tests with the calorimeter, and have found variations in the heating value of gas from the same main from 156·7 to 171·7 calories gross. The lower values are, as a rule, found early in the morning, presumably pointing to a deterioration of the gas while at rest in the pipes.

Professor Robinson, of Nottingham, and Mr. W. Norris, of Lincoln, have lately made a series of 130 calorimetric tests with Nottingham town gas, and in that town the heating value, although not very high, seems remarkably steady. I subjoin a table of the results, kindly furnished by Professor Robinson for the purpose, which gives the average values of each day's trials. All temperatures are given in Centigrades, the heating values in calories.

| —— | Temperature of Room. | Temperature of Water Inlet. | Temperature of Water Outlet. | Rise in Temperature. | Gas burned. Cub. Ft. per Min. | Temperature of Products of Combustion. | Condensed Water per Cub. Ft. of Gas. | Gross Calories per Cub. Ft. | Latent Heat of Steam. | Nett Calories per Cub. Ft. |
|---|---|---|---|---|---|---|---|---|---|---|
| First day ... | 21° | 15·322 | 26·113 | 10·79 | 0·0407 | .. | 25·7 | 165·3 | 15·4 | 149·9 |
| Second „ ... | 22·5 | 12·9 | 27·68 | 14·78 | 0·0584 | .. | 27·4 | 165·9 | 16·4 | 148·5 |
| Third „ ... | 17·5° | 13·71 | 28·6 | 14·89 | 0·1103 | 17·5 | 26·43 | 164·8 | 15·86 | 148·94 |
| Fourth „ ... | 17·5° | 13·75 | 28·53 | 14·78 | 0·1103 | 17·4 | 26·43 | 165·6 | 15·86 | 149·74 |

Fig. 3.



The calorimeter is placed as shown in Fig. 3, so that one operator can simultaneously observe the two thermometers of the entering and escaping water, the index of the gas-meter, and the measuring glasses.

No draught of air must be permitted to strike the exhaust of the spent gas.

The water supply tube *w* is connected to the nipple *a* in the centre of the upper container; the other nipple *b* is provided with a waste tube to carry away the overflow. This overflow must be kept running while the readings are being taken.

The nipple *c*, through which the heated water leaves the calorimeter, is connected by an india-rubber pipe with the large measure glass, and the water must be there collected without splashing.

The smaller measure glass is placed under the tube *d* to collect any condensed water.

After the thermometers have been placed in position with their india-rubber plugs, the water supply is turned on by the cock *e*, and the calorimeter filled with water until it begins to discharge at *c*. No water must at this period exude from the smaller pipe at *d*, or from the test hole under the air jacket, otherwise this would prove the calorimeter to be leaking.

During the first and fourth day, samples of the gas were analysed by Professor Frank Clowes, D.Sc., from which the heating value of the gas was ascertained as 164 calories gross, which fairly corroborates the above results.

Professor Robinson has also made some careful tests of Dowson gas, of which the following table gives the results:—

| Duration of Trial. | Temperature of Room. | Temperature of Water Inlet. | Temperature of Water Outlet. | Rise in Temperature. | Gas burned. Cub. Ft. per Min. | Temperature of Products of Combustion. | Condensed Water per Cub. Ft. of Gas. | Gross Calories per Cub. Ft. | Latent Heat of Steam. | Nett Calories per Cub. Ft. |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 minutes | 22° | 15·96 | 30·385 | 14·425 | 0·3056 | 19·6 | 2·73 | 37·56 | 1·63 | 35·93 |
| 10 " | 23° | 16·10 | 28·65 | 12·55 | 0·2600 | 19·4 | 2·66 | 38·1 | 1·59 | 36·51 |
| 12 " | 24° | 16·15 | 28·49 | 12·34 | 0·2633 | 19·5 | 2·6 | 37·17 | 1·54 | 35·63 |
| 12 " | 24° | 16·2 | 28·9 | 12·7 | 0·2667 | 19·5 | 2·6 | 37·84 | 1·6 | 36·24 |
| | | | | | | | Mean………………… | | 37·7 − 1·6 = 36·1 | |

The gas produced by the Dowson plant in question had been frequently analysed previous to the above tests, and rather wide variations in its composition had been found. The average heating value ascertained by a large number of tests came to 36·05 calories per cub. ft., which again coincides very well with the indications given by Junker's calorimeter. In the hands of a careful observer, Professor Robinson declares himself satisfied that the source of error to which the calorimeter may be liable is less than 1 per cent.

The severest test to which the calorimeter has perhaps been subjected, is a series of three months' trial by the Physical Technical Institute of the German Empire, which tests have been carried out with the greatest possible care, and under the most stringent safeguards against errors that can be brought to bear on scientific experiments of the highest order. The gas used was hydrogen only, and all conditions of temperature, barometric pressure, proportion of moisture and air in the gas, temperature of escaping gases, &c., have been accounted and allowed for. The final result was that, as compared with Thomson's method of ascertaining the calorific value of hydrogen—the one that is generally recognised as the best hitherto known,—there is only a deviation to the extent of 0·3 per cent. Those who know of Thomson's method will not maintain that even this trifling discrepancy must be necessarily debited to the calorimeter; anyhow Junkers' method is more than sufficiently correct for any practical purpose, and indications are not wanting that the instrument will soon be a recognised standard for measuring heating values.

## THE BRUNSVIGA CALCULATING MACHINE.

Mr. Charles Bradbury, of High Holborn, London, exhibited a compact arithmometer, the invention of Mr. Willgodt Odhner, of St. Petersburg, and known as the Brunsviga calculator.

## Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

| | |
|---|---|
| H. E. Aykroyd. | W. Mc'D. Mackey. |
| J. E. Bedford. | A. G. Perkin. |
| F. W. Branson. | C. Rawson. |
| *J. B. Cohen.* | *F. W. Richardson.* |
| T. Fairley. | *G. W. Slatter.* |
| W. Leach. | Thorp Whitaker. |

*Hon. Local Secretary and Treasurer:*
H. R. Procter, Yorkshire College, Leeds.

The names in italics are those of Members of Committee who retire at the end of the current session.

The following have been elected to fill the vacancies, and will take office in July next:—*Committee:* N. Farrant, A. Hess, and Geo. Ward.

Notices of Papers and Communications for the Meetings to be sent to the Local Secretary.

## THE EFFECT OF DIFFERENT TEMPERATURES IN THE EXTRACTION OF TANNING MATERIALS.

BY J. GORDON PARKER, PH.D., AND H. R. PROCTER, F.I.C.

In a foregoing paper, published in this Journal, 1895, 124, the authors described a new method of measuring the colour contained in a solution of tanning material of known strength, and expressing it numerically in terms of standard glasses. Using this method, we have endeavoured to find what ratio the tannin in various tanning materials bears to the colouring matter, and how the same is affected by extracting at different temperatures. This has proved a somewhat difficult and laborious work, since, for the sake of accuracy, it was found necessary to make at least three extractions at each temperature, stating our results as the mean of the three analyses.

It will be found on comparing our figures, that some very interesting information has been gained; many tanning materials parting with their tannin and colouring matter much more readily at *circa* 60° C. than at higher temperatures, and almost every one having its own peculiarities in this respect. Our method of extraction was in each case identical, so that the results obtained may be compared with one another.

A suitable quantity of tanning material was ground to a moderately fine powder in one of Burroughes and Wellcome's drug mills, a portion of this weighed out and placed in a beaker, at the bottom of which was some pure silver sand, into which a syphon filter was inserted, as described in a former paper by one of us (this Journal, 1892, 330). In using this method we have tried to approximate as much as possible in principle to that employed in the tanyard.

The beaker was now put into a water-bath, and the material covered with distilled water and allowed to macerate over night (*circa* 16 hours): after which the bath was heated so that a thermometer inside the beaker reached the required temperature, and the extraction commenced; the liquor, as it syphoned slowly over, being replaced by water of the same temperature as that required for extraction, which percolated through the material, so that a litre was extracted in from 2½—3 hours.

It was found that this was practically sufficient water to extract all the available tannin and colour, very small additional quantities being obtained when, for experiment, a second litre was percolated at the same temperature.

The solution was now allowed to cool, filtered, analysed, and measured in a ½-inch cell by Lovibond's tintometer, and the results calculated for a ½ per cent. solution of tanning matter, which was shown to be permissible in our previous paper (this Journal, 1895, 124). The analyses were made by the hide-powder filter described by one of us (this Journal, 1887, 91; 1892, 329).

Our first experiments were made with a somewhat poor sample of Belgian oak bark, 40 grms. of the ground material being extracted as described above, at each of the 10 following temperatures. The results are tabulated in percentages of the highest amount of tanning and colouring matter obtained from the sample. For the sake of simplicity the *total* colour is calculated in this way, but as the tint continually varies, and red and yellow are not of equal practical importance, the actual measurements at each temperature are also given, reckoned for a ½-inch layer of a ½ per cent. solution of tanning matter.

The sample taken gave by analysis—

| | Per Cent. |
|---|---|
| Tanning matters | 9·6 |
| Soluble non-tanning matters | 6·1 |
| Moisture | 11·6 |
| Insoluble fibre, &c. | 72·7 |
| | 100·0 |

Taking therefore 9·6, the total amount of tannin* in the sample, as 100 per cent.; and 14°·0 red and 41°·2 yellow, or 55·2 total degrees of colour in a ½-inch layer of ½ per cent. solution also as 100 per cent., the resuts calculated in percentages of these were as follows:—

| Temperature of Extraction. | Tanning Matters absorbed by Hide. | Soluble Non-tanning Matters. | Per Cent. of Tannin on Maximum Yield. | Colour of ½ per Cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum Yield. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| ° C. | Per Cent. | Per Cent. | | Deg. | Deg. | |
| 15 | 5·9 | 5·1 | 61·9 | 8·6 | 23·1 | 57·4 |
| 15—30 | 6·8 | 5·5 | 70·7 | 9·2 | 26·4 | 64·5 |
| 30—40 | 8·0 | 5·5 | 83·5 | 11·6 | 30·4 | 76·1 |
| 40—50 | 8·2 | 5·7 | 84·2 | 12·0 | 32·1 | 80·0 |
| 50—60 | 8·5 | 5·8 | 87·6 | 12·5 | 36·0 | 84·0 |
| 60—70 | 9·1 | 5·9 | 95·5 | 13·1 | 38·1 | 92·7 |
| 70—80 | 9·2 | 6·0 | 95·7 | 14·7 | 38·9 | 98·7 |
| 80—90 | 9·6 | 6·0 | 100·0 | 14·0 | 36·9 | 93·2 |
| 90—100 | 9·6 | 6·1 | 100·0 | 14·0 | 41·2 | 94·6 |
| Boiled ½ hour | 9·1 | 6·6 | 93·7 | 15·0 | 42·6 | 100·0 |

From these results it will be seen that all the available tannin cannot be extracted by cold water. A second litre was extracted at 15° and also at 50°, but they only resulted in getting less than another ¼ per cent. out of the material, showing that the extraction had been thorough. Scanning the above it will be noticed that 38·1 per cent., or more than one-third more tannin is extracted at 80°—90° than in the cold, but that the proportion of colour to tannin has also increased 35·8 per cent. It may therefore be necessary, where colour is a primary object, to continue to use cold extraction, but it is well to realise that one-third of the tannin is then wasted, and to consider whether this should not be extracted and utilised in some other way; for example, by mixing it with a light-coloured material, or using it on goods for which colour was not an important matter.

In order to further confirm these results, a second portion was weighed out and extracted cold; the temperature was then raised to 30°, and a further litre was extracted, and this was repeated at 50°, 70°, and 100° successively, a litre being extracted in each case.

The results got by this method coincided thoroughly with those given above. A sample of sheep skiver was tanned in some of the cold extracted liquor, and a second piece in the liquor extracted at 90°—100°, and the difference in the colour of the resulting leather was what one would expect from the above figures. The pieces of skiver were treated as described in our former paper (this Journal, 1895, 124).

*Myrabolans.*—Our experiments were made with a good sample of this material. 12 grms. of the ground material were taken in each case, as, being stronger than oak-bark, a larger quantity would have given inconveniently strong liquors for analysis. It was also allowed to soak for *circa* 16 hours before the extraction was commenced, which was carried out precisely as in the former case. The analysis of the sample gave as *maxima*—

| | Per Cent. |
|---|---|
| Tanning matters | 36·0 |
| Soluble non-tannins | 14·9 |
| Moisture | 12·1 |
| Insoluble fibre, &c. | 37·0 |
| | 100·0 |

---

* "Tannin" is used throughout the paper in the sense of "tanning matters absorbed by hide-powder."

Maximum colour, 1·26 red and 4·9 yellow. The percentage results calculated on these were as follows:—

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum Yield. | Colour of ½ per Cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum Yield. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| ° C. | Per Cent. | Per Cent. | | | | |
| 15 | 28·5 | 12·8 | 79·2 | 1·09 | 4·9 | 97·4 |
| 15—30 | 30·1 | 13·6 | 83·6 | 1·00 | 4·1 | 82·5 |
| 30—40 | 32·3 | 14·3 | 89·8 | 1·03 | 4·1 | 82·7 |
| 40—50 | 33·5 | 13·6 | 93·0 | 1·03 | 4·2 | 84·4 |
| 50—60 | 34·7 | 14·4 | 96·4 | 1·03 | 4·4 | 87·6 |
| 60—70 | 34·8 | 14·4 | 96·6 | 1·03 | 4·5 | 89·3 |
| 70—80 | 34·9 | 14·9 | 96·8 | 1·10 | 4·7 | 94·1 |
| 80—90 | 35·1 | 15·0 | 97·4 | 1·16 | 4·8 | 96·7 |
| 90—100 | 36·0 | 14·9 | 100·0 | 1·12 | 4·9 | 97·0 |
| Boiled | 35·4 | 15·5 | 98·1 | 1·26 | 4·9 | 100·0 |

In this case the best results as regards tanning matter are obtained at from 90°—100° C., whereas the maximum colour is got by actual boiling. The highest amount of colour is very low compared with some of the other materials examined, and is 1·26 red and 4·9 yellow, or 6·26 degrees of total colour in a ½ per cent. solution.

It is important to notice that the colour is very little affected by the temperature, 97 per cent. of the total colour being extracted by cold water, and the lowest amount of colour in proportion to tanning being obtained at about 40°. Probably the most profitable temperature to extract myrabolans for most practical purposes, having regard to both tannin and colour, is from 60°—70°.

*Smyrna Valonia (beard).*—12 grms. of this material, suitably ground, were heated exactly the same as the foregoing. The maximum analysis gives for this sample:—

| | Per Cent. |
|---|---|
| Tanning matters | 39·1 |
| Soluble non-tannins | 17·4 |
| Moisture | 12·3 |
| Insoluble fibre, &c. | 31·2 |
| | 100·0 |

Maximum colour was 3·0 red, 8·2 yellow, and 0·6 blue. The percentage results were as follows:—

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum Yield. | Colour of ½ Per Cent. Solution in ½-Inch Cell. | | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | Blue. | |
| ° C. | Per Cent. | Per Cent. | | Deg. | Deg. | Deg. | |
| 15 | 25·5 | 19·1 | 70·5 | 2·5 | 6·0 | 0·3 | 74·6 |
| 15—30 | 29·1 | 18·3 | 74·5 | 2·5 | 6·4 | 0·3 | 78·0 |
| 30—40 | 33·6 | 18·1 | 86·2 | 2·3 | 6·4 | 0·3 | 76·2 |
| 40—50 | 35·5 | 18·1 | 86·2 | 2·3 | 6·5 | 0·3 | 74·6 |
| 50—60 | 39·1 | 16·6 | 100·0 | 2·0 | 6·0 | 0·3 | 76·2 |
| 60—70 | 38·6 | 17·0 | 99·0 | 2·0 | 6·8 | 0·3 | 84·7 |
| 70—80 | 38·8 | 17·5 | 99·5 | 2·1 | 7·4 | 0·4 | 84·7 |
| 80—90 | 36·9 | 17·2 | 95·0 | 2·2 | 7·6 | 0·4 | 84·7 |
| 90—100 | 36·6 | 17·0 | 94·0 | 2·4 | 7·8 | 0·5 | 90·6 |
| Boiled | 35·4 | 17·6 | 90·6 | 3·0 | 8·2 | 0·6 | 100·0 |

Valonia behaves in rather a peculiar manner. It will be noticed that on increasing the temperature from 15° to 40°, the non-tannins steadily decrease with a corresponding increase in the tannins, which points to a probable transformation of some anhydrides or glucosides into tannin. 50°—60° C. appears to be the best temperature for extraction, as at higher temperatures the proportion of colour increases, and the tannin decreases.

*Greek Valonia.*—12 grms. of a sample of average Greek valonia (cup and beard) was treated as in former cases, and gave the following maximum analysis:—

| | Per Cent. |
|---|---|
| Tanning matters | 25·0 |
| Soluble non-tannins | 12·7 |
| Moisture | 12·6 |
| Insoluble fibre, &c. | 49·7 |
| | 100·0 |

With maximum colour 3·9 red, 9·4 yellow, and 0·8 blue, were taken and treated exactly as in former cases.

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum Yield. | Colour of ½ Per Cent. Solution in ½-Inch Cell. | | | Per Cent. of Colour in ½ Per Cent. of Tannin Solution. |
|---|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | Blue. | |
| °C. | Per Cent. | Per Cent. | | Deg. | Deg. | Deg. | |
| 15 | 16·0 | 13·0 | 64·0 | 2·9 | 6·3 | 0·3 | 67·3 |
| 15—30 | 18·1 | 12·6 | 72·4 | 3·0 | 6·6 | 0·3 | 70·0 |
| 30—40 | 21·1 | 12·0 | 84·4 | 2·8 | 6·5 | 0·3 | 68·0 |
| 40—50 | 23·6 | 12·1 | 94·4 | 2·4 | 6·6 | 0·3 | 65·9 |
| 50—60 | 24·8 | 12·1 | 99·2 | 2·7 | 7·0 | 0·4 | 71·6 |
| 60—70 | 25·0 | 12·6 | 100·0 | 2·9 | 7·3 | 0·5 | 75·8 |
| 70—80 | 24·6 | 12·5 | 98·4 | 3·1 | 7·9 | 0·6 | 82·3 |
| 80—90 | 24·0 | 12·5 | 96·0 | 3·4 | 8·1 | 0·6 | 85·8 |
| 90—100 | 23·6 | 12·6 | 94·4 | 3·5 | 8·8 | 0·7 | 92·0 |
| Boiled | 22·6 | 13·0 | 88·8 | 3·9 | 9·4 | 0·8 | 100·0 |

As would naturally be expected, the Greek valonia behaves in a very similar way to the Smyrna, and gives the best results between 60° and 70° C. It, however, gives off its tannin more quickly than the Smyrna beard; the colouring matter is also higher in proportion.

*Natal Mimosa.*—This is the "black wattle," and is identical with the best Australian barks. 20 grms. were taken and treated exactly as the former.

The maximum analysis of the sample gave :—

| | Per Cent. |
|---|---|
| Tanning matters | 32·0 |
| Soluble non-tannins | 11·6 |
| Moisture | 10·8 |
| Insoluble fibre, &c. | 45·6 |
| | 100·0 |

The maximum colour was 5°·7 red, and 7°·2 yellow.

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum. | Colour of ½ per Cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| °C. | Per Cent. | Per Cent. | | | | |
| 15 | 21·2 | 11·6 | 66·2 | 2·6 | 4·1 | 51·1 |
| 15—30 | 29·0 | 9·8 | 90·6 | 3·0 | 4·1 | 54·2 |
| 30—40 | 30·1 | 9·8 | 94·0 | 3·0 | 4·4 | 56·5 |
| 40—50 | 30·2 | 9·8 | 94·4 | 3·1 | 5·0 | 61·8 |
| 50—60 | 30·4 | 10·4 | 95·0 | 3·9 | 6·5 | 79·9 |
| 60—70 | 31·5 | 10·6 | 98·4 | 4·2 | 6·5 | 81·6 |
| 70—80 | 32·0 | 10·8 | 100·0 | 4·2 | 7·0 | 85·5 |
| 80—90 | 30·8 | 11·2 | 96·2 | 4·9 | 7·4 | 93·8 |
| 90—100 | 30·1 | 11·8 | 94·0 | 5·3 | 7·8 | 100·0 |
| Boiled | 29·4 | 12·0 | 91·8 | 5·7 | 7·2 | 98·4 |

A temperature between 70° and 80° C. gives the best results as regards tannin; but, on the other hand, where colour is of great moment, the temperature must be kept below 40°. Cold extraction sacrifices one-third of the available tannin, without any commensurate gain in colour. Between 15° and 50° the colour increases very slowly, but afterwards in much greater proportion.

*Sumach.*—20 grms. were taken and heated exactly as before. The maximum analysis of the sample gave :—

| | Per Cent. |
|---|---|
| Tanning matters | 20·2 |
| Soluble non-tannins | 23·1 |
| Moisture | 10·0 |
| Insoluble matters | 46·7 |
| | 100·0 |

The maximum colour was 3°·3 red, and 7°·7 yellow; the sample was rather below the average, 24—26 per cent. of tanning matter not being uncommon.

| —— | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum. | Colour of ½ Per Cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| °C. | Per Cent. | Per Cent. | | | | |
| 15 | 14·2 | 17·8 | 70·0 | 1·6 | 5·4 | 63·6 |
| 15—30 | 17·6 | 18·1 | 86·7 | 1·4 | 4·3 | 51·8 |
| 30—40 | 18·5 | 18·1 | 91·1 | 1·3 | 4·4 | 51·8 |
| 40—50 | 20·1 | 18·5 | 99·0 | 1·4 | 4·4 | 52·9 |
| 50—60 | 20·3 | 19·1 | 100·0 | 1·5 | 4·7 | 56·5 |

| —— | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum. | Colour of ½ Per Cent. Solution in ½-inch Cell. | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| ° C. | Per Cent. | Per Cent. | | | | |
| 60—70 | 19·0 | 19·4 | 93·6 | 1·7 | 5·6 | 66·6 |
| 70—80 | 18·0 | 19·9 | 89·1 | 1·9 | 6·2 | 72·8 |
| 80—90 | 16·9 | 21·1 | 83·2 | 2·3 | 6·8 | 82·7 |
| 90—100 | 16·6 | 22·3 | 81·7 | 2·6 | 7·0 | 87·7 |
| Boiled | 15·2 | 24·0 | 74·8 | 3·3 | 7·7 | 100·0 |

In this experiment the maximum yield of tanning matter was at 50°—60°, while Messrs. Seymour, Jones, and Palmer, who first drew attention to the matter, found it between 30° and 40°, a result which was confirmed by Mr. J. T. Wood. This difference may be due either to some peculiarity in our sample or to a difference in the manner of experimenting, and needs further inquiry. It seems probable from the increase in non-tannins, corresponding to the diminished yield of tannin at higher temperatures, that some actual decomposition takes place. It is worthy of notice that the proportion of colouring matter decreases up to 40°, and then increases again. The extractions made over 60° were extremely difficult to filter, and, on standing, continued to deposit, whereas those extracted at a lower temperature remained quite clear.

*Quebracho Wood.*—20 grms. were taken as before.

The maximum analysis gave for this sample:—

| | Per Cent. |
|---|---|
| Tanning matter | 21·7 |
| Soluble non-tannin | 3·0 |
| Moisture | 9·8 |
| Insoluble fibre, &c. | 65·5 |
| | 100·0 |

The maximum colour for ½ per cent. solution was 6°·6 red, and 9°·8 yellow.

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent. of Tannin on Maximum. | Colour of ½ Per cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| ° C. | Per Cent. | Per Cent. | | Deg. | Deg. | |
| 15 | 7·6 | 2·2 | 35·0 | 8·9 | 14·1 | 71·3 |
| 15—30 | 10·1 | 2·4 | 46·5 | 6·4 | 10·7 | 68·7 |
| 30—40 | 11·8 | 2·4 | 54·4 | 5·9 | 9·6 | 65·2 |
| 40—50 | 15·1 | 2·4 | 69·5 | 5·3 | 8·4 | 60·0 |
| 50—60 | 16·5 | 2·4 | 76·0 | 5·4 | 8·5 | 60·4 |
| 60—70 | 17·4 | 2·4 | 80·0 | 5·6 | 8·2 | 59·9 |
| 70—80 | 19·1 | 2·7 | 88·0 | 6·4 | 8·6 | 67·4 |
| 80—90 | 21·7 | 3·0 | 100·0 | 6·4 | 9·4 | 74·3 |
| 90—100 | 19·5 | 3·0 | 89·8 | 6·6 | 9·8 | 100·0 |

It will be noted that even in quebracho, where heat is essential to good extraction, the maximum yield of tannin is obtained below 100°, while the colour increases by over 25 per cent. between 90° and 100°. It is highly probable that in this case there is an actual conversion of some of the tannins into red anhydrides, similar to that which has been observed in other catechol tannins.

*Mangrove Bark.*—This was a sample from South America, of which the precise species is unknown. It is a bark of whitish exterior, about ¼ inch thick, of red and friable substance. We think it is not from *Rhizophora mangle*, but from some allied species.

20 grms. were treated exactly as before. They gave on analysis:—

| | Per Cent. |
|---|---|
| Tanning matters | 21·1 |
| Soluble non-tannins | 10·8 |
| Moisture | 11·9 |
| Insoluble fibre, &c. | 56·2 |
| | 100·0 |

| Temperature of Extraction. | Tanning Matters. | Soluble Non-Tannins. | Per Cent of Tannin on Maximum. | Colour of ½ per Cent. Solution in ½-Inch Cell. | | Per Cent. of Colour on Maximum. |
|---|---|---|---|---|---|---|
| | | | | Red. | Yellow. | |
| ° C. | Per Cent. | Per Cent. | | Deg. | Deg. | |
| 15 | 13·0 | 10·4 | 61·6 | 14·2 | 20·8 | 61·7 |
| 15—30 | 16·1 | 10·4 | 76·3 | 16·1 | 21·7 | 69·8 |
| 30—40 | 17·4 | 12·5 | 82·4 | 15·8 | 23·0 | 71·7 |
| 40—50 | 18·5 | 11·4 | 87·7 | 16·5 | 33·5 | 73·8 |
| 50—60 | 20·3 | 10·3 | 96·2 | 16·0 | 23·4 | 72·8 |
| 60—70 | 20·0 | 11·4 | 94·7 | 17·5 | 31·2 | 90·0 |
| 70—80 | 20·4 | 11·2 | 96·7 | 16·5 | 28·3 | 82·8 |
| 80—90 | 21·1 | 10·8 | 100·0 | 15·4 | 24·6 | 73·8 |
| 90—100 | 20·2 | 11·4 | 95·7 | 20·0 | 34·1 | 100·0 |

In this case the maximum yield of tannin is practically reached at 60°, while beyond this the tannin remains nearly steady and the colour increases very irregularly up to 100° C. It was noted that above 40°, the infusions became turbid on cooling, through deposits of difficultly soluble reds, and that over 60° they became very difficult to filter.

Prolonged extraction with large quantities of water at temperatures gradually increased gave a maximum yield of tannin of 22·5 per cent., but this is certainly more than would be obtained by any method for practical use.

As a check on our results, 100 grms. of each of the following materials—oak-bark, myrabolans, Greek valonia, and mangrove bark—were extracted with 5 litres of water each at gradually increasing temperatures. 2½ litres were taken off cold, 1 litre at 40°, 1 litre at 70°, and 1½ litres at 100° C. In carrying out these experiments the authors were greatly assisted by Messrs. F. J. Boulton and M. C. Lamb, who confirmed our results, and we would here gratefully acknowledge their help both in this and in verifying our colour measurements.

This completes the list of materials which we have hitherto been able to examine. It is evident that requires much extension, and the causes of loss of tannin at higher temperatures need further investigation; but the work demands so much time and labour that it has been deemed desirable to publish what has been already accomplished without further delay. It is intended ultimately to apply similar methods of investigation to the effect of the various constituents of natural waters, &c. in the extraction of tanning materials.

Finally, we would add that our conclusions are fully confirmed by results in tanyards where most of the extraction is carried on with cold water. By the kindness of various tanners we have had the opportunity of examining their waste tan, and have found that very few of those extracting cold realise 70 per cent. of the available tannin contained in their materials. We therefore trust our investigations may be of some use to the practical tanner in drawing his attention to a serious source of loss.

In confirmation of our tintometer tests, pieces of sheepskin were tanned in two infusions of each of the above materials, the one extracted cold and the other at 90°—100°. The difference in colour is much less than would be expected, and in sumach, myrabolans, and valonia is very small, while in mimosa and quebracho it is more evident. It is clear from our results that the three first-mentioned materials might with safety be extracted up to 50°—60° C. with gain to the tanner, and without deteriorating the resulting leather.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

*Comparative Tests of Carbonic Acid Cylinders of Various Origin.* M. Rudeloff. Mitt. aus d. königl. tech. Versuchs. zu Berlin, 1895, 206—224.

The following table gives the chief mechanical properties of the cylinders as such, and of the steel of which they were made, in a form admitting of ready comparison:—

| — | Method of Manufacture. | Dimensions. | | | Hydraulic Tests. | | Tensile Tests. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Longitudinal. | | | Circumferential. | | |
| | | Outer Diam. | Inner Diam. | Mean Thickness | Total Load in Atmospheres. | Stress in Material. | Yield Point. | Ultimate Strength. | Extension on 100 Mm. | Yield Point. | Ultimate Strength. | Extension on 100 Mm. |
| | | Mm. | Mm. | Mm. | | Kilos. per Sq. Mm. | Kilos. per Sq. Mm. | Kilos. per Sq. Mm. | Per Cent. | Kilos. per Sq. Mm. | Kilos. per Sq. Mm. | Per Cent. |
| I. | Skew-rolling ... | 141 | 129 | 6·0 | 434·6 | 46·7 | 62·8 | 85·7 | 15·8 | 63·2 | 86·6 | 12·3 |
| II. | Drawn down over a mandrel, German make. | 141 | 130 | 5·0 | 425·8 | 55·4 | 34·7 | 54·0 | 18·8 | 43·5 | 59·7 | 9·9 |
| III. | Drawn down over a mandrel, English make. | 140 | 129·4 | 5·3 | 447·8 | 54·5 | 27·3 | 50·9 | 21·7 | 39·9 | 54·7 | 10·0 |

Further experiments made later with duplicate cylinders, showed that the material of which samples II. and III. (a pair of cylinders being tested under each number, and test pieces being cut from various parts of each) were com-

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* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

posed, was uniform in quality, although showing some differences due to the different amount of mechanical working to which they had been subjected; the two cylinders classed under head I., however, differed appreciably. and further displayed considerable variations arising from the mechanical treatment which the material had received.
—B. B.

*Effect of Heat on the Mechanical Properties of Manganese Bronze.* M. Rudeloff. Mitt. aus. d Konig. tech. Versuchs. 1895, **13**, [1], 29.

*See under* X., *page* 660.

## PATENTS.

*Filter for Syrups and Heavy Liquids.* G. Rae, Dumfermline, N.B. Eng. Pat. 10,886, June 5, 1894.

The apparatus consists of one or more glass tubes filled with suitable filtering material — paper, cotton, sponge, asbestos. To prevent it being washed out, the filtering medium is put in in sections, each of which is held in position by glass or other weights.

The liquid to be treated is forced in at the bottom and leaves at the top.—R. B. P.

*Improvements in Condensers used for the Condensation of Acid Fumes.* H. L. Doulton and L. E. Sanceau, Lambeth, Surrey. Eng. Pat. 14,766, August 1, 1894.

*See under* VII., *page* 658.

*Apparatus for Sifting and Mixing Thick Fluid Masses such as Starch Solutions and, more particularly, Printers' Ink.* F. Schmidt, Rummelsburg, Germany. Eng. Pat. 2731, February 7, 1895.

This apparatus consists essentially of three brushes working over a perforated plate, through which they force the material to be treated.

One brush is situated at the centre of the apparatus, and the other two opposite each other, one on each side of the central one. The latter is rotated rapidly, and throws the material being treated, outwards towards the other two. These rotate round the central brush, and at the same time are given a reciprocating movement vertically, *i.e.*, parallel to their axis of rotation, and thus stamp or press the material through the perforated plate.—R. B. P.

*Improved Centrifugal Apparatus for the Continuous Separation from Liquids of Matters in Suspension therein.* G. C. Marks, London. From The Société E. Waunguier et Fils, Lille, France. Eng. Pat. 4680, March 5, 1895.

The object of this apparatus is to effect the continuous removal of denser matter from a liquid mixed with it.

Fig. 1 is a vertical section—on the line *u*, *v*, *x* in Fig. 2—of the apparatus, and Fig. 2 a plan, partly in section.

The liquid to be treated is admitted through the funnel A into the drum, and, through the revolving motion of the latter, is subjected to centrifugal force. But for a considerable reduction of the peripheral area of the drum, the whole of the liquid admitted would be at once thrown out without any separating action having occurred. This reduction of outlet area may be supplemented by a series of partitions (C C), which reduce the area of the outlet channels and still allow a sufficient number of discharge orifices (E E) to be retained.

The heavier parts of the mixture introduced will at first be driven towards the periphery, and, if a sufficient amount of mixture be admitted, two currents will be set up—one, consisting of the denser material, tending to escape through the outlets E E; and the other, consisting of the lighter material, being forced towards the centre, and escaping at D. Various other forms of drums besides that shown in Figs. 1 and 2, are described.—R. B. P.

Fig. 1.

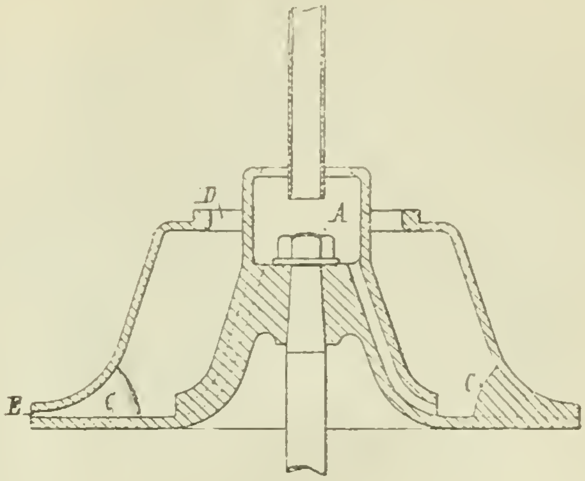
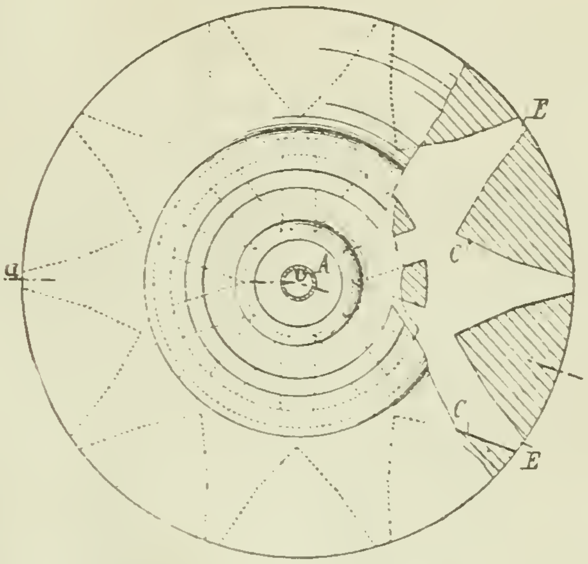


Fig. 2.



*Improvements in Pyrometers.* A. A. Simonds, Ohio, U.S.A. Eng. Pat. 7293, April 9, 1895.

The improved pyrometer consists of a thermo-electrical couple, preferably formed of platinum and an alloy of platinum and rhodium, and of an indicator, copper wire being used for the main conductors. The latter are attached to short connecting wires of platinum or the same material as the couple, and are embedded in plaster of Paris, and further protected from the heat of the furnace by a water jacket which surrounds them. By this device it is claimed that the expensive platinum connections may be shortened, while the sensitiveness of the instrument is increased.
—G. H. R.

## II.—FUEL, GAS, AND LIGHT.

*Temperatures employed in the Distillation of Coal.* L. T. Wright. Read before the Incorporated Institution of Gas Engineers at the May Meeting, 1895.

The results obtained from the distillation of coal in iron retorts cannot be used as a criterion of what the same coal should produce in clay retorts, for it can never be certain that the same mean effective temperature has been attained by the coal and gas in each kind of retort. Nor can the illuminating power—which decreases with increased volume of gas per unit of coal, with increased rapidity of gasification, and with increased temperature exterior to the retort—be used as a basis of comparison of the yields of gas from the two kinds of retort, and therefore of the loss by leakage from the clays; this is because the gas is never treated in a precisely similar manner when made in the experimental iron retort to that in which it is treated at the gasworks. For instance, the scrubbing of the gas at the works removes about 2 per cent. of its illuminating power.

Direct experiment has, however, convinced the author that the loss of gas from clay retorts in good working order is not at all important. Results, obtained with clay retorts free from perceptible holes and covered with carbon, are quoted, to illustrate this.

The author believes that the simplest way of regarding the complex problem of the influence of temperature in the distillation of coal, will be to assume that there is a necessary minimum temperature $x$, at which the gas can be expelled from the coal; any higher temperature applied to the gas must be considered as superheating it and producing chemical change other than that necessary to separate the gas from the coal. It is hardly probable that the moving stream of gas, when it is being rapidly evolved, can have the same temperature as the hottest of the heated solids (either a hot zone of partially carbonised coal, or the sides of the retort) in the retort, for if these be of a temperature higher than $x$, they cannot raise the temperature of the gas with which they are in contact without producing chemical changes which would at once render some portion of the heat insensible. It must be remembered that the velocity of the gas through the retorts is nearly five linear feet per second when the maximum evolution of gas is taking place and the temperature of the flues is very high, so that the time for superheating is very limited.

The author has endeavoured to find the relation between the following:—

1. The temperature surrounding the retorts, or flue temperature.
2. The temperature in the retorts during the distillation process.
3. The maximum rate of evolution of the gas per unit of retort heating surface.
4. The average of evolution during the whole extent of the charge per unit of retort heating surface.
5. The quantity of coal distilled per unit of retort heating surface.
6. The illuminating power of the gas at various times during the working of the charge.

The temperature in the flues was generally observed at two points, (1) under the crown of the retort bench arch, and (2) in the side flues, at the bottom of the retorts. Pyrometers, such as Murrie's, were used for temperatures not much exceeding 1,600° F., but for higher temperatures observation of the melting points of metals was adopted.

The retort temperatures were ascertained by introducing a long piece of iron gas-piping, closed at one end, through a hole in the retort lid, the open end being retained in the air; into this pipe, platinum boats containing salts of known melting points were passed. The temperature at which the end of the iron tube was first visible was recorded as 977° F. That the temperature in the retort is by no means equable, is obvious on looking down the iron tube, for light and dark zones are very apparent; consequently, observations at three different points of the tube were generally made during a trial.

The maximum rate of gas evolution was arrived at by reading the meters at intervals of 15 or 30 minutes, calculating the results to cubic feet of gas per superficial foot of internal retort surface per 24 hours.

The illuminating power was taken with the London Argand against the Methven standard of two candles. The gas was consumed nearly to smoking point and the quantity noted and reduced to the rate of 5 cub. ft. per hour.

In the case of a Derbyshire caking coal (taken as an example), of not very fine quality as regards illuminating power (named K in the table given in the paper), it is shown that the lowest yield of gas was 8,429 cub. ft. per ton, with a gas production of 49 cub. ft. per square foot of heating surface per 24 hours. The yield of gas per ton goes on increasing in a fairly regular manner with increased rapidity of distillation up to 12,190 cub. ft., and a gas production of 126 cub. ft. per square foot of retort surface, and after that maximum is reached it will be seen that the yield of gas per ton falls to 11,331 cub. ft., with an average gas production per square foot of retort surface of 166 cub. ft. The retort temperatures show that at a low rate of distillation practically all the gas comes off below 1,340° F. At the highest rate of distillation 66 per cent. of the gas was evolved at and below a temperature of 1,339° F.

Whilst the time required to distil a given charge can be readily ascertained, it is not possible by direct means to know what proportion of coal has been distilled at any time when the distillation is incomplete; failing this knowledge it will be assumed that the proportion of the total gas evolved in various times during the charge represents the proportion of the total coal distilled in the same time. Thus, in another table (Series A.) the average rate per cent. per second of the total gas evolved in certain observed times is given, and it will be noted that the most rapid distillation of the series ("1 A"), as also the most uniformly rapid, did not yield the most gas per ton.

It appears from the author's experiments that if trials similar to those here quoted, could be carried out with rates of coal distillation very much higher than those now described, it would be found that the more rapid rate of distillation would not be attended by any marked increase in the yield of gas per ton, but that in some cases even a decrease would result, as the more rapid evolution of gas and its increased velocity in the retort, would protect it against the destructive action of the increased flue temperature employed.
—A. G. B.

### PATENTS.

*Improvements in Flasks or Cylinders for Containing Gases under Pressure, or Liquefaction, or the like.* E. Hesketh and A. Marcet, both of London. Eng. Pat. 7326, April 12, 1894.

To prevent the flask being burst by the occurrence of an abnormal internal pressure, a disc of copper, or other material, is so fitted that it will give way before a pressure that would be likely to burst the cylinder, is reached.

The safety disc may be placed across the filling aperture, or across a special opening provided for the purpose.

A spring valve which will close after the abnormal pressure has been relieved, may be fitted behind the safety disc.—R. B. P.

*An Arrangement for the Prevention of Smoke and More Perfect Combustion of Fuel in Furnaces.* N. Chandler, Hednesford, Stafford, and H. Rallings, Aston, Birmingham. Eng. Pat. 8067, April 24, 1894.

Air is supplied to the furnace from the ashpit by covering the dead-plate and the front portion of the fire-bars with a protective shield, called an "air-box," open at the bottom, and thus to the draught ascending through this covered portion of the fire-bars, and having an oblong opening all along its front, which faces the fire. The air can thus pass between the fire-bars upwards into the "box," and then at right-angles through the oblong opening, to the fuel, on to which it is deflected by the curved form of the top of the box, which resembles the cover of a type-writing machine. The air must thus undergo a preliminary heating by contact with the hot bars and "box."—A. G. B.

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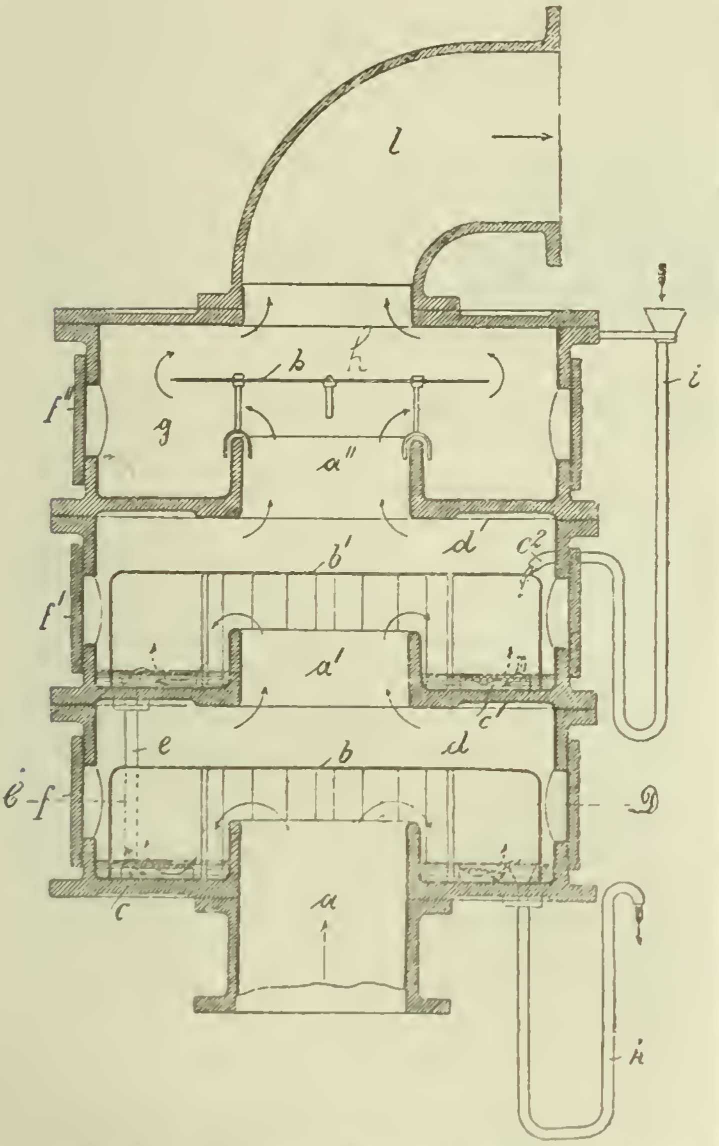
### *Improvements relating to the Drying of Lighting Gas, and to Apparatus therefor.* J. Bueb, Dessau, Germany. Eng. Pat. 9457, May 12, 1894.

The use of concentrated sulphuric acid for drying lighting gas, to prevent pipe stoppages in the winter, leads to the withdrawal, not only of the water vapour, but also of certain heavy hydrocarbons, and thus diminishes the illuminating power.

It has been found that this is not the case if the sulphuric acid used does not exceed a certain degree of concentration—that corresponding to a sp. gr. of 1·691—on which fact this invention is based. In order that the sulphuric acid may have a proper drying action it must not have a lower sp. gr. than 1·615.

The apparatus described is shown in Figs. 1 and 2, which are longitudinal and horizontal sections on the lines A B and C D respectively.

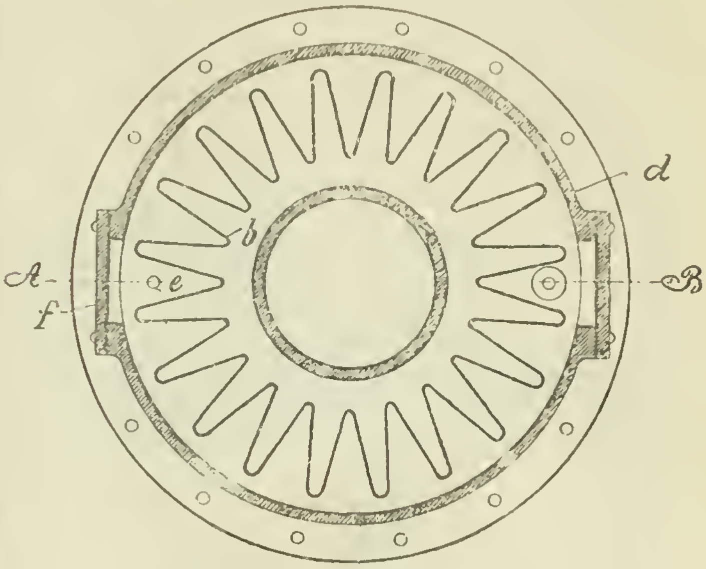
Fig. 1.



The sulphuric acid flows downwards, whilst the gas flows upwards, entering at *a*. *b* is a leaden cap dipping into the nearly spent acid in the lower cell *d*; *e* is an acid overflow between the cells *d* and $d^1$. To prevent the stream of gas flowing too rapidly, and also to subdivide it as much as possible, *b* is made star-shaped and has notches *c* round its lower edge. From *d* the gas passes through $a^1$ into the cap $b^1$ in the cell $d^1$, which is fed with sulphuric acid through the pipe $c^2$ and the funnel *i*. From $b^1$ the gas passes through the layer of acid, and up through the port $a^{11}$ into the upper cell *g*, in which there is a baffle-plate *h*. The dried gas finally escapes through the outlet *l*; *f* $f^1$, and $f^{11}$, are removable doors giving access to the interior, and *k* the outlet for spent acid. It is stated that 1 kilo. of acid of 1·691 sp. gr. will dry about 30 cubic metres of gas sufficiently to prevent the freezing of pipes in the winter.

—R. B. P.

Fig. 2.



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### *Improvements in or connected with Furnaces for Heating Steam Generators, or for other Heating Purposes.* W. Kneen, Manchester. Eng. Pat. 10,347, May 28, 1894.

The improvements are in the method of burning liquid hydrocarbons or creosote oil. The intimate mixture of the hydrocarbon vapours and air is ensured by supplying the air from behind the fire-bridge. The pipes from the blower pass under the fire-bars of the furnace and terminate in fire-brick chambers behind the fire-bridge; from these the air issues through numerous holes, which are towards the furnace. In this way the already heated air is, as it were, sprayed into the furnace, where it meets the oil vapour, which is introduced above the fire-bars, either from sprays in the front of the furnace or from perforated pipes running along the furnace walls.—A. G. B.

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### *Improvements in Boiler or other Furnaces.* G. A Newton, Liverpool, Lancaster. Eng. Pat. 10,509, May 30, 1894.

The furnace grate is formed of "shallow bottomless troughs" constructed of parallel bearers connected by tie-pieces and supporting slightly wedge-formed shallow grids, which are grooved on the surface. The fuel is heaped tolerably high on this grate, and the air, especially when forced in under the grate in the manner described in Eng. Pat. 10,363 of 1891, is delivered pretty uniformly all over the surface with a vertically upward motion, and passes up through the grate with a greater velocity than would be the case if the wedge-shaped construction, entailing very narrow openings for the passage of the air, were not adopted. The flames are thus caused to strike the crown of the furnace and are deflected over the fire-bridge, where any unconsumed carbon is at once burnt by the air which passes through a pipe running along the ash-pit and through the hollow fire-bridge, being thus heated during its passage. The grooves on the fire bars serve to collect the ash of the fuel and thus to form a layer of non-conducting material which preserves the bars. It is claimed that in this furnace, which is depicted as applied to a boiler, the temperature is raised more rapidly than is usual, and that much economy of fuel is the result. It is primarily designed for burning small coal and rubbish.—A. G. B.

*Improvements in and relating to Apparatus for Burning Liquid Fuel in Steam Generators and the like.* J. J. Kermode, Birkenhead, Chester. Eng. Pat. 11,760, June 18, 1894.

The apparatus described in this specification (roughly divisible into two portions) is adapted to burn either the ordinary light oils heretofore used for this purpose, or the foregoing in conjunction with heavy oils, tar, &c. The combustion of the light oil is effected by forcing it, and the air necessary for its combustion, through combined air and oil nozzles, the air and oil being heated before reaching the nozzles. When such nozzles alone are relied upon for burning the oil, it is found that the flame frequently goes out, and difficulty and risk are experienced in relighting it. To remedy this defect a body of asbestos or other refractory material, carried in a series of parallel racks resembling a toast rack, is provided; this body occupies the position usually filled by the fire, and extends, therefore, from the furnace door to the bridge. The nozzles are so disposed that the flames impinge on the asbestos and heat it to incandescence, their heating effect being thereby rendered much more uniform. The arrangement is shown in cross section in Fig. 1, and in longitudinal section in Fig. 2; in these figures 1, 1, or 1′, 1′ represent the positions of the nozzles, 2 is the asbestos, and 3 the rack.

Fig. 1.

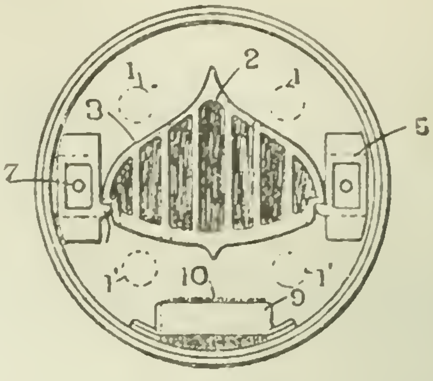
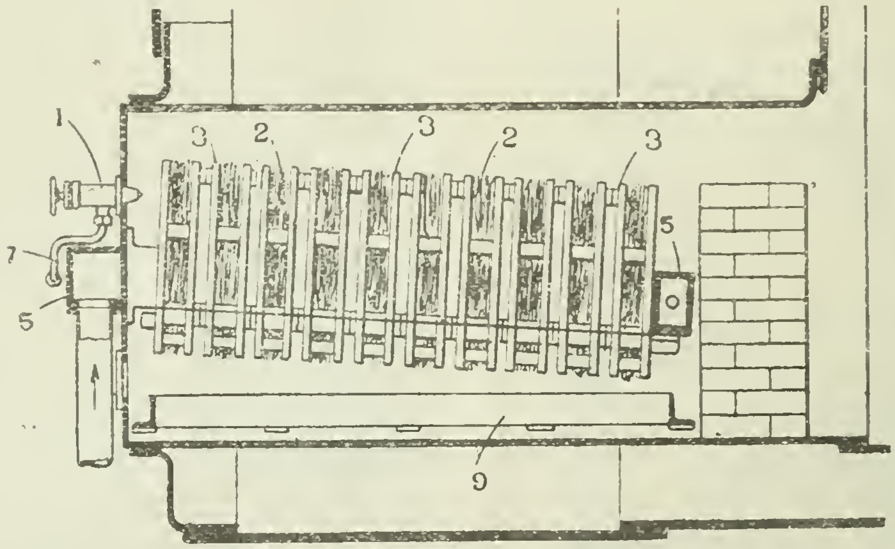


Fig. 2.



The air and oil pass through the furnace on their way to the nozzles, the air trunks (5) being shown in Fig. 1, on each side of the asbestos rack and the oil pipes (7) in the centre of these air trunks.

For burning heavier oils a container (9) is provided; this traverses the length of the furnace, and is so constructed that the oil may burn from asbestos wicks (10) if its nature will permit, or on a shallow tray. This container also serves for holding the oil, which must be burnt in the first instance to raise the asbestos to incandescence.

The details of the automatic feeding pumps are fully described.—A. G. B.

*An Improvement in the Purification of Gas.* E. Hermite, C. F. Cooper, and E. J. Paterson, London. Eng. Pat. 12,663, June 29, 1894.

These inventors describe a method of purifying gas from sulphuretted hydrogen by passing it through a scrubber, the coke in which is moistened by an "electrolysed solution of sodium chloride and a little magnesium chloride." The "electrolysing" of the liquid, which may be effected by such apparatus as is described in their patent, No. 1993 of 1887 (this Journal, 1888, 126), so reacts on the chlorine of the chlorides in the liquid, that it is able to decompose the hydrogen sulphide, with formation of sulphur and hydrochloric acid.

The liquid to be electrolysed may be sea-water.—E. R. B.

*Improvements in Furnaces for Burning Sludge, Slurry, and like Materials.* S. J. Beaman and J. Deas, Warrington, Lancaster. Eng. Pat. 13,029, July 5, 1894.

The furnace consists of an inclined feeding hearth and a grate arranged below a reverberatory arch. At the back of the grate is a hollow bridge, and beyond this a perforated screen, the space between these two forming a secondary combustion chamber, to which air is supplied through the hollow bridge. The ash-pit is closed, and the furnace fed by a forced blast, which enters below the fire bars. The products of the combustion are made to pass back through flues below the furnace, and are deflected by a suitable wall on to the under surface of the inclined feeding hearth; thus the material to be burnt is dried as it passes down the hearth on to the grate. Clinkers and dust are removed through side doors in the furnace and ash-pit. If the material does not contain sufficient combustible material it is mixed with breeze.—A. G. B.

*Improvements in and connected with Refuse-consuming Furnaces, and in Utilising the Waste Heat therefrom for Generating Steam.* T. W. Baker, London. Eng. Pat. 13,710, July 16, 1894.

The chief claim in this patent is for the use of any steam generator having its ordinary coal-, gas-, or oil-burning furnace, combined with a furnace for consuming refuse in such manner that the gases from the refuse shall be conducted into the combustion chamber of the steam generator, and there be burnt to contribute to the raising of steam. The steam generator, which may be of any known type, is placed on top of the refuse furnace; this is of the ordinary form, having a hopper at the top for the feeding of the fuel and a door at the bottom for the removal of the clinker. The fire-arch of this furnace is perforated to admit of the passage of the partially burnt gases into the combustion chamber, situated at the end of the generator and its ordinary furnace. Here they meet the hot gases from the ordinary furnace and are consumed, the products of the combustion passing through the smoke-tubes and flues of the generator. Drawings exhibiting this system are given, together with others showing how the principle may be applied to the storage of the heat when steam is not immediately required, by raising the temperature of the feed-water.—A. G. B.

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*Improvements in Apparatus and Process for Manufacturing [Peat] Coke and Charcoal, and for Separating the Products obtained in such Manufacture.* E. Edwards, London. From The Internationale Gesellschaft für Torfverwerthung, Oldenburgh, Germany. Eng. Pat. 15,486, August 14, 1894.

The air-dried peat is fed into the top of a vertical cylindrical oven, of which the lower two-thirds are made of fire-clay, the upper third being of cast-iron; the internal diameter is about 250 mm., and the centre is occupied by a column of rings of conical section, terminated at the top by a cone. This column serves for the collection of the gases resulting from the carbonisation, which are led away from the cone at the top by means of a pipe into a condenser, whence the combustible gases pass back to the oven, which is heated by their combustion. The tar produced by the carbonisation passes away from the bottom part of the oven into suitable condensers. The carbonised peat falls through a trap into a chamber, around which water is circulated to cool the charcoal rapidly. Into this chamber a pipe leads, "by which the contents can be saturated with steam containing saltpetre in solution, and in this way the coke or charcoal is rendered strong and durable."—A. G. B.

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*Improvements in or connected with Apparatus for the Manufacture of Gas from Liquid Hydrocarbons.* C. W. Pinkney, Smethwick. Eng. Pat. 22,184, November 16, 1894.

All the claims of this patent relate to the new form of retort proposed, its parts, and their combinations, especially noticeable being a "safety device," by means of which the supply of oil is automatically cut off, in the event of the exits of the retort becoming stopped or clogged.

In Fig. 1, which shows the new apparatus in vertical section, A is a furnace, with metal casing B, fire-brick lining C, fire-bars D, and door E. F is a retort suspended in the centre of the furnace by its flange *f*, which rests on the top-plate $A^2$ of the furnace.

The retort F is divided into two chambers H and I, by the partition G, except near the top, where the two chambers communicate. Into I depends the gas-exit pipe L; into H, the feed pipe K.

In the figure, the retort is represented with a single partition, but it is evident that, by increasing the number of partitions, the retort may be made many-chambered, and the path of the gas when manufactured considerably lengthened thereby; so also K and L are made to reach nearly to the bottom of the retort, all of these devices aiming at increasing the internal surface of the retort, this inventor "having found in practice" that the best gasification takes place when the hydrocarbon is caused to "travel over an extended, moderately heated, surface."

From the cistern M, a stream of liquid hydrocarbon, regulated by O, flows through N. To the end of this pipe, and in a plane at right angles to its length, is attached the plug P (see Fig. 1 and Fig. 2), which is perforated as shown at *a*, *b*, in Fig. 2. The "safety feeding device" $R^3$, $R^2$, Q, R (see Fig. 1) can freely rotate about P; but, normally, is so balanced that a perforation, *c*, in Q, (see Fig. 2) is exactly opposite the perforation *b* of P; liquid can therefore flow from N, through P, Q, and R (which is tubular) into S, and thence, by K, into the retort. Should,

Fig. 1.

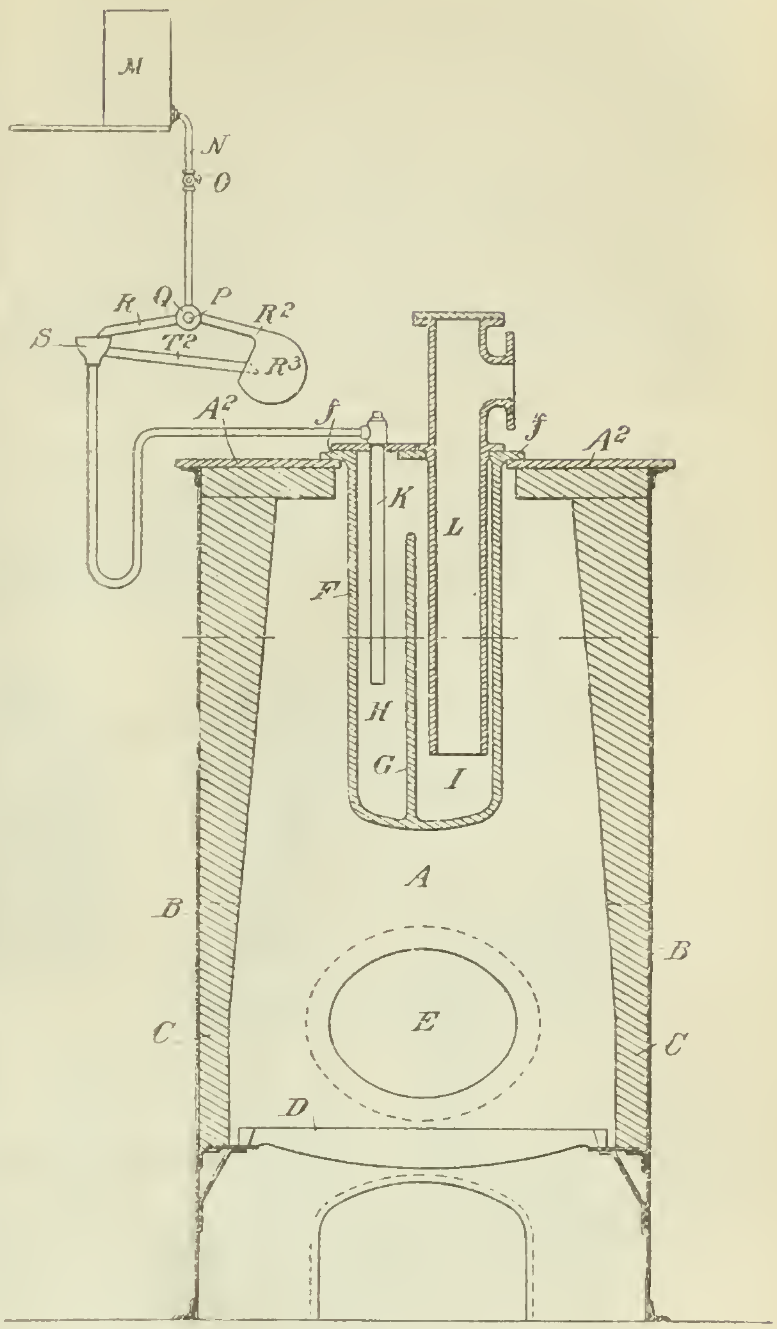
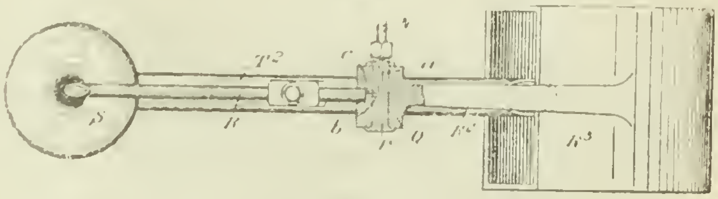


Fig. 2.



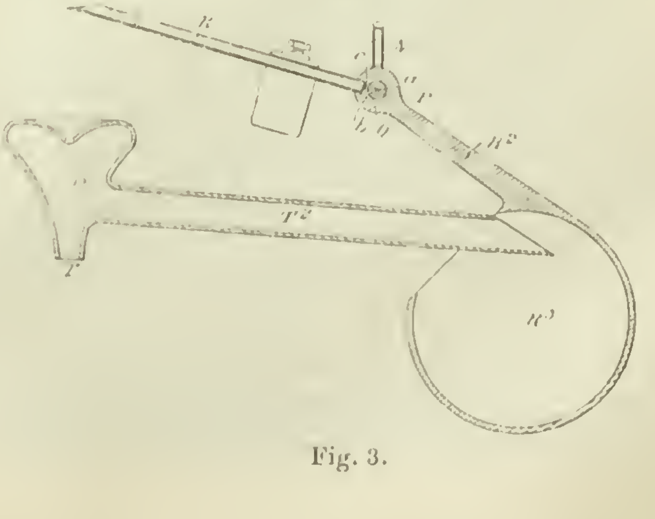


Fig. 3.

however, any pressure be set up in the retort, through obstruction in the gas-exit passages, &c., the liquid hydrocarbon will regurgitate into S, and travel, through $T^2$, into the chamber $R^3$ of the safety device, causing this structure to partly rotate and assume the position shown in Fig. 3, shutting off therefore the supply of liquid hydrocarbon to the retort.

In an alternative modification of the apparatus, R is considerably elongated, so that when the safety device operates, the outlet end of R is raised above the level of the liquid in M, the supply of oil being consequently stopped.

The inventor further points out that, either by the moving parts being so arranged as to complete, during their motion, the circuit of an electric bell when in motion, or by one of them striking a gong during its motion, audible notice of danger may be given to the attendant.—E. R. B.

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### *Improvements in Furnaces.* T. Richards. St. Austell, Cornwall. Eng. Pat. 23,536, December 4, 1894.

Immediately above the inner ends of the bars of the grating is a ledge of a suitable material and of convenient depth, at a sufficient distance outside which ledge, is a wall extending from the top of the furnace nearly to, though slightly beyond, the base of the ledge; under this wall the flues run, the furnace smoke having thus to travel over the ledge (like a fire-bridge), and then to pass underneath the wall.

Thus, the smoke, being confined within the furnace, is hindered to so large an extent in its escape, that it becomes in great measure consumed.—A. G. B.

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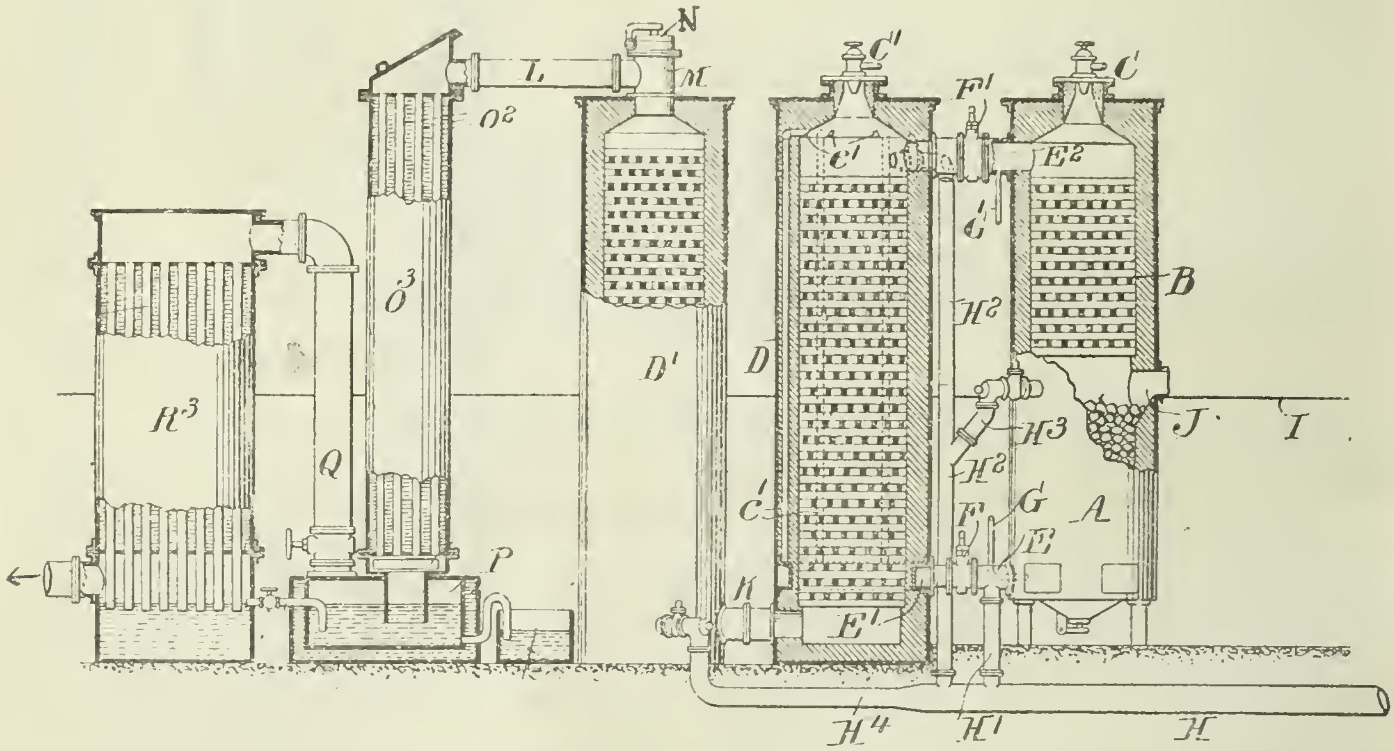
### *An Improved Method or Process of Carburetting Water-Gas, and Apparatus therefor.* A. C. Humphreys, New York, U.S.A., and A. G. Glasgow, London. Eng. Pat. 3089, February 12, 1895.

This improved method (which extends A. G. Glasgow's previous invention, Eng. Pat. 24,005 of 1894; *vide* this Journal, 1895, 261) consists in conducting water-gas successively through distilling, carburetting, and fixing chambers of special construction, wherein, and at certain temperatures, it is treated with hydrocarbons, the carburetted water-gas so produced being subsequently passed through one or two surface condensers, wherein it is cooled, and deposits any excess hydrocarbon it may be carrying.

The chambers employed are peculiar, in that they are filled with "checker-work or equivalent refractory filling," and in that they are maintained at temperatures considerably lower than those "employed in what is now recognised as good practice," with the result that less oil than usual is converted into fixed gas. Indeed, the temperatures employed "do not substantially exceed those at which a gas having the maximum illuminating effect is produced from the [particular] oil employed."



In operating the inventors' apparatus (see figure), the generator A is first charged with fuel from the platform I, through the door J. Next, a blast of air, arriving by H, is urged through $H^1$ and E into the fuel in A, rendering the fuel incandescent. The heated gases of combustion ascend through the filling of the distilling-chamber B, pass, by $E^2$, into the carburetting-chamber D, thence, by K, into the fixing-chamber $D^1$, whence they escape through the, at this time, open valve N at the top of M. Any imperfection in the combustion of the fuel in A may be remedied by supplying further air to the gases of combustion, either near the bottom of B, by $H^2$, $H^3$, or near the top of D, by $H^2$, or near the bottom of $D^1$ by $H^4$. As soon as B, D, and $D^1$ have attained a suitable temperature, the air-blast is cut off, and the manufacture of water-gas is commenced, by the admission of steam through G. The valve N is next closed, and simultaneously hydrocarbon is injected at C and $C^1$ into B and D respectively. In its passage through B, D, and $D^1$, the water-gas becomes carburetted, and then, through L, passes into the water-surrounded tubes $O^2$ of the surface-condenser $O^3$, where it is cooled, and deposits tarry matters and excess hydrocarbon, which latter collect in the seal-box P. Besides preventing a backward flow of gas, the heavy hydrocarbon liquid in P is intended to act as a purifier, scrubbing the gas as it passes through. The scrubbing is intended to be still more thorough in the next condenser, $R^3$, (reached by the gas passing through Q), where the gas passes through a large number of small tubes, each dipping below the level of the liquid hydrocarbon in the seal-box of this condenser.

Sometimes hydrocarbon is only supplied to B, in which case D acts as a "fixing chamber." If both chambers are acting as carburettors, D is supplied with a lighter hydrocarbon, while that injected into B is preferably the heavy tarry oil collected in the seal-boxes of $R^3$ and $O^3$.

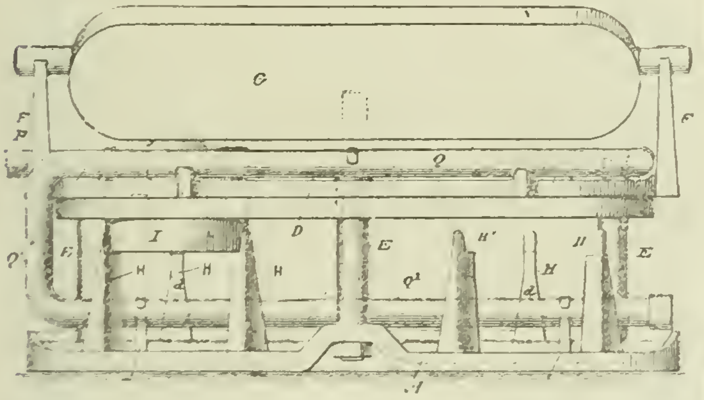
The flow of hydrocarbon is with the gaseous current in D, but against it in B, "very valuable advantages," according to the inventors, accruing from this procedure; for, without overloading any part of the apparatus, a highly-carburetted gas is obtained.

Any hydrocarbon not volatilised in B, generally falls through on to the fuel in A, and is burnt; but should carbonaceous matter, caking on the refractory filling, clog the apparatus, C, F$^1$, and G are closed, F opened, and steam injected at G$^1$. At the elevated temperature to which the refractory filling and its carbonaceous coating have been raised, the steam is able to react with the latter, and the water-gas so formed, together with that made as the steam passes through the fuel in A, passes, through F, into the annular chamber E$^1$ in D, whence by $e^1$ $e^1$, it reaches the top of D. This means of reversal of the water-gas current is also useful for regulating the incandescence of the fuel in A.—E. R. B.

### *Improvements in Reversible Hydrocarbon Generators and Burners.* B. G. Devoe, Lima, Ohio, U.S.A. Eng. Pat. 4042, February 25, 1895.

The object of this invention is to provide a simple and efficient reversible hydrocarbon generator and burner, and the claims of the patent all refer to the novel features of its construction and their combination. In Fig. 1, which shows a side view of the apparatus, the frame D is seen to be supported by columns E, arising from the tray-like base A. The burner I, is carried by the three supports H, H, H, while three other supports, H$^1$, H$^1$, H$^1$, are provided to carry another burner, if necessary. G is a deflector, movable upon its supports F, F, said supports being attached to the frame D.

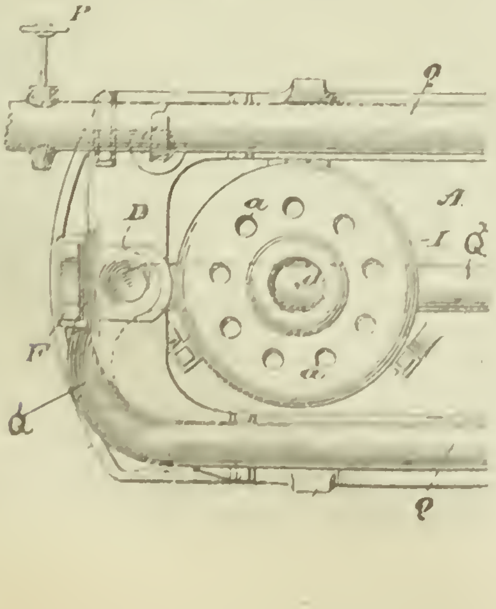
Fig. 1.



The burner I, which is shown in section (*but reversed as to position*) in Fig. 3, and from above in Fig. 2, consists of an inner cylinder K (through which the hydrocarbon vapour passes) enclosed by an outer one, J (through which heated air passes). K is freely open at each end, but J is closed at its upper end (*lower*, as shown in Fig. 3), save for a ring of apertures *a a*, in Fig. 2.

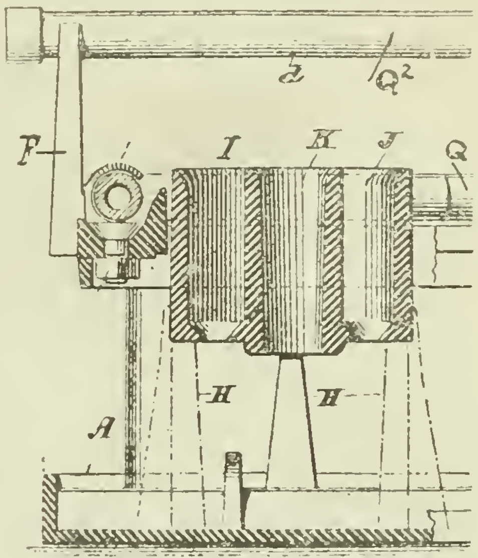
The vaporiser Q, Q$^1$, Q$^2$, is a tube, peculiarly bent so that its three limbs lie in three distinct planes; the upper limb Q, is a U-shaped loop lying on the frame D, and following its periphery; next follows the descending limb Q$^1$, succeeded by the horizontal limb Q$^2$, the latter lying on the base A, and in its middle line. In Q$^2$, exactly under the centres of the burners, are the pin-hole apertures *d d*.

Fig. 2.



In working the apparatus, P is opened sufficiently to allow a small quantity of hydrocarbon to enter the vaporiser; this hydrocarbon escapes by *d d* and moistens some asbestos, which, for the purpose, has been placed in the tray-like base B. The hydrocarbon is ignited and all parts of the apparatus become highly heated. Further hydrocarbon is now admitted, and this is converted into vapour in the hot vaporizer, and escapes with violence through *d d*. As the stream of vapour rushes through K, it draws heated air through the apertures *a*, *a*, *a*, and a smokeless and odourless flame is formed above the burner; this flame may be directed as required, by moving the deflector G, or this latter structure may be removed.

Fig. 3.



To reverse the action of the apparatus, the vaporiser is lifted off its supports, reversed, and replaced on the frame, so that its lower limb, Q$^2$, is no above the frame, see Fig. 3, and can rest in the supports F F of the deflector (which for this end is removed). The burner also is reversed. The apertures *d d* (see Fig. 3) now give a downwardly directed stream of vapour, and the base acts as flame deflector.

—E. R. B.

### *Improvements in the Combustion of Gaseous Fuel and Apparatus therefor.* P. Douin, Beuvrages, Nord, France, and P. Kestner, Lille, France. Eng. Pat. 6585, March 30, 1895.

Recognising that when burning combustible gases of inferior quality the best heating effect can only be attained if the excess of the air supplied for combustion be reduced to the smallest possible quantity, and that this reduction can only be practised with hot and intimately mixed gases; and, further, that these gases must have completed their chemical combinations before reaching the cool surfaces of the object which is to be heated, these inventors propose an improved method for the combustion of gaseous fuel, whereby successive quantities of combustible gas are brought into contact with the air supply in such fashion that the first quantity of gas supplied burns with a portion of the air supply, heating the remainder of the air supply before this meets the second gas supply. Upon meeting the second gas supply, a second combustion takes place, consuming a further fraction of the air supply; the mixed and heated gases then pass on to the third gas supply, and so on.

The quantity of air admitted into the apparatus at any given moment is thus burned, little by little, as it successively meets the different gas supplies: its gradually decreasing tendency to combustion—as it becomes weak in oxygen and diluted by the products of combustion—bein counterbalanced by its constantly augmenting temperature. The inventors state that "the whole of the air is consumed, or nearly so."

The apparatus for carrying out the invention is also claimed. It consists of a horizontal combustion chamber, through which passes a current of air, the air being cold at entering. Subjacent to the combustion chamber, and communicating with it at intervals by vertical passages, is a flue conducting the gaseous fuel. Columns, &c. are arranged in the combustion chamber, acting as baffles, and assisting in mixing the gases.—E. R. B.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Origin of Petroleum.* C. Engler. Chem. Ind. 1895, **18**, 1—6 and 31—37.

(This Journal, 1892, 995.) Of the various speculations put forward by different investigators to account for the formation of petroleum, the theory of Sokoloff, which assumes a combination of carbon and hydrogen to form hydrocarbons at an early stage of the development of the heavenly bodies, the compounds subsequently dissolving in the still viscid *magma* of our planet, dispersing later on through fissures and fractures, and finally undergoing condensation, is the only one that can be designated *cosmic*. However, various considerations, and among them the composition of petroleum, and the presence therein of such bodies as pyridine bases, &c., prevent our accepting this hypothesis. Neither can Mendelejeff's well-known theory (this Journal, 1885, 72) be regarded as justified, when all the circumstances are considered. For instance, the fissures he speaks of could only extend through the *solid* crust of the earth, and would be absent from the viscid or slaggy interior; besides, we should expect from such a process of formation to find the more volatile hydrocarbons from the carburetted iron condensed at a greater distance from the centre of the earth than the heavier fractions, whereas the opposite is very frequently the case. The fact also that the formation of the pyridine bases found in petroleum is directly connected with organic vitality, militates against hypotheses of this class.

Hochstetter and others held the opinion that petroleum was derived from marine and land flora, and Krämer showed that by a suitable process of dry distillation at low temperatures, a mixture of hydrocarbons similar to petroleum could be prepared from vegetable matter, especially coal. Daubrée also formed an oil having the odour of Pechelbronn petroleum by the action of superheated steam on wood; but whilst it is not impossible that in individual cases petroleum may have resulted from vegetable matter or remains, there are many weighty geological and chemical reasons against the acceptance of this theory for universal application. For instance, Höfer ("Das Erdöl," Part I., page 108) demonstrated that were petroleum formed from vegetable matter, large masses of coke-like residue must have remained such as are hardly ever actually found in conjunction with oil deposits.

The most generally adopted theory of recent years is that of animal origin advanced in the first instance by Leopold von Buch. The chief obstacles in the way of a general acceptance of this assumption were the lack of a plausible explanation of the chemical processes involved in the transformation of animal remains into petroleum, and the absence of a proper conception of the collection of such enormous quantities of these remains required for the production of the oil deposits. In connection with the first point, although oil similar to crude petroleum, could be prepared from animal matter by dry distillation, a considerable quantity of nitrogenous bodies, far in excess of the proportion discoverable in petroleum, was simultaneously produced and this constituted a formidable difficulty.

In order to determine whether the remains of marine fauna, which geological circumstances indicated with some certainty in this connection, would yield more satisfactory results, Engler subjected a mass of marine animal matter, fish, and mussels, to distillation under high pressure (with the object of preventing the separation of carbon), but the resulting distillates still contained a large proportion (some 8 to 9 per cent.) of nitrogen. Thereupon the question arose as to whether petroleum might be formed during the transformation of a portion only—viz., the fatty matter—of the animal residues, after removal of the muscular tissue and other nitrogenous constituents by previous putrefactive decompositions. Colour was lent to this hypothesis by the behaviour of triolein, tristearin, train oil, as well as free fatty acids, on being subjected to heat under pressure; and the distillation of a quantity of train oil in an apparatus invented by Krey, yielded a distillate containing some 33 per cent. of hydrocarbons of the olefine series, with a little acetylene, the remainder being found to consist chiefly of saturated hydrocarbons, of which pentane, normal and secondary hexane, heptane, octane, and normal nonane were isolated in addition to the methane obtained in a gaseous condition. Other bodies occurring in small quantities in petroleum were also detected in the distillate, among them paraffin, lubricating oil, naphthenes, &c., and marsh gas, carbon dioxide, carbon monoxide, and olefines, were found in the gaseous products. The "artificial crude oil" was brown in colour, transparent in thin layers, exhibited green fluorescence, and had a specific gravity of 0·8105. Fractional distillation gave, between 140° and 300°, about 60 per cent. of a water-white burning oil, with slight bluish fluorescence, of sp. gr. 0·8025 and flashing point 26·5° C. The mean illuminating power for six hours' burning in a 10-line burner was 9·2 normal candles, compared with 7·8 obtained with ordinary Pennsylvania oil in the same burner. From train oil 79·5 per cent. and from triolein 83·9 per cent. of crude oil was obtained by working on a small scale, which results, when properly adjusted, correspond to about 88 per cent. of the theoretical maximum yield.

It remains uncertain whether the glycerin of these fatty matters is first separated from the fatty acids, but, judging by the decomposition undergone by fossilised fatty residues, it is probable that such is the case, since glycerin is removed without difficulty from fats by mere prolonged contact with cold water, as was long ago demonstrated by Jünnemann. Whether this occurs or not, these distillation experiments show that the transformation of fat into petroleum can be effected without any separation of carbon.

Turning now to the consideration of the accumulated remains of marine animals in sufficient quantity to account for the formation of petroleum, the association of petroleum with such remains in sedimentary rocks like the lias shales in Würtemburg, Baden, &c., the coral reefs of the Red Sea, the Trenton limestone in Canada, and dolomite in Bohemia, as traced by Höfer, and the presence of saline waters, rich in iodine and bromine, usually occurring with petroleum, support the theory of marine origin. Various explanations to account for the accumulation of these remains have been attempted.

Zaloziecki's view is that ocean currents drifted immense masses of animal remains on to the ancient sea coasts, where, covered up by alluvium, &c., and depressed by movements in the earth's crust, they underwent gradual decomposition (this Journal, 1891, 753).

The details of the transformation processes cannot yet be completely accounted for, but two main divisions would appear to have occurred, namely, the separate decomposition of the nitrogenous matter at an early stage, followed by the conversion of the fatty residue, probably after removal of the glycerin. From this point onward the details are obscure, but from Engler's experiments it may be concluded that heat and pressure, or long continued pressure at a moderate temperature (time being an important factor), would suffice to effect the transformation, and that Krämer's opinion that the conditions have varied with the locality (low temperatures in Pennsylvania and Galicia, for example, and greater heat in the Baku district) has some foundation, since it would appear that naphthenes would not be formed at ordinary temperatures. It may be assumed that the superimposition of alluvial deposits over the beds of animal remains would complete the exclusion of oxygen, and at the same time furnish the necessary pressure, rises in temperature being perhaps caused by fermentation, friction of the strata during elevation or depression, or by the actual temperature of the earth at the depths to which the beds may have been forced by the pressure of superior strata. The actual conversion was probably in most cases effected by simple dissociation without distillation, resembling in this respect the behaviour of oleic acid and train oil, both of which can be transformed into hydrocarbon oils under pressure.

Experiments made to ascertain the tenability of Zaloziecki's opinion that ozokerite may be an intermediate product between fatty acids and petroleum, by extracting bituminous shales with benzene, yielded doubtful results.

Another point still in doubt is whether the dissociation of the fat chiefly consisted in the removal of water or carbon dioxide. The former would seem to be the more probable; at least it yields results coinciding with the analyses of Baku oil by Markownikoff and Ogloblin.

With respect to the gases obtained by distillation under pressure, F. C. Phillips, in objecting that carbon monoxide and olefines are thereby produced, but are absent from American natural gas, overlooks the fact that Engler does not claim for his process identity in point of temperature with the assumed natural method of conversion, but rather favours the idea of low temperature for the latter, under which conditions a smaller proportion of carbon monoxide and ethylene would be produced. Phillips also forgets that the production of carbon monoxide can occur at comparatively low temperatures, as in the condensation of ketones to hydrocarbons; and it may well be that ketones are formed in the natural transformation of the fatty bodies under consideration. Besides, other investigators have found the monoxide in gases from petroleum and brown-coal deposits.

The fact that anthracite has been found associated with petroleum in certain dolomites in Bohemia does not militate against the animal theory, since this anthracite is nearer in character to asphalt than to true anthracite: besides, the Engler theory only claims that conversion of animal fats into petroleum *may* (not *must*) be effected without the formation of a carbonaceous or asphaltic residue.

Lastly, the presence of aromatic hydrocarbons is explained by the assumption that they have most probably been formed, together with the terpenes, by condensation, and not from the acrolein resulting from glycerin, nor from acetylene hydrocarbons, as supposed by Veith and Zaloziecki respectively; or again, we may suppose that the small quantities of these bodies in petroleum are due to the decomposition of animal matter, a method of formation that has already been demonstrated by Salkowsky.—C. S.

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### *Roumanian Petroleum.* Chem. Ind. 1895, **18**, 238—239.

The Austrian Vice Consul at Plojest reports a decreased production of petroleum in Roumania last year (1894). The best results are still obtained from shafts, bored wells being too narrow to permit the ready removal of sand, and being also liable to silt up.

In Glodeni (Dambovitza district) over 900 tank-waggon loads of crude oil were obtained, part of which was disposed of in Bukarest and the remainder in Kronstadt (Hungary) and Tergovest. The Campina wells yielded over 800 car-loads, and the production in Doftaneti and Bustenari was increased to some 700—800 car-loads by the sinking of new shafts to depths of 40 to 120 metres. A second pipe-line, 10 kilometres in length, was laid during the year to the station at Telega. One of the oldest oil lands, Colibasi (Prahova) has been lately reopened by deepening an abandoned well, the result being very satisfactory. The production at Ochisori and Matitza only amounted to 80 loads, and these works are handicapped by their remote situation. Sarata (Buzeu) yielded 600 loads from shaft wells; and Tega, the crude oil from which contains 50 per cent. of lubricating oil, has, after having been abandoned for some time, recently received a fresh impetus by the discovery of a good well producing 100 loads in the year. About 200 loads in all were obtained from various scattered districts. The employment of residuum for heating purposes as well as of refined oil and benzine for motors, is on the increase.—C. S.

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### *Petroleum in Peru.* H. Polakowsky. Chem. Ind. 1895, **18**, 188—191.

As far back as 1866, E. P. Larkin, an American engineer, estimated the petroleum lands of Peru to have an area of 7,200 square miles, and Fonville ("Le Pétrole," Paris, 1888) attributed to them an extent of 16,000 square kilometres. These dimensions, however, only refer to the northern oil-region (department of Piura) lying between Cabo Blanco, 50 miles N. of Paita, and the ravine ("Quebrada") of Charán, 10 miles S. of Rio Tumbes. The discovery of oil in the peninsula of Punta Aguja in 1890, raised the above figures to 32,000 square kilometres, according to F. Moreno, whose report on the Peruvian Region of Peru, drawn up at the end of 1892 ("Boletin de la Sociedad geográfica de Lima," December 1893), forms the best source of information on the subject. There are also other districts where petroleum has been found, but their extent has not been estimated. The yield of crude oil has increased from 650,000 litres in 1885 to 80,000,000 litres (from 49 wells) in 1892, since when there are no statistics available.

In the most northern district of the three into which the oil-lands may be divided, namely, the littoral of the province of Tumbes, extending from the valley of Mancora to the Rio Tumbes, a distance of 150 kilometres, the oil-bearing strata form a compact mass 100 kilometres long and 35 wide, and boring is mostly carried on in the numerous mountain ravines; the most highly productive territory is considered by Moreno to lie back up in the hill passes.

The central zone reaches from the Mancora Valley, over Punta Toca, to Punta Lobos, and the southern belt lies between 80° 58′ and 81° 11′ W. of Greenwich, and 5° 48′ to 6° 10′ S. latitude, at 400—16,000 metres from the coast.

Oil is frequently struck at 30 ft. below the surface, and the deepest wells hitherto do not exceed 800 ft. Moreno thinks that likely strata should be proved to 1,200 ft., even though oil may be met with at less depth, because a greater yield would be obtained and pumping dispensed with. The best results are obtained at the foot of the valleys or ravines. The oil in flowing wells does not rise to any height, but comes up quietly and continues running sometimes for years together. The spouting wells often send up a column of oil and gas 100 ft. high, causing a loss of oil until they can be closed.

Both the "life" and yield of a well are very variable, one in Zorritos having flowed for 17 years, and some in Talara and Zorritos giving daily outputs of from 100 galls. to 800 barrels. The upper strata in Tumbes and Negritos consist of sand and impervious clay, succeeded by layers of sand, conglomerate, and shale to a depth of 250 metres.

Import duties of 5 cents per litre for crude petroleum and residuum, 6 cents for kerosene, 9 cents for lubricating oil, and 30 cents for benzine, protect the home industry; so that the import from the United States will soon cease altogether, that of lubricating oil having already been discontinued. The price of Peruvian burning oil is 3·50 sol. (American costs 8·20 sol.) per 100 galls.; crude oil costs 20 sol. per ton, and is largely used as fuel on the railways, in gasworks and smelting furnaces, with good results, as well as being exported to Chili for similar purposes.

The majority of the syndicates and companies working these oil lands appear from their titles to be in English hands. The oldest establishment (that of F. G. Piaggio, at Zorritos) is close to the shore near Tumbes, and comprises 216 hectares, each "claim" of 4 hectares paying a rent or tax of 30 sol. per annum. The 14 wells have been running from 6 to 17 years uninterruptedly, and the works are lighted by natural gas.

In Talara the London Pacific Petroleum Company owns some 400,000 acres, most of which is oil-bearing land; at the foot of the Amotape mountain, oil appears on the surface in many places, forming small streams.

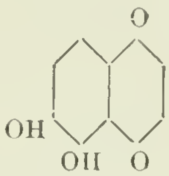
The Petroleum Syndicate, Limited, has oil lands at Punta de Aguja. Here the borings pass through 80 ft. of sand, 78 ft. of soft earth (kind not specified), whereafter a layer of oil is encountered, yielding 15 barrels per diem. Then follow 6 ft. of sand, 200 ft of white, very hard, gold-bearing quartz, and finally 16 ft. of white, highly porous quartz impregnated with gas and oil, which come up in large quantity. At 201 ft. a second oil layer is struck, and at 388 ft. a third containing an abnormal amount of gas, indicating, in the opinion of Moreno, the existence of a very rich oil stratum below the quartz.

(For analyses of Peruvian petroleum see this Journal, 1893, 33.)—C. S.

## IV.—COLOURING MATTERS AND DYES.

*Naphthazarin.* T. Zincke and M. Schmidt. Liebig's Annalen, 1895, **286**, 27—57.

The fact that naphthazarin is a mordant dyestuff makes it probable that the two hydroxyl groups which it contains are in the ortho-position to each other. It easily forms a stable addition product with chlorine or bromine, in which it resembles α-naphthoquinone. The authors accordingly ascribe to it the formula—



The dichloride easily loses HCl. The monochloronaphthazarin thus obtained yields on further treatment with chlorine a body $C_{10}Cl_6O_4$. On heating, this is converted into a tetrachlordiquinone, $C_{10}Cl_4O_4$, which on reduction with stannous chloride gives tetrachloronaphthazarin, $C_{10}Cl_4O_4H_2$. With *o*-phenylene-diamine this gives a eurhodol, one atom of oxygen and one of chlorine being replaced by the group $-NH.C_6H_4-N=$ . This reaction only takes place with bodies containing the oxygen and chlorine atoms in the α, β,-position. Dichlor β-naphthoquinone yields, on treatment with *o*-phenylene diamine, an azine.—T. E.

*Quercetin and its Derivatives.* J. Herzig. Monatsh. Chem. 1895, **16**, 312—320.

The author repeats a number of arguments which he has already brought forward in previous papers to show that quercetin possesses the formula $C_{15}H_{10}O_7$, as Liebermann has thrown some doubt on it (Monatsh. Chem. 1895, 180). —T. E.

*Pyrogallol and its Salts.* R. Godeffroy. Mitt. Tech. Gew. Museum in Wien, 1895, **5** (4, 5, and 6), 151—155.

Pyrogallol yields a colourless crystalline salt on treatment with ammonium carbonate (Berzelius), but by the action of aqueous ammonia, a black amorphous mass is obtained. By passing gaseous ammonia into the ethereal solution of pyrogallol, de Luynes and Esperandieu (Ann. Chim. Phys. (4), **12**, 120) prepared a white crystalline salt of the formula $C_6H_3(OH)_2ONH_4$. Various basic salts of lead and antimony have also been described.

The author obtained large colourless needles by treating pyrogallol solution with excess of barium hydroxide. On exposure to air the crystals became superficially black and lost water of crystallisation, but suffered no further change. On analysis they gave numbers agreeing approximately with the formula $C_6H_3(OH)O_2Ba + 4H_2O$. They are insoluble in water, alcohol, and ether, but soluble in dilute acid. On boiling with water a black amorphous mass is obtained. Calcium, magnesium, and strontium salts could not be obtained.—H. I.

## PATENTS.

*Manufacture of Nitro Amido Anthraquinone.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 13,695, July 16, 1894.

By heating dinitro-anthraquinone with sodium, ammonium, or calcium bisulphite under pressure it is converted into nitro-amido-anthraquinone, which crystallises from alcohol in small red crystals melting at about 200° C. The dinitro compound is heated with 6 to 12 times its weight of commercial sodium bisulphite solution for 2 to 5 hours at a temperature of 120°—180° C. The crude product is washed with water and purified with alcohol. According to its purity, the compound dissolves in 70 per cent. fuming sulphuric acid with a red to a reddish-violet colour, which on long standing turns blue, whilst diamidoanthraquinone dissolves with a blue colour. The compound dissolves in concentrated sulphuric acid with a faint yellowish-red colour, and does not separate out on cooling.—T. A. L.

*Manufacture of the* 1.4.6 *and* 1.4.7 *α-Naphthol Disulphonic Acids.* O. Imray, London. From "The Farbenfabriken vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 14,134, July 23, 1894.

The acids referred to in the title, which hitherto have been obtained from the corresponding naphthylamine disulphonic acids, Dahl's II. and III. acids, are formed according to the present specification by sulphonating α-naphthol carbonate. 50 kilos. of this substance are stirred into 250 kilos. of fuming sulphuric acid containing 20 per cent. of $SO_3$. In about 12 hours the melt solidifies to a hard paste, which determines the completion of the sulphonation, and after stirring into 400 kilos. of ice-water, the solution is heated to 60°—70° C., until effervescence ceases. The tetrasulphonic acid first formed is thus decomposed, yielding a mixture of the 1.4.3′- and 1.4.2′-naphthol disulphonic acids. After conversion into the sodium salts of the two acids, they are separated by their difference in solubility. On adding salt to the solution, the sodium salt of the 1.4.2′-acid is precipitated, whilst that of the 1.4.3′-acid remains in solution, and this solution can be used directly for the production of colouring matters. On fusing the 1.4.2′-naphthol disulphonic acid with caustic alkalis, it yields a dihydroxynaphthalene sulphonic acid, probably the 1.2′.4-acid, whilst by heating it under pressure with dilute acids, one sulphonic acid group is eliminated, and there results 1.2′-naphthol sulphonic acid.—T. A. L.

*Manufacture of α-Naphtholmonosulphonic Acid* 1.4 *from α-Naphthol Carbonate.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 14,135. July 23, 1894.

The subject-matter of this patent has already been abstracted (this Journal, 1895, 360). In the preparation of azo colouring matters from the 1.4-naphtholsulphonic acid, the product of the sulphonation of the α-naphthol carbonate, which is a disulphonic acid, can be used directly, since one sulphonic acid group is eliminated in the presence of diazo-compounds.—T. A. L.

*Manufacture of Blue Gallocyanin Colouring Matters.* J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, St. Fons, Rhone, France. Eng. Pat. 14,137, July 23, 1894.

These colouring matters are derived from gallamide by heating it with dialkylamidoazobenzene, or its hydrochloride, or with a sulphonic acid of the general formula—

$$HO_3S.C_6H_4.N:N.C_6H_4.NR_2$$

where R represents a methyl or ethyl radicle, in the presence of a suitable solvent. About 17 kilos. of gallamide, 32 kilos. of dimethylamido-azobenzene hydrochloride, and 150 kilos. of glacial acetic acid are heated, with constant agitation, to about 120° C. in an oil bath. When no further trace of an amido-azo derivative is to be detected, the melt is poured into water and the colouring matter is precipitated from the solution by salt, after which it is filter-pressed and kept as a paste. The colouring matters produced are easily soluble in water, and dye blue shades on chromed wool. In concentrated sulphuric acid they dissolve with a blue colour, which changes to reddish-violet on addition of water. Alkalis in excess added to a solution of the colouring matter turn the shade reddish-violet and the dyestuff is precipitated.—T. A. L.

*Production of Methylglyoxalidine.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst a/ Main, Germany. Eng. Pat. 14,600, July 30, 1894.

270 grms. of hydrochloride of ethylenediamine are mixed with 350 grms. of dehydrated sodium acetate, and the mixture subjected to distillation. The portion passing over from 190° C. to 220° C. contains methylglyoxalidine and ethylenediamine, the hydrochlorides of which can be separated from each other by means of alcohol.

Methylglyoxalidine melts at 105° C., boils at 198° C., is easily soluble in alcohol, acetone, and chloroform, but almost insoluble in ether.—J. W.

*Manufacture of New Colouring Matters derived from Muscarine.* J. C. L. Durand, E. Huguenin, and A. J. J. d'Andiran, St. Fons, Rhone, France. Eng. Pat. 14,983, August 4, 1894. Date under Internat. Convent. January 16, 1894.

Muscarin, which is obtained by the action of nitrosodimethylaniline on 1.2′-dihydroxy-naphthalene, can be converted into new colouring matters by reacting on it with ammonia or fatty or aromatic amines. If aniline be employed, 1 kilo. of muscarin is heated on the water-bath with 3 kilos. of aniline until a sample no longer shows the presence of free muscarin. The melt is mixed with an equal volume of alcohol, well stirred and cooled. The precipitate, after filtering off and drying, forms a green colouring matter easily soluble in acetic acid. The mother-liquor contains a bluish-grey colouring matter, which can be separated by the addition of hydrochloric acid. Both these colouring matters are insoluble in water and benzene, but dissolve in alcohol, acetic acid, aniline, nitric and sulphuric acids with characteristic colours. Caustic soda added to a solution of the green colouring matter produces a violet precipitate, whilst the bluish-grey colouring matter under similar conditions gives a grey precipitate. Both dyestuffs may be employed in paste form and, printed on a tannin mordant being subsequently treated with tartar emetic, the dyed fabric resists soap and light.—T. A. L.

*Production of Green and Blue Dyes or Colouring Matters.* T. R. Shillito, London. From J. R. Geigy and Co., Basle, Switzerland. Eng. Pat. 15,205, August 9, 1894.

The products obtained by condensing tetramethyldiamidobenzhydrol with the sulphonic acids of primary aromatic amines are treated with nitrous acid in presence of alcohol yielding leuco sulphonic acids, which on oxidation give new colouring matters. For instance, 15 kilos. of tetramethyldiamidobenzhydrol and 11 kilos. of *m*-sulphanilic acid are boiled with 10 kilos. of sulphuric acid and 300 litres of water until the hydrol has disappeared. The condensation product, precipitated by the addition of soda-lye and acidulated with acetic acid, is filtered, dissolved in 20 kilos. of sulphuric acid and 100 litres of water, mixed with 100 litres of alcohol, and when cold 6 kilos. of sodium nitrite in 20 litres of water are added. The addition of a small quantity of cuprous oxide accelerates the decomposition, and when the evolution of nitrogen has finished, the solution is diluted to 4,000 litres, mixed with sodium acetate, and oxidised by means of lead peroxide. When the oxidation is complete, sodium carbonate is added, and after filtering and slightly acidulating, the filtrate is dried down. The colouring matter forms a bronzy powder dissolving in water to a blue solution, which dyes wool and silk blue from a slightly acid bath. The solution is unaltered by soda-lye or acetic acid, but mineral acids turn it from blue to green and yellow.—T. A. L.

*The Production of Yellow Colour in or upon Silk by the Aid of Diazo Compounds or Nitrosamines.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,305, August 10, 1894.

Silk, when immersed in a solution of a diazo compound or of a nitrosamine, preferably in presence of sodium acetate, is coloured yellow, which varies in shade according to the amine employed. The colour produced is in many cases very fast to light, water, and soap. One kilo. of the sodium salt of *p*-nitrophenylnitrosamine is converted into the diazo compound, and the solution is diluted to 5,000 litres. One kilo. of sodium acetate is then added, and 100 kilos. of silk previously soaked in water are introduced into the solution and kept in constant agitation for about half an hour, when the coloration will be complete and the bath nearly exhausted. The silk is then washed, passed through dilute acetic acid, and dried. The amines most suitable for this process are those containing nitro or halogen groups, but aniline, sulphanilic acid, α- and β-naphthylamine react in the same way. The colour can be discharged by reducing agents, and if the silk be printed with a suitable dyestuff component, such as β-naphthol, then, on subsequently passing the fabric through the diazo solution a coloured design is produced on a yellow ground.—T. A. L.

*The Manufacture or Production of Dyestuffs, and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 15,621, August 16, 1894.

When 1.2.4-tolylenediamine is heated with resorcinol with or without a condensing agent at not too high a temperature, the amido group para to the methyl reacts with one of the hydroxyl groups in the resorcinol, yielding *m*-hydroxyphenyl-*p*-amido-*o*-toluidine, having the constitution $[1.2.4]C_6H_3.CH_3.NH_2.NH.C_6H_4.OH[1.3]$. Equal weights of resorcinol and *m*-tolylenediamine are heated in an oil bath for 12 hours to 200°—220° C., a current of carbonic acid being passed through the mixture. When cool, the resulting product is extracted with hot water and an excess of soda-lye, the solution filtered, cooled with ice, and an excess of dilute hydrochloric acid added. After filtration, the excess of hydrochloric acid is neutralised with dilute soda-lye. The filtered solution is then mixed with sodium carbonate or acetate, and the precipitate is crystallised from dilute alcohol. The *m*-hydroxyphenyl-*p*-amido-*o*-toluidine thus obtained is sparingly soluble in water and benzene, but easily soluble in hot alcohol. It crystallises in scales, melting at 177°—178° C., is slightly soluble in petroleum spirit, dilute alkali, and dilute mineral acids and is precipitated by adding acetic acid to its alkaline solutions. The substance can be diazotised, and gives colouring matters when combined with amines and phenols, but it is principally to be used for condensing with the nitroso derivatives of secondary and tertiary aromatic amines yielding azine dyestuffs, the following being an example of the method employed :—A hot solution of 2·14 kilos. of *m*-hydroxyphenyl-*p* amido-*o*-toluidine in alcohol has added to it 2·8 kilos. of nitrosodimethylaniline hydrochloride, and the mixture is stirred and gently heated until the nitroso compound has disappeared and the melt is a pure magenta red. The dyestuff crystallises out on cooling and is filter-pressed, washed with alcohol, and dried. It dissolves easily in water and gives violet-red shades on tannin-mordanted cotton fast to alkalis and light. Other nitroso compounds may be used or any substances which act in a similar manner, such as quinone dichloroimide, or the azo-derivatives formed by combining diazo compounds with primary, secondary, or tertiary aromatic amines or their substitution products.—T. A. L.

## V.—TEXTILES : COTTON, WOOL, SILK, Etc.

### PATENTS.

*Improvements in the Manufacture of Gum or Size, applicable for Use with Cotton, Wool, Silk, Linen, or other Textile Fabrics.* W. P. Thompson, Liverpool, Manchester, and London. From P. C. D. Castle, Frankfort-on-Main, Germany. Eng. Pat. 13,345, July 10, 1894.

To ordinary gum tragasol made from the locust bean (*ceratonia siliqua*) is added an aqueous solution of the kind of gum found in certain species of *fucus algæ* and other seaweeds, and especially abundant in Carragheen moss (*sphærococcus crispus*). The advantage claimed is that the mixture can be evaporated to dryness without decomposition.—R. B. B.

*Composition for Use in the Waterproofing of Woven Fabrics.* E. J. Knowlton, Ann Arbor, Washtenaw County, Michigan, U.S.A. Eng. Pat. 13,982, July 20, 1894.

This composition is used for the purpose of filling up the pores of the fabric previous to the application of the waterproofing material. 2 lb. of common flax seed are steeped in half a gallon of water until it reaches the consistency of laundry starch. The mixture is strained, and a quart of the liquor is mixed intimately with ¼ lb. of Spanish white. Instead of Spanish white, there may be used ochre, ground chalk, soapstone, or pumice stone. —J. J. K.

*An Improved Process for Removing the Gum or Glutinous Matter from Textile Fibres.* J. Soltau, Bergedorf, Germany. Eng. Pat. 4803, March 6, 1895.

The raw material, such as cocoons of wild silk, flax, hemp, &c., is treated with the pancreas of mammals or pancreatic preparations.

After being cleaned in the usual manner, the material is placed in vessels filled with water, to which about 1 per cent. of pancreas or raw pancreatine and ¼ per cent. of bicarbonate of soda are added. When the material is thoroughly soaked, the whole is heated to 40° C., and maintained at this temperature until solution of the pectinates, &c. is complete.—R. B. B.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Nature of the Dyeing Process.* G. v. Georgievics. Mitt. Tech. Gew. Museum in Wien, **4**, (11 and 12), 349—361.

In a previous paper (this Journal, 1895, 149—151) the author has discussed the chemical theory of dyeing, and the present paper forms a continuation of the series.

### *Part II.—Witt's Solution Theory.*

This well-known theory views the dyeing process as a phase of solid solution, and is based by its author on the following facts :—(1.) Fabrics dyed with magenta, methyl-violet, &c., do not show the metallic lustre characteristic of these dyestuffs in their solid state, but the colour of their solutions. (2.) Fluorescent colouring matters such as rhodamine, eosin, which only fluoresce in solution, give fluorescent colours upon silk. (3.) The solution theory explains also why a fibre does not show an equal absorptive power for all dyestuffs. (4.) The dyeing process is viewed as being in every way analogous to the extraction of an aqueous solution by a solvent non-miscible with water.

(1.) The author finds that if magenta be finely powdered and mixed with chalk or other white substance, the original green colour changes at once to red. In the same way, magenta or methyl-violet, when rubbed between two ground-glass plates, exhibits no longer the green colour characteristic of the crystals, but is now red and violet respectively. The colour of magenta and other crystals is not the colour of the solid substance, but is due to abnormal dispersion of the light on their surface, such dispersion only taking place with relatively thick layers.

If wool be dyed with a concentrated solution of magenta, the fabric shows the same surface colours as the crystals, an effect known to dyers as "bronzing." When dyed in the ordinary way, the magenta is so finely divided in the fabric that it now exhibits its proper colours (for the nature of this deposit, see Part I., this Journal, 1895, 149).

(2.) The author contends that fluorescence is not restricted to solution, and points out that many solids, *e.g.* fluorspar and barium platino-cyanide, show this property to a marked degree. It is not exhibited by the dyestuffs of the eosine group, because they are only known in very finely-divided crystalline state.

Silk dyed with fluoresceïn fluoresces ; wool does not. According to Witt's theory, therefore, the dyestuff exists in the former in solution, in the latter in the solid state. The author shows that silk, the surface of which has been injured by mechanical treatment, no longer exhibits fluorescence when dyed with these colouring matters. Jute finely bleached before weaving, and fine Angora wool, exhibit fluorescence when dyed with fluoresceïn, but on weaving lose this property.

The appearance of fluorescence on a dyed fabric is dependent, therefore, not on the state of aggregation of the colouring matter, but on the condition of the surface or lustre of the material.

(3.) All substantive dyestuffs are *per se* "colours." The adjective dyestuffs are not colours, but only produce them when treated with lake-producing agents, *i.e.* mordants. Adjective dyestuffs are not insoluble in the fibre, indeed they are absorbed by it, but since they themselves are not highly coloured the fabric does not exhibit any dark shade. Magenta, according to Witt's theory, is soluble in wool and silk, but insoluble in cotton. It is, however, made soluble in the latter by treatment with tannic or oleic acid.

Cotton, as shown in Part I., can, however, be dyed with this dyestuff without these additions.

(4.) If the dyeing of wool is a selective solution of the colouring matter, then it should be a reversible process ; by treatment with much water a dyed material should give up its colour, which with many dyestuffs is well known not to be the case. Further, since wool takes up the colour best at the boiling heat, and does not absorb it in the cold, it would appear, according to Witt, that the colour is more soluble in wool at 100° than in water, and at the lower temperature *vice versa*. Hence wool dyed at 100° should give up its colour at the ordinary temperature, which is contradicted by experience.

Finally, the author is of the opinion that when all the properties of the dyed fabric are taken into account the solution theory is not adequate to explain them, since not only the substance but also the structure of the fibre plays an important part in the process.

### *Part III.—The Mechanical Theory.*

L. Hwass (Lehne's Färb. Zeit. 1890–91, 224) von Perger (*ibid.* 356, 371), and Spohn (this Journal, 1893, 599) have recently largely contributed to the support of this theory.

The mechanical theory bases itself on the fact that in no case has a definite compound of the fibre and colouring matter been shown to exist (see Part I.).

A dyestuff on the fibre nearly always shows the same properties as in its free state, *e.g.* it may be diazotised and combined with phenols and amines to form azo-dyestuffs—a behaviour which, according to Möhlau (this Journal, 1893, 675), is shown by quartz, sand, barium sulphate, &c. when dyed with various colouring matters. "Rubbing off" and the sublimation of some dyes from the fibre are cited as evidence in favour of the mechanical theory.

If substantive dyeing were really the production of a chemical compound of the fibre and colouring matter, then, on "topping" an already dyed fabric with a colour, no juxtaposition of the colouring matters should occur. A piece of silk is dyed with magenta and a similar piece with chrysoidine, and the two are then dyed to the same shade in chrysoidine and magenta solutions respectively, and treated, after washing out, with hot water. The wash liquors show in each case the colour of the last applied dyestuff, and only after treatment with large quantities of water do they exhibit the same shade. All textile fibres have the property of taking up relatively more colouring matter from a very dilute solution than from a concentrated one, and, moreover, these small quantities of colour are held so energetically by the fibre that their extraction by washing rarely succeeds. Those dyestuffs, which are not exhausted by dyeing a fabric in their concentrated solution, are said to possess a relatively weak affinity for the fibre; still the smallest quantities of them are taken up from their dilute solution, and in order to procure a darker shade a much more concentrated solution must be used. This behaviour, shown by all dyestuffs without exception, is not explained by the chemical or by the solution theory, but only by the phenomenon of adhesion and capillarity.

The behaviour of textile fibres towards mordants has likewise been explained as a chemical decomposition of the mordant by the substance of the fibre. L. Hwass (*loc. cit.*) has carefully examined the behaviour of fibres to various mordants, but the author has made some further experiments with alum. Wool takes up from an alum solution not only alumina, but also sulphuric acid—a very basic aluminium sulphate—while much free sulphuric acid remains in the bath.

Havrez (Monit. Scient. 1872, 598—606) has shown that when very concentrated alum solutions are used, more sulphuric acid than alumina is absorbed. The author's experiments prove the truth of Havrez' result, and he further finds that when wool is dyed with 24 per cent. of alum and 30 times its weight of water, alumina and sulphuric acid are taken up in the proportions present in the normal sulphate. The process receives a similar explanation to that given in the case of the behaviour of wool to magenta solution (see Part I.). The wool fibre possesses an absorptive capacity for alumina and also for sulphuric acid; in very dilute solution the absorption of alumina is greater than for sulphuric acid, the latter only being taken up in relatively concentrated solutions. Experiment proved the truth of these assumptions. Wool takes up much acid from a moderately concentrated solution of sulphuric acid, and holds it so energetically that mere washing with water does not suffice to remove it. Water plays the part of a base to the acid in dilute solutions, just as it precipitates basic salts from solutions of salts of the heavy metals.

Alum solution is, as Carey Lea (Zeits. f. anorg. Chem. **4**, 440—450) has shown, dissociated—in fact the whole of the $SO_3$ present as aluminium sulphate may be titrated with caustic soda, using phenolphthaleïn as indicator.

Wool mordanted with alum reacts acid, and so the sulphuric acid present in the fibre must be regarded as being in the free state. From the experiments of L. Hwass, it follows that not only the dyeing, but also the mordanting process can be explained from a mechanical standpoint, and the assumption of a chemical reaction between the dyestuff or mordant and the fibre is quite gratuitous.

L. Vignon's experiments (this Journal, 1890, 855; 1893, 351) seem to show that wool and silk possess acid and basic properties. These facts, together with the fact that all dyestuffs are either acid or basic, or both, in character, have been used by Vignon in support of the chemical theory. The author contends that these experiments are compatible with a chemical explanation of the dyeing process, but that they do not prove it. Many purely physical phenomena—as capillarity, surface tension—are influenced by the chemical character of the active substances. The author is therefore of the opinion that until stöchiometric relationships are shown to exist between the various factors of the dyeing process, the chemical theory must be rejected.—H. I.

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### *Nature of the Dyeing Process.* G. v. Georgievics.
### Monatsh. für Chem. **25**, 705—717.

The author has made a study of the manner in which indigo carmine distributes itself between the dyed fabric and the dyebath by varying concentration.

Silk was dyed in a bath containing indigo carmine and dilute sulphuric acid. The amounts of silk, dyestuff, sulphuric acid, and water were varied separately and in pairs, and the amount of dyestuff remaining in the bath after the process, was estimated by careful colorimetric comparison with the original solution. The difference gave the amount taken up by the fibre. Seven series of experiments (26 in all) were carried out, and it was found that, where $C\,w$ is the amount of dyestuff in 100 c.c. of the dye liquor after the process, and $C\,s$ the amount of colour taken up by 100 grms. of silk; the expression $\sqrt{\frac{C\,w}{C\,s}}$ = constant. This is called the coefficient of distribution.

This would agree with van't Hoff's and Nernst's modification of Henry's law for solid solution, and it follows further that the colouring matter exists in the silk in simpler molecular condition than in aqueous solution.

With more concentrated solutions of the dyestuff the value $\sqrt{\frac{C\,w}{C\,s}}$ increases; this would point to the presence of more complex molecules in the dye liquor, a fact that is compatible with modern ideas on solution. Since different fibres probably absorb the colouring matters in different molecular conditions, this would account for the varying fastness shown by the same dyestuff on different fibres.

Although these experiments speak strongly in favour o the solution theory of dyeing, the author maintains, on account of the non-reversibility of the dyeing process (see previous abstract), his position towards this theory.—H. I.

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### *Principles of Turkey-Red Dyeing and Discharging.*
### H. Schmid. Chem. Zeit. **19**, 776—778 and 808—810.

(1.) *Dyeing.*—The long and tedious Turkey-red process formerly employed was greatly simplified by the introduction, in 1870, of artificial alizarin and of soluble Turkey-red oils, and while the old process required 17 operations, occupying many weeks, the same result is now attained with four or five operations within one day. The more rapid Turkey-red process was first described by H. Koechlin, and his method, with certain modifications, forms the basis of present day processes. Alizarin, aluminium, lime, tin, and fatty acid must be presented to the fibre, the form and order in which this is done offering a wide field for variation. The organic mordant is now usually first applied. This is followed by the aluminium compound, which consists of basic aluminium sulphate instead of "red-liquor," as formerly. Occasionally an alkaline aluminium solution is employed. Calcium, the second mineral constituent of the colour lake, is either applied in a special chalk-bath, or more frequently in the form of acetate or other salt in the dye-bath. It should be noted that lime does not precipitate alizarin under all conditions, but soluble calcium alizarates also exist, and the proportions must be chosen so that gradual precipitation takes place in the dye-bath. The presence of the maximum of lime in the lake is useful if soap is to be subsequently applied, and it also increases the fastness of the colour to mineral acids such as are used in producing indigo discharge on Turkey-red. Tin is added to the aluminium mordant, or to a final soap-bath, in the form of stannous chloride; or stannic acid paste, made by precipitating nitrochloride of tin with sodium carbonate, is added to the dye-bath. Tin increases the brilliancy of the colour.

One process resembles the "saddening" method used for dyewoods: The alizarin is dissolved in ammonia with addition of Turkey-red oil. After padding in this solution, drying, and evaporation of ammonia, the goods are mordanted in a mixture of aluminium and calcium acetates, dried, and steamed. This is only suitable for pinks.

The process most in favour at present is as follows:—The goods are boiled with soda, dried, and the Turkey-red oil is applied, followed by steaming or hot drying. Mordant with basic aluminium sulphate, wash thoroughly, and dye in bath containing alizarin, Turkey-red oil, calcium acetate, and stannic acid paste. Steaming may complete the process, though some dyers oil after dyeing, or brighten in a soap-bath. This final brightening increases the fastness, *e.g.*, prevents rubbing off. The above is the quickest and safest process.

The aluminium mordant is prepared by neutralising the commercial sulphate with soda as far as possible, without precipitation. In effecting this it should be noted that neutralisation can be carried much further in the presence of neutral salts, such as $Na_2SO_4$ or $MgSO_4$. Using 22 per cent. of $Na_2CO_3$ of the weight of alum, or 32 per cent. of the weight of aluminium sulphate, in the presence of about 20 per cent. of $Na_2SO_4$, a solution of the basic sulphate $Al_2SO_4(OH)_4$ results. Most dyers use rather less $Na_2CO_3$, and obtain a somewhat less basic salt. Alum is more easily neutralised than aluminium sulphate, as it contains the neutral salt $K_2SO_4$. The more concentrated the mordant, the better it keeps without change; the usual strength is between 100 and 200 grms. per litre.

The oil used is a preparation of castor oil, generally neutralised sulphated castor oil. Chemists are not agreed as to the constitution of this substance, but the researches of Juillard, Scheurer-Kestner, &c. in no way affect its application in dyeing. Whatever the chemical reactions occurring, there is no doubt that aluminium, combined with ricinoleïc acid, is the mordant *par excellence* for alizarin. Although the glycerin and sulphuric acid take no part in the lake formation, they are useful in keeping the fatty acids in solution. Fabrics designed for the indigo discharge style must not be too oily; if they contain excess of oil it must be removed by treatment in soda solution.

Steaming after oiling should be at a pressure of $\frac{1}{2}$—1 atmosphere. The higher the pressure the more readily the desired saponification is effected. Steaming also affects favourably the subsequent penetration of dye into the fibre.

(2.) *Discharging.*—The coloured pattern may either be printed on the ground of mordant, or the completed Turkey-red may be discharged. One method of the first kind is that of the Arnold Printworks, North Adams, Mass. The material is padded with tannin, dried, and passed through tartar emetic. Mordant in aluminium acetate and print the basic coal-tar dyestuff together with a non-volatile organic acid. On steaming, a tannin colour-lake is formed, and the aluminium transformed into a soluble organic salt, which can be washed off. On subsequent dyeing the Turkey-red appears only on the unprinted portions. Or we may pad with aluminium mordant and tannin (in presence of acetic acid) and print the dyestuff together with an antimony salt. A method long known in Russia is to mordant with alumina, print with tannin, colour, and organic acid, fix with antimony, clear, and dye with alizarin. This method gives patterns with sharper outlines than the American process, but the latter yields faster colours. Another method is to pad the oiled goods in a bath of alizarin and mordant, dry, and print the coal-tar colour and tannin together with ammonium citrate, finally steaming. The aluminium mordant is naturally used as weak as possible, not stronger than $2\frac{1}{2}$—3 B. Some basic dyes are more suitable than others. Thioflavin T and Nile blue are to be preferred to auramine and methylene blue. For black, use steam aniline black on a base of Prussian blue, or an oxidation vanadium black. Dyeing is accomplished in a bath of alizarin, Turkey-red oil, calcium acetate, and albumin. Then follow clearing with china clay, steaming under pressure, and brightening with soap.

*Discharge of Finished Turkey-Red.*—Patterns were first produced on Turkey-red by simply printing a logwood and iron black over it. The next step was the discovery of the chlorine discharge. Originally the pieces were folded and pressed tightly between two metal plates, the pattern being formed by corresponding holes in the two plates. The acidified bleaching powder solution ran through these holes, penetrating the fabric and discharging the red.

The two processes chiefly in use at present are (1) various improvements on Koechlin's (bleaching powder) method, and (2) the caustic soda discharge. In the former the design is printed with a thickened fixed organic acid. On passing through bleaching powder solution, chlorine is set free in the printed portions, discharging the red. A coloured design is obtained by mixing the required colour, or a part of it, with the organic acid; thus, if plumbite of soda be printed, a subsequent passage through $K_2Cr_2O_7$ will develop chrome yellow. This method of discharge depends upon the complete destruction and oxidation to phthalic acid of alizarin by chlorine. The organic acid is replaced in Russia by arsenic acid, its use being not prohibited in that country. Astafiew proposes the use of organic ammonium salts. They are dearer than the free acids, but injure the fibre less, and have the additional advantage of acting as a resist for aniline black, and by making use of this fact the effects may be greatly varied.

In the caustic soda process, now largely carried out in Russia, the alizarin is not decomposed, but the complicated colour lake is broken up completely into sodium alizarate, aluminate, and stannate with calcium hydrate. The discharge allows of the use of the fastest colours known to us, viz., indigo, chrome yellow, and aniline black in combination with Turkey-red. The advantages over the chlorine discharge are (1) the application of indigo for blues and greens in place of Prussian blue; (2) a much more stable aniline black is applied; (3) aniline black can be printed over the white, blue, yellow, and green patterns, which are not affected thereby, and indigo can be printed over the white and yellow. The price is no greater, but the white portions of the pattern tend to be less clear. The details of the process, in which concentrated colours containing 30 per cent. NaOH are employed, are well known. Prussian blue can replace indigo, but it is more rational to use in this connection the fastest possible colours.—R. B. B.

### *Chemistry of Mordanting Wool with Potassium Bichromate.* A. Ganswindt. Chem. Zeit. 19, 454—455.

1. *Bichromate and Sulphuric Acid.*—The amounts usually recommended are 3 per cent. of bichromate and 1 per cent. of sulphuric acid. Such a bath must contain large amounts of unchanged $K_2Cr_2O_7$, since to entirely decompose 3 per cent. of $K_2Cr_2O_7$, 10·5 per cent. of $H_2SO_4$ is necesary. If the object of mordanting is the precipitation on the fibre of $Cr_2O_3$, this method is little suitable. The wool acquires a pale yellowish tint, which can be entirely removed by washing with water. It is sometimes stated that the wool acts as a reducing agent, by virtue of its sulphur, but the proportion of sulphur in wool is so small as to render this very doubtful. It has been sought in many ways to supply sulphur for this purpose to the wool or to the mordant, but no process has been practically successful, owing to multiplicity of methods or cost of materials,

except, perhaps, the addition of sulphurous acid to the mordant bath. Sulphurous acid is fairly stable if kept in closed vessels without access of light.

2. *Bichromate and Tartar.*—This is a more rational process than (1), in so far as it effects a partial reduction of the $K_2Cr_2O_7$. If a concentrated solution containing bichromate and tartar be allowed to stand, a reddish-grey precipitate of chromium chromate gradually separates. This does not take place in mordanting, as the solution is too dilute, but it indicates that, in practice, reduction is not complete; and, indeed, if after two hours' boiling the green liquid be treated with silver nitrate, the characteristic red silver chromate precipitate is produced. In this process tartrate of chromium results, according to the equation—

$$K_2Cr_2O_7 + 2C_2H_2(OH)_2(COOH)(COOK) =$$
$$2C_2H_2(OH)_2(COOK)(COOCrO) + 2KOH + 3O.$$

Thus, for 295 parts of bichromate, 336 of tartar are necessary, which corresponds in practice to 3 per cent. of $K_2Cr_2O_7$, with $3\frac{1}{2}$ pure, or 4 of crude tartar. Chromic oxide is not deposited on the fibre here any more than in (1).

3. *Bichromate and Oxalic Acid.*—Bichromate solutions are really reduced by oxalic acid, although the solution does not become green, since oxalic acid reduces the bichromate to the green modification of chromium salt. The product is chromium-potassium oxalate, but the reaction is not quite similar to that given for tartar, as, although a colourless gas is evolved, it is not oxygen, but $CO_2$. The equation representing the reaction is—

$$K_2Cr_2O_7 + 5(COOH)_2 =$$
$$2(COOK)(COOCrO) + 6CO_2 + 5H_2O.$$

For the reduction of 295 parts bichromate, 450 of oxalic acid are necessary.

The shades differ very slightly from those obtained with tartar. The general effect of oxalic acid compared with tartar, most noticeable with aluminium mordant, is to influence the shade in the direction of the violet end of the spectrum. For instance, logwood extract with alum and tartar yields a dark greyish blue; with oxalic acid a bright navy blue. Alizarin orange N with alum and tartar, orange red; with oxalic acid a pure orange. It would thus appear that the shades produced by "adjective" colours depend, not only on the dyestuff and metal which form the colour lake, but also on the acid with which the lake-forming metal is combined.—R. B. B.

### *The Improvement of Bronze- and Brocade-Colours.* R. Kayser. Chem. Zeit. **19**, 807—808.

It is possible to increase the intensity of metallic colours and to vary the shades by the addition of suitable coal-tar dyestuffs. The dyes used for this purpose are those basic colouring matters which are soluble in spirit. The colour is thus prepared:—40 grms. of tannin are dissolved in 400 c.c. of alcohol (90—96 per cent.). With this solution 1 kilo. of the metallic colour is well mixed, and the alcohol removed by evaporation at 30°—40° C. When the mass is cold, a solution of 40 grms. of coal-tar dyestuff in 400 c.c. alcohol is added, the mixture well stirred, and dried at a moderate temperature. Much better results are obtained with the white metallic colours, consisting chiefly of tin and antimony, than with the yellow colours containing copper and zinc.

An addition of 2 grms. potassium acetate to the tannin solution is useful. In all cases the colour is finally brightened in a polishing-mill.—R. B. B.

## PATENTS.

### *Improvements in Printing on Velvet and other Fabrics or Materials, and Apparatus therefor.* H. Botschen, Vienna, Austria. Eng. Pat. 11,174, June 8, 1894.

The process described is for printing with metallic or "bronze" colours on ribbons, velvet, &c. The colour is dissolved in linseed oil varnish, and the solution poured into a trough, from which it is taken up by the roller bearing the pattern. To ensure sharpness of outline in the pattern, the roller, which is hollow, is heated by means of gas burners arranged within it.—R. B. B.

### *Improvements in Apparatus for Dyeing and otherwise Treating Yarns.* F. Barraclough, Yeadon, Yorks. Eng. Pat. 14,092, July 23, 1894.

The apparatus consists of two closed reservoirs of equal size, and a smaller treating tank provided with a cover. The reservoirs are connected with the tank by delivery pipes leading from the lower part of the reservoirs, one to the top, and one to the bottom of the treating tank. Air-pipes also lead from the top of the reservoirs to the top and bottom respectively of the tank. The yarn in the tank is wound on hollow perforated tubes through which the liquor is forced or drawn. The reservoirs are connected to pressure or suction appliances, and by means of pressure or suction the liquor is caused to pass from one reservoir to the other through the treating tank and then back again, the transference of the liquor being repeated as often as necessary.—R. B. B.

### *Improvements in Apparatus for Dyeing, Veneering, and Washing Hat Bodies.* J. Booth and L. Thornley, Hyde. Eng. Pat. 14,565, July 30, 1894.

This invention refers to the provision of mechanical means as a substitute for manual labour in agitating and separating hat bodies during the dyeing, veneering, or washing processes. At one end of a longitudinal vat is placed a revolvable paddle, the floats of which break up and separate the mass of hat bodies. At the other end is a paddle float which dips into and propels the liquid, causing a current to flow along the top towards the paddle, carrying with it the hat bodies. The current naturally returns along the bottom of the vat to the float, and constant circulation of the hat bodies in the vat thus takes place.
—R. B. B.

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## VII.—ACIDS, ALKALIS, AND SALTS.

### *A Peruvian Salt Mine.* Robert Peele, jun. School of Mines Quarterly, **15**, [3], 219—221.

Description of a deposit of salt on the west coast of Peru, about 60 miles north of the port of Callao. The salt field is about four miles by three, in a level tract at or below sea-level, separated from the sea by a narrow sandy strip containing shallow lagoons.

The deposit varies in thickness from a few inches to over 15 ft., lying in irregular depressions, often covered by drift sand. An efflorescence of white salt usually distinguishes the sand-covered salt from the portions of the area which are entirely sand. The massive salt below is often nearly pure; but on the surface, sometimes above the sand, a layer of "caliche" or sodium nitrate, some inches thick, often occurs. The amount of salt is very great, but the small extent of the workings prevents any accurate estimate of it being made yet.

For many purposes the salt is pure enough as it is taken out of the beds. Where purer salt is wanted, the surface material is excavated, and water from the lagoons let into the pit so made by digging channels; this water saturates itself with salt, and on spontaneous evaporation, leaves a layer of practically pure salt. This layer, after one or more, usually two, years of this treatment, is cut into blocks 18 or 20 ins. square, and 8 or 10 ins. deep, which are drained and dried, and carried on a small railway to the nearest harbour for shipment. The cutting up is now done by axes, but it is intended to use channelling machines to lessen the waste.

There are four grades of salt :—"Sal Corriente," prepared as described, pure and rather soft ; "Sal de Corazon," the older salt, from the older layers, after removing the Sal Corriente, harder, less pure and coursely crystalline ; "Sal de Espuma," the efflorescence above spoken of, pure, but occurring in small quantity only ; the fourth grade, coursely crystalline, from the portions of the deposit below water level.—J. T. D.

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*Manufacture of Nitric Acid.* P. E. Hallwell. Chem. Zeit. 1895, 118—119.

Owing to the increased consumption of nitric acid many chemists have devoted their time to devising improved methods of manufacture, attention being chiefly directed to improvements of the apparatus rather than the method, as the decomposition of nitrate of soda by sulphuric acid is practically the only reaction by which nitric acid is commercially prepared. The author has had the opportunity of observing in action one of the recently introduced nitric acid processes, viz., that of Valentiner. The essential principle of this consists in carrying out the decomposition under reduced pressure.

The apparatus consists of a cast-iron retort to hold a charge of 800 kilos. of nitrate of soda, a condenser of acid-resisting stoneware, and a large water air-pump.

The retort is set in a furnace so that it is not exposed to to the direct flame, but only to the hot gases. The condenser is composed of a stoneware coil 60 mm. in diameter with a cooling surface of 4·7 cub. metres ; this is connected by a three-way tap to two large vessels of 260 litres capacity, these to smaller vessels of 80 litres capacity, afterwards to another shorter coil of the same diameter with a cooling surface of 2·4 cub. metres, this to a large vessel of 260 litres capacity, and finally to five smaller ones of 80 litres capacity. The second small vessel contains water, and the fourth contains sulphuric acid ; the entrance tubes of these two vessels dip below the surface of the contained liquids. The last vessel is connected with the pump. The greater portion of the nitric acid collects in the first two large vessels, and a three-way tap allows one or the other to be thrown out for drawing off the acid without stopping the distillation.

The connecting pieces are made with grooved flanges, and the joints are made tight with water-glass.

The apparatus is used as follows :—The charge of nitrate is introduced into the retort and the pump set in action ; the sulphuric acid is then drawn in, and immediately a vigorous evolution of nitrosyl chloride takes place, which, owing to its volatility, is chiefly condensed by the second coil. With a vacuum of 500 mm. of mercury and a temperature 80° C. the distillation of nitric acid follows, and during its progress the pressure falls to 650—670 mm. Towards the end the temperature is raised to 120°—130° C., and when the distillation ceases the pump is stopped and the temperature raised to 170°—175° to render the bisulphate sufficiently liquid to be easily drawn off. In the ordinary process of distillation at the atmospheric pressure it is necessary to raise the retort to a low red heat in order to obtain the whole of the nitric acid. At such high temperatures loss is caused owing to the formation of nitric oxide and peroxide and the increased corrosion of the retort.

Owing to the low temperature employed in this process very little nitric oxide, &c., is formed, and the condensation is good, so that a yield is obtained closely approaching the theoretical quantity. Thus from an undried 95 per cent. saltpetre and sulphuric acid of 60° Baumé, 95·7 per cent. of the theoretical quantity of nitric acid was obtained as a strong acid of 78 per cent. (45° Baumé), and 3·8 per cent. as a weak impure acid of 14° Baumé — the total yield being thus 99·6 per cent. of the possible. With stronger sulphuric acid a larger quantity of strong nitric acid is obtained, and if sulphuric acid of 66° Baumé and dried saltpetre be used, it is possible to obtain a large proportion of the nitric acid as pure monohydrate.

The acid prepared by this process has also the advantage of being free from chlorine, and contains but a trace of the lower oxides of nitrogen.

The process is economical, as four to five times as much can be made with plant of the same size as in the old process, and it requires but one-half the quantity of coal. Owing to the low temperature the retorts last longer, and as the pressure in the interior of the apparatus is always less than the external pressure, no noxious fumes can escape and cause a nuisance.—A. L. S.

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*Action of Metals on Nitric Acid. Part 2. Reduction of Nitric Acid by Copper and Lead.* G. O. Higley. J. Amer. Chem. Soc. **17**, 18—26.

*See under* X., *page* 661.

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*Formation of Sulphuric Acid by Direct Oxidation of Sulphurous Acid by means of Air, in the Manufacture of Copper Sulphate.* G. Friese. Chem. Ind. **18**, 1895, 136—138.

A few years ago there was increasing demand for sulphate of copper, and the author was of opinion that the sulphuric acid necessary might be obtained by direct oxidation of sulphurous acid in the presence of sulphate of copper.

A series of experiments were carried out under varying conditions, by mixing sulphurous acid with air, or air and steam, in presence of a solution of sulphate of copper. The results, however, were not satisfactory. The following conclusions were arrived at :—

1. An oxidation of sulphurous acid to sulphuric acid by the aid of the catalytic action of copper sulphate could not be proved.

2. Sulphurous acid reduces sulphate of copper to cupric-cuprous sulphite, and finally to metallic copper.

As the cupric-cuprous sulphite was easily obtained, the author endeavoured to oxidise it, without, however, obtaining satisfactory results, and this led him to try to liberate sulphuric acid from sulphate of copper by means of sulphurous acid without the formation of the double salt. On allowing sulphurous acid to act on a hot dilute solution of copper sulphate, a characteristic green solution is produced, owing to the partial formation of cuprous sulphate, which exists in weak acid solutions.

$$2CuSO_4 + SO_2 = Cu_2SO_4 + 2SO_3$$

In order to make use of this reaction, a thick layer of copper residues ($Cu$, $Cu_2O$, and $CuO$) was treated with sulphurous acid, air and steam, and continuously moistened with a saturated solution of copper sulphate. The resulting green solution was allowed to flow through fresh copper residues, and at the same time was treated with air and steam. The solution immediately turned blue, and after repeated treatment could be crystallised. It will be seen that although the oxidation of sulphurous acid is possible, such a process would never answer on a manufacturing scale.—J. R.

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## PATENTS.

*Improvements in the Manufacture of Ferrocyanides of Potassium and Sodium from their Sulphocyanides, and Apparatus relating thereto.* H. W. Crowther, West Bromwich; E. C. Rossiter, Smethwick; J. J. Hood, London; and G. S. Albright, Edgbaston, Birmingham. Eng. Pat. 8305, April 26, 1894.

When an alkali sulphocyanide is heated with iron to obtain the ferrocyanide, it is necessary that the sulphocyanide should be dry, and the iron free from rust. As some water is obstinately retained by alkali sulphocyanides when heated, the inventors effect the drying by blowing an inert gas, such as nitrogen, or preferably carbonic acid gas as given off from lime kilns, through the melted salt. Iron is used in the state of borings or turnings, previously dried ; or, if rusty, after treatment with a soluble sulphide, such as occurs as a by-product of the process.

An arrangement is shown of four furnaces, of which two receive the pots in which the sulphocyanide is dried, the pots being afterwards lifted and transferred to the two hinder furnaces having overhead mechanical apparatus for agitating the fused sulphocyanide with the iron turnings or borings. The shaft to the agitator is so arranged at its lower end that it may be coupled with a removable piece, and that to the agitator in the pot, by a rod passing through a close-fitting cover. The furnaces are cylindrical, lined with fire-brick, and each is covered with an iron plate with a hole in the centre on which the lower flange of the pot rests. The pot has also an upper flange, on which the cover (made in two halves) is fastened, and having two pillars supporting a cross-bar, which serves to keep the shaft to the agitator vertical, and to add rigidity to the apparatus. The cross-bars are removable with the agitator. Lugs are fixed between the two flanges, in which hooks may be inserted, so that by means of an overhead travelling crane carrying suitable chains, the pot may be lifted and transferred to another furnace.

When a suitable quantity of potassium sulphocyanide has been melted in a pot, the proper proportion of iron (previously treated as described, if necessary) is added, and the lime-kiln gases are passed in dry, and under pressure, through a pipe connected to a ring at the bottom, suitably perforated. When at about 450° — 500° F. the moisture is expelled, the pot is transferred to the decomposing furnace, the agitator is introduced, and the pot, with its lid fitted on air-tight, is fired. When the reaction is finished, the charge becomes red-hot, and is stirred with difficulty. The pot is then removed to cool. Sodium sulphocyanide is placed at once in a pot in the decomposing furnace, and, when melted, the treated iron is added. The charge is heated with stirring until most of the water is removed, and the lime-kiln gases are then passed in to prevent oxidation of the iron and sulphocyanide. The process is then concluded as in the case of the potassium salt. The pots are allowed to cool without access of air, after which the contents are transferred to a vat, and water is added and boiled up by live steam, until all the cyanide is converted into ferrocyanide. After settling and decantation, the liquor is concentrated for crystallisation of the ferrocyanide. The mother-liquors from the first crystallisation, containing sulphides, &c., are converted into carbonates by carbonic acid, the process described in Eng. Pat. 1495, 1888 (this Journal, 1889, 118), being preferably employed.—E. S.

### *Improvements in and connected with the Manufacture or Production of Ammonia-Soda.* James Greenwood, London. Eng. Pat. 11,655, June 15, 1894.

Ammonium chloride, which at present in the ammonia-soda process is treated with lime to recover the ammonia, is in this case treated with a metallic oxide, such as oxide of zinc so as to form a chloride of the metal, at the same time liberating ammonia. The chloride of zinc is then caused to flow into an electrolytic vat, with zinc as cathode, and on passing an electric current, chlorine is liberated in the anode section, zinc being deposited on the cathode. To obtain the zinc oxide, calamine is roasted, the escaping carbonic acid being utilised in the ammonia-soda process. —J. R.

### *An Improvement in the Manufacture of Yellow Prussiates from the Alkaline Sulphocyanides.* O. Imray, London. From Goerlich and Wichmann, Hamburg. Eng. Pat. 13,260, July 9, 1894.

Formerly the mass, obtained by heating together iron and alkaline sulphocyanides, was lixiviated with hot water, forming $K_4Cy_6Fe$, $K_2S$, and FeS. If the sulphide of iron thus obtained be exposed to the air, it forms a basic sulphate of no value. In the present process, however, instead of treating with water, the mass is exposed to the air containing its usual amount of carbonic acid, and it is moistened with steam or otherwise. It is decomposed substantially as follows :—

$$2(6KCN.6FeS) + 17O + 21H_2O + 2CO_2 =$$
$$2K_4Cy_6Fe.3H_2O + 2K_2CO_3 + 5Fe_2(OH)_6 + 12S.$$

The salts $K_4Cy_6Fe$ and $K_2CO_3$ are extracted with water, the sulphur with carbon bisulphide, the residue being $Fe_2(OH)_6$, which may be converted into metallic iron —J. R.

### *Improvements in the Manufacture of Ammonia.* W. McD. Mackey, Leeds, and J. F. Hutcheson, Glasgow. Eng. Pat. 13,315, July 10, 1894.

Carbonaceous material, such as charcoal or coke, is charged into a vertical furnace, preferably lined with basic material, together with potassium carbonate, hydrate, oxide, or nitrate, to which a proportion, not exceeding one-fifth, may be added of a similar barium, calcium, or sodium salt. A hot blast is supplied by one or more tuyères near the bottom of the furnace, and at a suitable height steam is injected, which decomposes the cyanides formed, producing ammonia and alkali carbonate. The ammonia passes with the gaseous products of combustion from the upper part of the furnace, to be led through condensing apparatus by which the ammonia is recovered. "The liberated alkaline carbonate is mostly carried down by the materials descending in the furnace, to be again acted on by the nitrogen of the blast and to produce cyanide as before," so that fresh alkali salts need only be added to replace working loss.—E. S.

### *Improvements in the Manufacture of Sulphocyanides.* G. S. Albright, Edgbaston, Birmingham, and J. J. Hood, London. Eng. Pat. 14,154, July 23, 1894.

Carbon bisulphide, ammonia solution, and magnesium hydrate, preferably with calcium hydrate (though a caustic alkali or barium or strontium hydrate may be used), are placed in a suitable steam-jacketed digester, and heated until a pressure of from 50 to 90 lb. to the inch is attained. When the reaction is completed, the charge is boiled under atmospheric pressure, free exit being allowed for the hydrogen sulphide. Or the liquid may be withdrawn into another vessel and boiled, and the magnesium hydrate precipitated be filtered off for re-use. The hydrogen sulphide is utilised for the production of sulphur or of sulphuric acid by known methods. If magnesia is employed as the only base in the process, magnesium sulphocyanide is formed, which is decomposed by calcium hydrate (or other alkali or earth), the corresponding sulphocyanide being obtained with recovery of magnesia. When caustic alkali, or potash, replaces lime, in the original mixture—

$$MgH_2S_2 + 2KCNS$$

is obtained in the digester, producing on boiling—

$$MgH_2O_2 + 2H_2S + 2KCNS,$$

so that on separating the magnesium hydrate, a solution of alkali sulphocyanide is obtained in one operation. If lime be employed as the second base, the reaction is represented by the equation—

$$Mg(H_2O_2) + Ca(H_2O_2) + 2NH_3 + 2CS_2 =$$
$$Mg(H_2S_2) + Ca(CNS)_2 + 4H_2O.$$

When, after boiling, the precipitated magnesia is separated, the solution of calcium sulphocyanide may be treated with an alkali carbonate or sulphate to obtain an alkali sulphocyanide.

Reference is made to Hood's Eng. Pat. 5354, 1891 (this Journal, 1892, 816); and to Crowther and Rossiter's Eng. Pat. 17,846, 1893 (this Journal, 1894, 887).—E. S.

### *Improved Process of Rectifying Sulphuric Acid, and Means or Apparatus therefor.* J. W. Scott, Leeds. Eng. Pat. 14,215, July 24, 1894.

A series of glass retorts is employed, arranged one below another, each on a separate bed composed of brickwork faced with an iron dish, and therein a saucer to hold the retort. In case of breakage of retorts an iron or "metalline" spout conveys the acid into a trough without loss, or detriment to brickwork. The glass retorts are so connected that the sulphuric acid can siphon from one to the other and finally be cooled in a cistern at the bottom. The fumes which are cooled are conducted through a leaden pipe into a condenser. The whole apparatus is covered by an iron roof with a glass front to enable workmen to control the boiling acid. The apparatus is arranged with a furnace so constructed that the flames strike directly on opposite sides of the concentrating retorts and thence pass underneath, thus enveloping the retorts with a uniform heat.—J. R.

*Improvements in Condensers used for the Condensation of Acid Fumes.* H. L. Doulton and L. E. Sanceau, Lambeth, Surrey. Eng. Pat. 14,766, August 1, 1894.

The acid condenser consists of a series of vertical cylinders of pottery ware, in two rows, each cylinder being connected at the top to the one opposite by a ∩-pipe, and alternately near the bottom by a branch pipe to the one next it, so that the flow of vapour may be alternately up and down throughout the series.

It is stated that nitric acid is obtained bleached in this apparatus.—E. S.

*Improvement in the Manufacture of Potassium Chlorate.* K. J. Bayer, Brünn, Austro-Hungary. Eng. Pat. 17,978, September 21, 1894.

Chlorine, otherwise lost as calcium chloride in the manufacture of potassium chlorate, is recovered in this process, and for this purpose, instead of lime, oxide of zinc is used.

Three equivalents of ZnO are mixed with one equivalent of KCl and heated to 95°—98° C. with a suitable quantity of water, an excess being avoided so as to prevent formation of oxychlorides. Chlorine is then admitted, when chlorate of zinc or of potash is formed without the intermediate formation of hypochlorite. A sample of the clear liquor obtained, is tested with water to ascertain whether it be basic; if not, oxide of zinc is added and the whole concentrated to about 40° B.

Potassium chlorate crystallises on cooling. After decantation the mother-liquor is evaporated to about 60° B., when on cooling and refrigerating, a further quantity of potassium chlorate is obtained. Finally, the mother-liquor is evaporated to dryness, with addition of a little HCl to decompose any traces of chlorate. The chloride of zinc thus obtained is extremely white and pure.—J. R.

*Improvements in the Method of and Apparatus for Concentrating Sulphuric Acid.* I. Levinstein, Manchester. Eng. Pat. 22,844, November 26, 1894.

This invention relates to a previous patent, Eng. Pat. 19,213, granted to the same inventor, but introduces certain improvements.

In this case, instead of employing a single fireplace for each row of sulphuric acid condensing vessels, only one fireplace for two such rows is used. The furnace is so constructed that the hot gases pass into two flues, each regulated by a damper, and each of which is under one of the rows of the concentrating vessels. From each of these flues the hot gases enter a flue containing the lower parts of the concentrating vessels, so that the lower members of the series containing the more concentrated liquid, are exposed to the greater heat.

The mouths of the concentrating vessels are contained in two flues, which are connected to another flue divided into two parts, a lower and an upper one. Thus, the vapours arising from the concentration of the acid contained in the upper vessels are drawn into the upper part of this flue, whence they pass into a tower for utilisation in the usual way; those vapours, however, which arise in the lower vessels of the series are drawn into a suitable absorbing apparatus.

With this improved construction of apparatus it is found that eight concentrating vessels will do the work previously done by 14, besides economy in fuel and a saving in the recovery of vapours containing $SO_3$.—J. R.

## VIII.—GLASS, POTTERY, AND ENAMELS.

*Japanese Porcelain.* Hesoki. Chem. Ind. 18, 139—140.

The Imari porcelain or Arita, or Nabeschina-porcelain, is manufactured from a natural clay, which does not require any preparation, as the ingredients are contained in the exact proportions required for the manufacture of porcelain. Still more remarkable is the fact that the same material is used for glazing by the simple addition of a little wood-charcoal, the alkalis contained therein, just reducing the fusing point in a sufficient degree. This ideal porcelain-clay is found in beds on a range of mountains, called Tdzumiyama, not far from the town of Arita.

There are also two other clays of importance, the one being known as Amakusa-clay, the other as Gairome. The latter is full of small particles of transparent quartz, from which the name is derived. After grinding and mixing with the proper proportions of felspar and quartz it is ready for use. It might be said that the porcelain industry of Owari is the most important of the whole Japanese empire, and since the largest factories are situated at the village of Seto, the porcelain of the whole province is named Seto-porcelain.

The following ingredients were estimated as those of the several porcelains named:—

| — | Clay. | Quartz. | Felspar. |
|---|---|---|---|
| Tdzumiyama-clay..... | 49·07 | 14·32 | 36·61 |
| Amakusa-clay ........ | 60·66 | 9·63 | 29·71 |
| Gairome.............. | 94·75 | 2·04 | 3·21 |

From these materials the mixtures for porcelain were made according to Japanese directions, and practically tested. The recipes which have proved trustworthy are given below as $M_1$, $M_2$, $M_3$, for porcelain, and $G_1$, $G_2$, $G_3$, for glazing:—

| — | Tdzumiyama-Clay. | Gairome. | Amakusa-Clay. | Felspar. | Quartz. |
|---|---|---|---|---|---|
| $M_1$.. | .. | 29 | 45·1 | 16·7 | 9·2 |
| $M_2$.. | .. | 55 | .. | 24·0 | 21·0 |
| $M_3$.. | 100 | .. | .. | .. | .. |

| — | Tdzumiyama-Clay. | Amakusa-Clay. | Marble. | Quartz. |
|---|---|---|---|---|
| $G_1$...... | 100 | .. | 38 | 25·0 |
| $G_2$...... | .. | 100 | 40 | 35·0 |
| $G_3$...... | 100 | .. | 20 | 14·4 |

—J. R.

*Influence of Magnesia Mixture on Glass.* L. L. de Koninck. Chem. Zeit. 19, 450—451.

*See under* Analyt. and Scient. Notes, *page* 691.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Vitrified Bricks for Street Pavements.* J. W. Gibson. School of Mines Quarterly, (U.S.) 1895, **16**, [2], 149—176.

The author points out the many advantages of brick as a paving material, provided the bricks used be clinkered throughout their mass. The cost of such a paving is compared with that of other materials in the following table :—

| | Per Square Yard.<br>Dollars. |
|---|---|
| Cedar-block on 6-in. sand | 0·75 |
| Cedar-block, on 2 layers of 1-in. boards, with tar composition | 1·30 |
| Cedar-block, on 6-in. concrete | 1·50 |
| Light asphalt, 4-in. concrete, 2-in. asphalt | 2·10 |
| Vitrified brick, on 4-in. concrete | 2·25 |
| Heavy asphalt, 6-in. concrete, 2½-in. asphalt | 2·60 |
| Granite sets on 6-in. concrete | 3·85 |
| Scoria blocks on 6-in. concrete | 4·00 |

In making clinkered bricks for paving use, the quality of the clay is of the first importance. A sandy clay will yield a brick of porous structure and low strength, while a tough plastic clay, if sufficiently fusible to clinker at a moderate temperature, but not so fusible as to be actually deformed on burning, will give a tough impervious product. An actual fire test in addition to the analysis, is necessary to ascertain the suitability of the clay for its proposed use.

In Ohio there are three sources of clay suitable for the manufacture of clinkered bricks: (1) the shale clays coming largely from the coal measures, but represented in all the older deposits as well; (2) the impure and low-grade fireclays, coming from the coal measures; (3) river clays or sedimentary deposits of recent origin. None of these is a perfect material: the shales and river-clays are too fusible and lose their shape at too low a temperature; they clinker perfectly, however.

The character of the ultimate particles of clay has been studied by Koenig, of Pennsylvania, with the view of discovering a cause for its eminent plasticity. He finds that the ultimate molecular particles of kaolin, when magnified to 1,100 diameters, appear globular, resembling fish-roe in general aspect. He lays stress on their resemblance to starch granules, in that they are capable of absorbing water and swelling, yielding a mass which is mobile and plastic on account of the rounded form of the particles.

The manufacture of bricks for paving differs in some respects from that adopted for common brick. If the raw material be shale, it is powdered and mixed with water in a pug mill, and then passed to the brick machine, which may be of the "auger" type. The clay is handled in the condition known as "stiff mud," the "soft mud" process being considered unsuitable for making firebrick. A certain amount of success has attended the use of the dry-press system for firebrick. Drying is best done on hot or slatted floors, or in flues or tunnels by means of artificial heat. The bricks are best burnt in a down-draught kiln, the fires being started slowly to expel the residual water gradually. At a temperature of about 1,000° F. the combined water of the clay is expelled and approximation of the particles of the clay begins. Care should be taken that the middle of the brick has reached the same stage of burning as the outside, for otherwise, swelling of the bricks may occur from the expansion and expulsion of the enclosed gases and water-vapour. The larger the brick the more risk there is of this accident. As the temperature is raised clinkering proper begins. The early stage of heating, during which water is expelled, occupies 2 to 4 days, the burning proper needs 4 to 6 days, and cooling takes 3 to 5. When cooled too rapidly, the bricks become glassy and brittle, the annealing process being essential for the production of a tough brick.

The quality and method of testing bricks of the clinkered class may be briefly described. A good paving brick should be as difficult to abrade as cast-iron; it should have a sp. gr. of 2·25 and a crushing strain of about 12,000 lb. per sq. in. A transverse test made by treating the brick placed on edge as above should give a strength (calculated by the usual formula) of about 1,600 lb. per sq. in. The percentage of water absorbed on immersing a paving brick in water for three days, should not exceed 2 per cent., anything over 5 per cent. being an indication that the brick is unsuitable for northern climates, where it will be subject to the disintegrating action of frost. (A common red building brick with a sp. gr. 1·82, will absorb 15 per cent.). Large pieces of chalk in the clay, yielding lumps of unslaked lime in the brick, of course condemn it. The presence of caustic lime in a brick is revealed by the immersion test, the brick becoming broken or cracked. A convenient comparative test for power of resisting abrasion, consists in placing the brick in a foundry tumbler together with pieces of cast-iron, and estimating the loss of weight suffered after a given number of revolutions.

Tables with comparative tests of bricks made at Ontario and in the United States are given.—B. B.

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### PATENTS.

*Improvements in the Preservation or Treatment of Buildings, Structures, Building Materials, and the like.* R. Hauers, Hanover, Germany. Eng. Pat. 9455, May 12, 1894.

A solution of potassium oleate in weak crude alcohol is prepared by heating a mixture of "36 parts by weight of olive oil, 12 of oleine, 45 of wood naphtha, 375 of distilled water, and 11½ of caustic potash (65—66 per cent. $K_2O$)." A solution of aluminium acetate is prepared by dissolving the aluminium hydroxide resulting from 30 parts by weight of the sulphate in 32 parts of 50 per cent. acetic acid, and making up the solution to 250 parts by weight. The stone or other material to be treated is cleaned and impregnated with these solutions in succession, the resulting aluminium oleate being, it is stated, a better preservative than the stearate or palmitate. The aluminium soap may also be dissolved in "benzine," and applied thus instead of being formed *in situ*.—B. B.

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*Improvements in the Manufacture of Cement, Lime, and the like Materials, and Apparatus connected therewith.* C. E. Blyth, Rugby. Eng. Pat. 11,788, June 18, 1894.

The mechanism patented consists of an inclined revolving sieve, hexagonal in section, and having longitudinal panels fitted with wire gauze of mesh suitable for the character of the material to be sifted.

The cement or lime as it comes from the stones is fed axially into the revolving drum, and is sifted through the panels into a surrounding casing, from which it is removed by a conveyor. "Cooling" of the material is favoured by a blast of air, introduced through an axial tube and distributed by perforated pipes. An auxiliary blast from the lower or delivery end of the drum is provided by a fan running loose on the shaft carrying the drum and driven at a higher speed. Hammers of soft material, *e.g.* white metal, are pivoted to the drum, and are tripped by projections from the casing surrounding the drum, and are brought back to their original position by appropriate springs, thus jarring the panels of the drum. The object of this device is to prevent clogging of the sieves.—B. B.

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*Improvements in Glazing and Enamelling Bricks and the like, and Iron or other Metals.* M. Ahern, New Southgate. Eng. Pat. 12,383, June 26, 1894.

A mixture is made of "arsenic glass about 60 parts by weight, broken china about 14 parts, carbonate of potash about 4 parts, carbonate of soda about 5 parts, lead about 2 parts, tin, about 1 part, and bismuth, from ½ to 1 part." The finely powdered composition is spread evenly on the surface of the bricks before they are compressed, and burnt in the ordinary way. The composition may also be fused, granulated, powdered, made into a paste with water, gum, sugar, &c., and applied as a glaze to iron. The usual method of colouring with appropriate oxides may be adopted. —B. B.

*Improvements in Artificial Stone.* G. T. Jenkins, St. Leonards. Eng. Pat. 7542, April 13, 1895.

VARIOUS mixtures of Kentish ragstone, Portland stone, and Portland cement, with or without ferruginous colouring matters, are described as suitable for the production of artificial stone.—B. B.

## X.—METALLURGY.

*Effect of Heat on the Mechanical Properties of Manganese Bronze.* M. Rudeloff. Mitt. königl. tech. Versuchs. zu Berlin. 1895, 29—42.

THE author has already published a report in the above periodical (1893, 292—330; this Journal, 1894, 520) on the effect of heating manganese bronze and other structural metals and alloys as regards their mechanical properties. He then showed that in the case of manganese bronze no sensible effect was produced up to a temperature of 250° C., and that with a sample nominally containing 15 per cent. of manganese a similar constancy of behaviour obtained up to 400° C., the alloy being thus distinguished from the other materials examined, all these suffering alteration of strength. Before proceeding to detail the results of the present series of experiments it may be noted that the nominal 4 and 15 per cent. manganese bronzes previously tested, proved, upon analysis, to contain a somewhat smaller quantity of Mn, viz., 3·2 and 13·5 per cent. respectively.

The tests about to be described were performed with three alloys, containing respectively 5·35, 7·3, and 9·4 per cent. of manganese. The material was cast and then rolled into round bars 27 mm. in diameter. Two tests were made of each alloy at the ordinary temperature of the testing room, and at 100°, 200°, 300°, and 400° C., making 30 tests in all for the three alloys. The same apparatus as that previously adopted was used on this occasion. The bath in which the heating was accomplished whilst the test-piece was between the jaws of the machine, contained paraffin for the two lower temperatures (100° and 200° C.), an alloy of tin and lead for the tests at 300° C., and lead alone for those at 400° C. In determining the extension of the test-piece with a given load, a correction was made for the elongation of the head of the test-piece to which the extension gear was attached. The chief results obtained may be summarised by the following excerpts from the table accompanying the paper. Values, which for one reason or another are considered not perfectly reliable, are enclosed in brackets.

5·35 PER CENT. MANGANESE BRONZE.

| Temperature. | Modulus of Elasticity. | Proportionality Limit. | Yield Point. | Ultimate Strength. | Extension on 90 mm. | Reduction of Area. |
|---|---|---|---|---|---|---|
| | | | Kilos. per Sq. Mm. | | Per Cent. | Per Cent. |
| Ordinary | 11,550 | 7·7 | 17·7 | 35·9 | 40·0 | 72·7 |
| 100° C. | (8,985) | (11·6) | 16·8 | 35·6 | 32·4 | 60·2 |
| 200° C. | (9,500) | (10·9) | 19·1 | 35·7 | 36·5 | 52·4 |
| 300° C. | (10,150) | (9·1) | 15·5 | 33·5 | 37·1 | 51·9 |
| 400° C. | .. | .. | 11·6 | 25·9 | (23·7) | .. |

7·3 PER CENT. MANGANESE BRONZE.

| | | | | | | |
|---|---|---|---|---|---|---|
| Ordinary | (11,800) | (7·5) | 21·7 | 35·4 | 34·2 | 66·7 |
| 100° C. | 10,450 | 8·4 | 20·0 | 33·6 | 30·5 | 64·6 |
| 200° C. | (9,575) | (9·6) | 19·8 | 33·6 | 30·2 | 60·1 |
| 300° C. | 8,990 | 6·4 | 16·6 | 31·9 | (32·2) | .. |
| 400° C. | 8,885 | 3·9 | 13·5 | 25·9 | 29·0 | 27·1 |

9·4 PER CENT. MANGANESE BRONZE.

| | | | | | | |
|---|---|---|---|---|---|---|
| Ordinary | 11,320 | 5·1 | 19·1 | 32·5 | 37·1 | 69·8 |
| 100° C. | .. | .. | 17·8 | 30·8 | 32·5 | 66·4 |
| 200° C. | 9,925 | 11·5 | 18·5 | 30·2 | 28·5 | 59·7 |
| 300° C. | (10,550) | (5·8) | 16·0 | 28·9 | 34·3 | 59·6 |
| 400° C. | (8,380) | (6·4) | 11·5 | 23·2 | 30·6 | 28·6 |

On reviewing these results certain general conclusions concerning the behaviour of the three alloys under the influence of temperatures above the ordinary, can be arrived at. Thus the proportionality limit, *i.e.*, the load up to and including which the extension of the specimen is proportional to the load, is raised by heating to 200° C., this being most marked in the case of the 9·4 per cent. alloy. It falls at higher temperatures, but does not disappear even at 400° C., save in the case of the alloy containing only 5·35 per cent. of Mn. The yield point, on the other hand, on the whole, lowered with fair uniformity; an exception, however, appears in the figure for the 5·35 per cent. alloy at 200° C. The ultimate strength is but little affected up to 200° C. for all three alloys, but is decreased at higher temperatures. The extension decreases at first with rise of temperature, and then increases up to about 300° C., beyond which it again decreases. The reduction of area generally decreases with rise of temperature. With the 7·3 per cent.

bronze this decrease is continuous, whereas there is no considerable drop between 200° and 300° C. in the case of the other alloys.

The whole of the foregoing work, together with that previously carried out on the 3·2 per cent. and 13·5 per cent. (nominally 4 and 15 per cent.) bronzes, is compactly stated in comparative form in the following table, the corresponding values for the alloys tested at the ordinary temperature being taken as a standard, and called 100 in all cases :—

Table III.

| | ° C. | Content of Mn. | | | | |
|---|---|---|---|---|---|---|
| | | 3·2 per Cent. | 5·35 per Cent. | 7·3 per Cent. | 9·4 per Cent. | 13·5 per Cent. |
| Proportionality limit | 100 | 131 | 134 | 112 | 175 | 115 |
| | 200 | 352 | 142 | 128 | 226 | 108 |
| | 300 | 196 | 118 | 85 | 175 | 152 |
| | 400 | 151 | .. | 52 | 100 | 42 |
| Yield point | 100 | 88 | 95 | 92 | 93 | 100 |
| | 200 | 85 | 108 | 91 | 97 | 96 |
| | 300 | 88 | 88 | 77 | 84 | 102 |
| | 400 | 71 | 66 | 62 | 60 | 91 |
| Ultimate strength | 100 | 92 | 99 | 95 | 95 | 93 |
| | 200 | 89 | 99 | 95 | 93 | 97 |
| | 300 | 89 | 93 | 90 | 89 | 96 |
| | 400 | 71 | 72 | 73 | 71 | 77 |
| Extension on 30 mm. | 100 | 94 | 83 | 88 | 86 | 79 |
| | 200 | 93 | 89 | 87 | 78 | 100 |
| | 300 | 91 | 90 | 88 | 89 | 91 |
| | 400 | 39 | 57 | 78 | 78 | 98 |

As a practical upshot of this investigation the author concludes that manganese bronze containing 5—6 per cent. manganese is the most generally useful for a structural material used in tension. The 7—8 per cent. alloy, although having a high yield point, and being on that account free from tendency to suffer deformation, is not sufficiently ductile (as shown by its extension), to be considered a reliable material; the 5—6 per cent. alloy is to be preferred.

The influence of manganese when alloyed with copper appears to be similar to that which it exercises upon iron to form the manganese-iron alloys which have been investigated by Hadfield, in this respect, viz., that the strength of the alloy increases at first with increase of manganese, then decreases, and finally increases again.—B. B.

### *Action of Metals on Nitric Acid. Part 2. Reduction of Nitric Acid by Copper and Lead.* G. O. Higley. Amer. Chem. J. 17, 1895, 18—26.

This is a continuation of an earlier paper published by the author conjointly with Freer (this Journal, 12, 1893, 601), in which nitric acid of sp. gr. 1·4 and copper, were employed, and nitrogen dioxide was practically the only reduction-product. With lead, no acid stronger than that having sp. gr. 1·35 could be used, by reason of the sparing solubility of the lead nitrate in the menstruum, and the consequent formation of a protective film. The results of the work indicate that nitric acid of sp. gr. 1·30 or higher, when reduced by copper, yields only nitrogen trioxide and dioxide, the trioxide increasing and the dioxide diminishing rapidly with increasing dilution of the acid. Nitric oxide is a product of the decomposition of nitrogen trioxide and dioxide when the sp. gr. of the acid employed is 1·25 or more; whilst if the acid has a sp. gr. below 1·25, the trioxide is the only source of the monoxide. Lead reacts much more readily than copper, and produces, with acids of equal strength, relatively much more nitrous oxide and less of the higher oxides of nitrogen. With copper, no nitrous oxide is produced when the sp. gr. of the acid exceeds 1·15. The effect of varying temperature, *ceteris paribus*, appears to be but slight. The author is of opinion that the results of his work favour a theory of direct de-oxidation rather than one which presupposes the presence of nascent hydrogen. In a table of curves given, the percentages of the copper dissolved, which are equivalent to the proportion of each of the oxides of nitrogen produced, is shown for all strengths of acid up to 1·4 sp. gr.—W. G. M.

### *Manufacture of Tin Plate in Austria.* M. Judd. U.S.A. Consular Report. September, 1894.

White iron, alone or mixed with a little grey, is treated in the puddling-furnace or refinery at a cost of from 2·7 to 3·7 dols. per 100 kilos. After shingling, the blooms are rolled into plates 19·7 ins. long and 0·98 in. thick, which are piled and re-rolled for the better qualities. After cutting into lengths, the plates are re-heated on the hearth of the mill-furnace, each stack being covered with a defective plate for protection; under these circumstances there is a loss of from 0·5 to 1·0 per cent. if the temperature do not exceed a red heat. After re-rolling, doubling, re-heating, re-rolling, and re-cutting several times, until the desired dimensions have been attained, the plates are pickled, either in warm hydrochloric acid or in sulphuric acid, at 70° C. (steam-heated). They should be dipped in cradles containing from 60 to 240 plates, which are separated from one another by copper wires to facilitate the cleansing. The iron loses about 3 per cent. by weight; and, at most, 13 lb. of hydrochloric or 7 lb. of sulphuric acid should be used per 100 lb. of plates. About 10 tons of plates, of from 0·013 to 0·055 in. in thickness, can be put through the pickling process in 12 hours by two men and four boys. After thorough washing in running water, which may sometimes contain a little alkali, the plates are re-heated (at a red heat) in air-tight iron boxes for from 8 to 12 hours, at an expenditure of from 30 to 40 lb. of coal per 100 lb. of plate, and with a waste of 3 to 6 per cent. on iron, or of 1 to 1½ per cent. on steel plates. The annealing boxes last about a year if made of steel, or three months if of iron. The subsequent pickling is conducted in sulphuric acid of 5° to 8° at 70° C. After scouring, the plates are tinned by passing through five kettles containing, successively, melted tallow or palm oil, tin, tin at a lower temperature (brushing kettle), pure tin covered with palm oil, and fat at 250° to 300° C. In the last kettle are placed the rollers which give the surface to the plates; a five-roller machine for tin plate requiring a 2 h.-p. engine, and for terne or zinc plates (in which greater pressure is used), a 4 h.-p. engine. The plates are then thoroughly cleansed and polished at a temperature above the solidifying point of the fat. Three or four polishing hands (girls) and a like number of men are employed to each series of kettles. When a fine polish is required, the plates are passed finally through dry rollers. Even with the aid of the protective tariff of 4·96 florins per 100 kilos. of thick or 6 florins for thinner plates, and 8 florins for tinned plates, the manufacturer cannot compete with his English rivals. But the industry has extended somewhat since the introduction of ingot-iron plates. The Austrian plate has a heavier coating of tin than the English, but is less brilliant, because it is not polished so highly prior to tinning. The cost of producing 100 kilos. of tin-plate, excluding the iron employed, is approximately as follows :—

| | Florins. | |
|---|---|---|
| *Rolling :—* | | |
| 150 kilos. coal | 0·86 | |
| Fat | 0·24 | |
| Labour | 1·02 | |
| | | 2·12 |
| *Cleaning and Heating :—* | | |
| Coal, $H_2SO_4$, fat, depreciation, &c. | 1·27 | |
| Labour | 0·36 | |
| | | 1·63 |
| *Tinning :—* | | |
| Fat | 0·60 | |
| Coal | 0·11 | |
| Sulphuric acid, oil, &c. | 0·17 | |
| Wooden box | 0·76 | |
| Tin | 6·00 | |
| | | 7·64 |
| Total | | 11·39 |

—W. G. M.

### *Action of Alkaline Sulphides in Cyanide Solutions.* Eng. and Mining J. 59, 1895, 510.

At a meeting of the Johannesburg, South Africa, Chemical and Metallurgical Society, Loevy described some recent experiments with cyanides containing alkaline sulphides. He is of opinion that a small proportion of such sulphides has no influence upon the gold-dissolving power of the cyanide, but that higher percentages may have a markedly bad influence. Crosse reported a case in which tailings, containing 3 dwt. 20 grs. of gold per ton, yielded 71·2 per cent. of the gold to a 3 per cent. solution of pure cyanide in 46 hours; and 63·6 per cent. to the same cyanide solution with four drops of ammonium sulphide added; whilst it gave 65·1 per cent. with the solutions in actual use at the mine. Complete aëration of the solution was always necessary in cyaniding; and he believed that the influence of the sulphides was greatest when oxygenation was lowest, as, for example, in the case of solutions that had just passed the zinc boxes. Small percentages of alkaline sulphides appeared to be non-prejudicial when thorough aëration was ensured.—W. G. M.

### *A Bromo-Cyanide Process for Gold Extraction.* C. A. Mulholland. Eng. and Mining J. 59, 1895, 510. From the Australian Mining Standard, April 13, 1895.

If a gold leaf be placed in a flask containing two or three ounces of water and a few grains of dissolved potassium cyanide, and a portion of the air be displaced by bromine vapour, the metal will be rapidly dissolved on shaking. Apparently the bromine displaces cyanogen, which, in the nascent condition, readily attacks the gold, whilst potassium bromate is formed, the following equation being provisionally suggested as expressing the reaction—

$$4Au + 8KCy + 2Br + O_7 + H_2O =$$
$$4KAuCy_2 + 2KBrO_3 + 2KOH.$$

With an excess of bromine, potassium bromide and hydrocyanic acid are formed; but the loss of acid may be prevented by the addition of alkaline hydrates. The quantity of the cyanide required is less than in the ordinary process, the action is more rapid, and the recovery of gold more complete. The reagents should be added in the correct proportion, calculated after carefully assaying the ore. In use, the fine ore may be kept agitated, the requisite amount of bromine being admitted intermittently; or the solution may be caused to percolate through the ore in presence of bromine vapour; or air and bromine together may be blown through the ore in the leaching solution. The bromine may be recovered by concentrating the solution after it has passed the zinc-boxes, and treating it with hydrochloric acid, the evolved bromine being condensed.—W. G. M.

### *Condition of Silicon in Cast-Iron.* Eng. and Mining J. 59, 1895, 458.

Referring to Hogg's paper on this subject, read before the Newcastle Section of this Society. (This Journal, 1895, 245.) On this subject, experiments are quoted supporting the view that, while *graphitoidal* silicon has never yet been found, the silicon may possibly exist in two forms corresponding with those of carbon in quenched and annealed steel respectively. A piece of good, open-grained pig-iron (high class 1 X) was re-melted several times in succession in a plumbago crucible, and cast in a fine sand mould, fair samples from each running being analysed. By Drown's method, a silicon determination showed a slight loss each time; whilst a determination by combustion in dry chlorine showed a rapidly increasing loss of silicon; so that after each re-melting there was a greater discrepancy between the two sets of determinations. This may indicate that the silicon can exist in two forms, and that it may pass from one into the other by repeated re-meltings. After each fusion the iron was less fluid, and the pig produced showed more blow-holes, whilst the grain became somewhat finer, until at the fifth melt there was a trace of chilling. The colour only became perceptibly lighter after the third fusion. From the first there was a gradual change of graphitic to combined carbon, and a very slight decrease of the phosphorus and increase of the sulphur percentages, which were very low throughout.—W. G. M.

### *"Flouring" and "Sickening" of Mercury.* T. A. Rickard. Eng. and Mining J. 59, 1895, 460—461.

The terms "flouring" and "sickening," as applied to mercury, are often wrongly regarded as synonymous. The flouring is a purely mechanical effect, caused by the cutting up of the mercury into microscopic globules, through excessive agitation under the stamps, or by sharp grains of ore. It may also be produced, during barrel amalgamation, by the use of too large a proportion of iron, or by a too rapid rotation; and again, it militates against the success of those amalgamators in which the ore is either passed through liquid, or mixed with sprayed or agitated mercury. Amalgamation may be more perfect after flouring, but the quicksilver is with difficulty reunited. Sickening follows, and causes further flouring; it is due to the formation of a film upon each globule, which prevents reunion. The film may be of mechanical origin—as of grease or ore oxides; or it may be due to chemical action upon the mercury. In the latter case the use of nascent hydrogen (by sodium amalgam or electrolysis) may be remedial. When the sickening has been due to grease, as in one instance quoted, through the use of condenser water in the stamps, the addition of lime may neutralise its effects. —W. G. M.

## PATENTS.

*Improved Method of Utilising the Waste Gases from Iron-smelting Blast-Furnaces.* B. H. Thwaite, London. Eng. Pat. 8670, May 2, 1894.

The inventor proposes to employ the above-mentioned waste gases, after they have been subjected to a process of purification, for generating power direct, in gas engines and other "internal-combustion thermo-dynamic motors."

The process of purification consists in causing the effluent gases of the blast-furnace to pass successively through four towers. In the interior of the first two of these are arranged the mains carrying the air to the tuyères; the third is filled with coke, down which water trickles; and the fourth, which is much smaller than the others, contains a vertical partition, constructed of asbestos cloth, wire gauze, &c. Much of the suspended solid matter is deposited in the first tower, and subsides into a water-seal arranged at its base; tarry matters, &c., are caught by the coke tower, while any very finely divided matters, which may have escaped removal in the other towers, are caught by the fine screen in the last.

In the arrangement of plant described, the waste gases are cooled in towers 1 and 2, while heating the air supply to the blast-furnace; but, in an alternative arrangement, the inventor cools the waste gases by passing them through an ordinary air-cooled condenser, before leading them to the coke tower.

The movement of the gaseous current is accelerated by means of a high-pressure fan, situate between the second and third towers.—E. R. B.

*An Improved Process and Apparatus for the Manufacture of Zinc Oxides, Sulphates, and Sulphides from Zinc Ashes, Zinc Blende, Carbonate of Zinc, and other Ores of a Complex Nature, such as Ores containing Lead, Zinc, Silver, Copper, Manganese, Iron, or other Metals in Combination.* A. Crossley, Pontypool. Eng. Pat. 11,233, June 9, 1894.

To recover zinc from a complex ore it is roasted, if necessary, to convert the sulphides into oxides, and is then heated with sulphuric acid. The liquor is filtered from the insoluble lead sulphate, gold, and silver, and is treated with an alkaline sulphide or sulphuretted hydrogen, by which the copper is precipitated. The solution is neutralised with ammonia and chlorine gas, passed into it to oxidise the manganese and iron, after which ammonia in excess is added and the manganic oxide and ferric hydrate filtered off. The solution is partly distilled to recover the ammonia, when zinc oxide is precipitated. This is then washed, dried, and heated, for use as a pigment. Sulphide or sulphate of zinc may be obtained by slightly altering the above process, and the other metals may be recovered by any convenient method.—A. W.

*Process for Treating Sulphurous Zinc Ores in Blast-Furnaces by the Addition of Ferriferous Substances.* R. Biewend, Clausthal, Germany. Eng. Pat. 15,761, August 18, 1894.

The object is to completely extract zinc from its ores in the blast furnace without a preliminary roasting, and the process is based on the fact that at a high temperature iron decomposes zinc sulphide, forming iron sulphide and zinc. When metallic iron is used the operation is simple, but when ferric oxide is employed to produce the iron *in situ* it is necessary to take precautions to prevent the zinc vapours becoming oxidised by the carbon dioxide or by the ferric oxide. The furnace gases therefore must be freed from carbon dioxide, and the ferric oxide thoroughly reduced before it is allowed to come into contact with the zinc vapours. For this purpose a specially constructed blast-furnace is employed. It has an extra set of tuyères at the top of the furnace near the charging hopper, and the gases and zinc vapours are led off, to suitable condensers, by means of passages placed at about one-third of the height of the furnace, instead of at or near the top.

By this arrangement the ferric oxide is reduced in the upper portion of the furnace, and the carbon dioxide thereby formed is forced downwards through incandescent heat or fuel to the outlet passages, where as carbon monoxide it meets the zinc vapours coming up from the reaction between the zinc sulphide and iron in the lower portion of the furnace. The zinc is suitably condensed in chambers, and the waste gases, consisting of carbon monoxide and nitrogen, are utilised for heating the blast.—A. W.

*Process of and Apparatus for Treating and Desulphurising Ores.* J. Y. Johnson, London. From L. Pelatan, Paris, and F. Clerici, Milan. Eng. Pat. 1514, January 22, 1895.

The furnace consists of a series of soles, trays, or beds placed horizontally one above the other in a fire-brick chamber, so that a current of air entering at the base will travel from one end to the other across each bed before it reaches the exit at the top. The beds can be removed if necessary alternately from opposite ends of the furnace. On each bed is a hanging rake, by which the ore can be raked off one bed on to the one next beneath it. At the base of the furnace is a fire-grate, so that the sulphide ore entering at the top and being raked down from bed to bed is roasted in stages of increasing temperature, and finally strongly heated and completely desulphurised on the lowest bed. Seven beds in each chamber is a convenient number, and the centre one may be temporarily carried right along from end to end of the chamber and the fuel gases led off by a side outlet, thus leaving the roasting of the new ore on the upper beds to continue by the heat of its own combustion. The completely roasted ore is discharged below and passed by spiral carriers into vats, where it is subjected to the action of chlorine water to dissolve the gold. After filtration the gold is precipitated by small pieces of aluminium or zinc.—A. W.

*Method or Process of Reducing Metals or Mixtures of Metals containing Oxygen.* A. Reichwald, London. From F. Krupp, Essen, Germany. Eng. Pat. 6323, March 27, 1895.

The object is to remove oxygen in a simple manner and render it innocuous in the casting of metals or alloys. This oxygen combines unless prevented, with the carbon of the cast metal to form CO, so that blow holes are liable to be formed.

To prevent the blow-holes in steel castings, aluminium has been employed, thereby producing a solid oxide. This oxide is stated to remain in the metal as an impurity. To remove it and produce a perfect casting there is introduced with the aluminium an element, such as silicon or boron, which will also reduce the iron oxide, producing an acid which will then combine with the alumina to produce a slag that will rise quickly to the surface of the molten metal.

To increase the fusibility of the slag it is advisable to introduce two metals, so as to produce a double silicate, and the mixture that is recommended consists of an alloy of aluminium with manganese and silicon, the last two elements being obtainable in the form of ferro-manganese. —A. W.

*Improvements in the Manufacture of Alloys of Iron or Steel with Nickel.* J. Johnson, Liverpool. From N. McConnell, Munhall, U.S.A. Eng. Pat. 7575, April 16, 1895.

Instead of adding metallic nickel or an alloy to the iron, the nickel is produced *in situ* by the introduction of oxide or oxide ore, mixed with coke dust, to the metal in the furnace. The mixture may be either wet or dry, and to prevent loss by furnace currents it is mixed with about its own weight of metallic borings or turnings, preferably of iron or steel, to give it weight. The mixture is laid on the heated hearth of the furnace, and the solid metal or steel placed upon it. The whole is then melted, and the nickel steel or alloy thereby produced.—A. W.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*Expenditure of Electromotive Force in Electro-Chemical Processes.* F. Quincke. Zeits. d. Vereines deutscher Ingenieure, **39**, 1—6.

A concise explanation is given of the units used in electrical measurement and of the theoretical method of calculating (from known heats of combination) the electromotive force required for the electrolysis of a given compound. Unfortunately the electromotive force thus deduced is very different from that found necessary in practice. The latter is affected by changes in concentration and temperature, and by secondary reactions. These changes cannot be satisfactorily allowed for, even by using the corrected formulæ introduced by Helmholtz, Gibbs, and, more recently, by Nernst. Consider, for instance, the electro-deposition of copper. When this takes place between copper electrodes in copper sulphate, the conditions are ideally simple. The amount of copper deposited on the cathode is equal to that removed from the anode; there is practically no energy lost in overcoming the electromotive force of polarisation. But as soon as we turn to the application of this in extracting copper electrolytically, we find that complications arise. The raw material contains, say, 15 per cent. of copper; it may also contain iron, which will go into solution; it may be partially decomposed, so that sulphuric acid and oxygen are produced. The current may not extract copper from the anode as rapidly as it deposits copper on the cathode; any oxidisable salts exisiting in the solution may be attacked, *e.g.*, $FeSO_4$ may be converted into $Fe_2(SO_4)_3$. Sulphuric acid present in the solution is decomposed, and large quantities of oxygen are liberated at the anode, and of hydrogen at the cathode. All these represent uncompensated losses. Even in the electrolysis of copper sulphate between copper electrodes, Oettel has shown that as much as 20 per cent. of the current may be spent in producing persulphuric acid.

The weak point in almost every electrolytic process at present employed is loss of energy in the evolution of hydrogen. Take, for instance, two processes which admit of easy comparison, viz., the production of chlorine by the electrolysis of hydrochloric acid, and the decomposition of hydrochloric acid by air, aided by the contact-action of copper. In the electrolytic process we have—

$$2H \mid Cl = 78 \text{ calories for 70 kilos. of Cl.}$$

(The calorie here used is equal to a million gramme-calories.) As the hydrogen goes to waste, only 50 per cent. of the electrical energy is used. Only 12 per cent. at most of the energy of the coal is converted into electrical energy, so that under the best conditions only 6 per cent. of it goes to produce chlorine. Hence, in order to get 70 kilos. of chlorine, we must use 100 × 78.6 = 1,300 cal. In the case of Deacon's process we have—

$$2H \mid Cl = 78 \text{ cal. lost,}$$
$$H_2 \mid O = 58 \text{ ,, gained,}$$

leaving 20 cals. to be supplied. Now it is found that 40 kilos. of coal are required per 100 kilos. of chlorine, *i.e.*, 28 for 70. If we take the average calorimetric value of the coal as 7 cal. per kilo., this gives 7 × 28 = 196 cal. for 70 kilos. of chlorine. In other words, the process requires less than 200 kilos. where the electrolytic process requires 1,300, or 6½ times as much. A great saving would be effected if the hydrogen evolved could be made to combine with oxygen so as to produce electric currents, decompose chemical products, and produce heat and light. As long ago as 1839 Grove, by the invention of his gas-battery, showed how this problem could be attacked; but it practically remains unsolved to this day as far as technical applications are concerned. The nearest approach to a practical gas-battery is the form introduced by Mond and Langer (Proc. Roy. Soc. **46**, 2961, 1889. This Journal, 1889, 550); but even this, the author states, has been found to get out of order, and to require greater skill than can be expected from workmen. The author looks forward to the invention of a practical gas-battery, fed with air and producer-gas, as an event of great importance.—D. E. J.

*A New Electro-Chemical Gold-extracting Process.* Dr. Gaze. Eng. and Min. J. **59**, 1895, 442.

The author makes use of "chloride of bromine" as a solvent for the gold, precipitating the metal by electrolysis, and recovering the chlorine and bromine by means of caustic soda. The solvent is made in vessels 3 ft. in diameter and 2 ft. deep, in which are placed a number of porous cells containing water. The containing vessel is filled with a solution of chloride and bromide of sodium, and in this, as well as in each porous cell, are immersed a number of carbon rods. The whole is fitted with a lid, and the one set of carbons connected with one pole of a dynamo and the other set with the other pole. The salts are decomposed by a strong electric current, the chlorine and bromine unite and form chloride of bromine, which is then forced up into a vessel above. Thence it is run on to the crushed ore in a vat which can be made air-tight, air is forced in, up to a pressure of 50 lb. per sq. in., and the whole is left for two hours, in which time all the gold becomes dissolved. The solution is filtered off and again used with fresh ore, until it becomes either rich in gold or weak in solvent power, when it is electrolytically decomposed into gold and "chloro-bromic acid." The solvent seems to split up by use as the solution becomes charged with hydrochloric and hydrobromic acids. These acids are neutralised with caustic soda, producing the original salts which are again used for producing the solvent.—A. W.

### PATENTS.

*Improvements in and connected with Electrolysis, and in Apparatus connected thereto.* E. Gautier, Paris, France. Eng. Pat. 10,032, May 23, 1894.

The improvement consists in providing means for cooling the electrodes, so that the temperature of the cell may be kept down to that of the best working conditions. This is perfectly effected by causing the liquid to be electrolysed to pass through pipes contained in the positive electrode, while the negative electrode is caused to revolve, and is cooled by the circulation of water through it.—G. H. R.

*An Improved Melting and Reducing Furnace.* R. Urbanitzky, Linz-on-the-Danube, Austro-Hungary. Eng. Pat. 7265, April 9, 1895.

The furnace consists of a short hollow shaft or circular chamber made of refractory basic material and provided with a lid through which passes the positive carbon electrode. The base of the chamber consists of a carbon block, which forms the negative electrode. The lid is carried on a vertical revolving tube and is supported near the edge by balls running in a circular groove, so that it will revolve when a stirring or rocking motion is imparted to the bath by moving the positive electrodes. The ore, such as alumina, for instance, is introduced through the tube, which latter also serves as an exit for the gases produced by the action of the electric current. Wherever possible the various parts are made hollow and kept cool by currents of water.—A. W.

*Improved Construction of Electrical Accumulators.* G. De Schrynmakers de Dormael, Brussels, Belgium. Eng. Pat. 7795, April 18, 1895.

According to this improvement the peroxide which surrounds the positive electrode is in direct contact with the negative plates which support it on either side; or the peroxide may be enclosed in a perforated leaden sheath. —G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Basswood Oil.* F. G. Wiechmann. Amer. Chem. J. 17, 305—308.

Two samples of basswood (*Tilia Americana*) from Saginaw, Michigan, were examined. No. 1 was sound wood; No. 2, which had been kept lying in water for a long time, had a peculiar stained appearance and a very strong odour like rancid butter. The oil was extracted by means of ether from raspings of the wood placed in a Soxhlet's tube, and in the case of No. 2 care was taken to obtain the raspings chiefly from the "stained" portions of the wood. The following results were obtained:—

| — | No. 1. | No. 2. |
|---|---|---|
| Yield, per cent. of wood powder .. | 5·24 | 3·72<br>3·70<br>3·68 |
| Sp. gr. of the oil at $\frac{15^\circ}{15^\circ}$ C. ........ | 0·938 | .. |
| Congealing point................ | − 10° C. | + 5° C. |
| Saponification equivalent......... | 315 | The saponif. eq. could not be determined; it varied from 152 to 77 within a few hours. |
| Iodine value.................... | 111 | 60 |
| Colour.......................... | Olive brown. | Dark brown |
| Heydenreich's reaction........... | Yellow and red-brown. | Yellow and red-brown. |

To ascertain the nature of the change which the oil from No. 2 sample was undergoing, an ether extract of this oil (extracted from 70 grms. of the wood powder) was saponified by potash, 20 hours being allowed for the reaction. Water was then added, the mixture placed in a separating funnel, shaken with ether, and the soap solution and ether solution separated and examined, with the following results:—

| | Grm. | |
|---|---|---|
| In soap solution:— | | |
| Insoluble fatty acids... | 0·1951 | Sp. gr. 0·898.<br>Congealing Pt. +5·5° C.<br>Mean combining weight, 312. |
| Volatile fatty acids .... | 0·1307 | Mean combining weight, 92. |
| Glycerin............... | 0·2235 | |
| In ether solution:— | | |
| Hydrocarbons and unsaponified oil ........ | 0·1616 | Congealing Pt. + 2° C. |

Thus the oil is a glyceride which has suffered partial decomposition, originally induced, most likely, by the presence of mucilaginous or albuminous matter. The volatile fatty acids consisted in great measure of butyric acid and its homologues, &c.—L. A.

*Purification of Oils by Liquid Sulphurous Acid.* M. Villon. L'Industrie. Through Eng. and Mining J. 59, 1895, 539.

The oil is treated with 0·05 to 1·0 per cent. of liquid sulphurous anhydride in a boiler lined with sheet lead, provided with a paddle agitator. The sulphur dioxide, which is introduced in a tube, becomes vaporised at once, and acts upon the albuminous and proteid matters in the oil; the action is stimulated by warming with the aid of a steam-worm, taking care that the pressure in the boiler never exceeds 13·7 lb. per square inch. After cooling, the reaction is continued for some hours, and the oil is then well washed with warm water, and filtered. The resulting oil is clear, slightly yellowish, and very bright; it burns well, without carbonising the wick, and lubricates satisfactorily; it also retains its good qualities for several months. The waste is not great. When the oil is first agitated with zinc chloride in syrupy solution, and then treated as above, even better results are obtained; but the washing must be most carefully effected, because the presence of but a small quantity of zinc chloride in the oil is prejudicial to combustion.—W. G. M.

*Investigation of the Twitchell Method for the Determination of Rosin in Soap.* T. Evans and J. E. Beach. Amer. Chem. J. 17, 1895, 59.

*See under* XXIII., *page* 689.

*Modification of Renard's Method for the Detection of Arachis Oil.* H. Kreis. Chem. Zeit. 19, 451—452.

*See under* XXIII., *page* 688.

### PATENTS.

*Improvements in the Treatment of Cotton-Seed Oil.* F. B. Aspinall, London. Eng. Pat. 11,324, June 11, 1894.

The crude oil is heated in a capacious tank to about 80° F., and then agitated whilst a solution of common salt of about 10° Tw. is run in, about 80 gallons to a ton of oil. As soon as the oil and salt solution are thoroughly mixed, caustic soda-lye of about 22° Tw., previously warmed to 80° F., is added, until a sample of the mixture spread on a plate looks clear, although full of minute dark spots (a test well known to oil-refiners). The addition of caustic and the agitation are at once stopped, and water warmed to about 110° F. is sprinkled over the mixture. The clean oil will then rise to the top. Sprinkling with water must be continued until the oil is free from clots and any oil entangled in the lower aqueous layer has risen. It is then drawn off, heated to 160° F. to remove water, and finally brightened for market by ordinary means.—L. A.

*Improvements in the Manufacture of Soap.* J. McDonald, Glasgow. From E. J. Pearson, Sydney, New South Wales. Eng. Pat. 11,832, June 19, 1894.

A specification for the production of a soap for cleaning copper, brass, steel, iron, and tinware:—10 per cent. of tallow, 2½ per cent. of caustic soda, and 36 per cent. of water are boiled together; when saponified, 50 per cent. of pumice sand is stirred in, and 1½ per cent. of carbolic acid is then mixed in, and the product is then poured into moulds. —J. J. K.

*Improvements in and relating to the Manufacture of Soap for Laundry and other Purposes.* J. P. F. Field, London. Eng. Pat. 12,072, June 22, 1894.

For an improved soap for laundry purposes, there are added to ordinary soap, in a liquid condition, 15 per cent. of sodium or potassium carbonate, and 10 per cent. of pipe-clay, china clay, clay marl, or fuller's earth, or any mixture of them when these are well mixed, about 5 per cent. of turpentine, benzin, benzolin, paraffin, liquid ammonia or ammonium salts, is thoroughly incorporated therewith. Water is then added, and the soap moulded in the usual way. There is also a claim for the preparation of a saponaceous compound for cleaning and polishing metals, by adding to liquid soap about 15 per cent. of any of the above-named earthy matters, and incorporating with the mixture the same proportion of caustic soda or potash.—J. J. K.

*Soap.* W. Ford and P. Maher, Liverpool. Eng. Pat. 6717, April 2, 1895.

Eucalyptus oil is incorporated with soap, whilst it is in a viscous condition, whereby it is said to acquire antiseptic properties. For toilet soap, six drops of the oil are added to 1 lb. of soap, whilst for household and dry soap, a larger proportion may be used.—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

### PATENTS.

*Improvements in or relating to the Manufacture of White Lead and Salts of Ammonium.* H. Wilcox, Stanford-le-Hope, Essex. Eng. Pat. 13,202, July 7, 1894.

Ammonium sulphate is decomposed by means of chalk, either by boiling the solution in a still, or by heating the dry substances in a retort. The gaseous mixture of ammonia, carbon dioxide, and steam, cooled if necessary, is passed into a solution of normal lead nitrate, when lead carbonate is precipitated and ammonium nitrate remains in solution. The unabsorbed carbon dioxide passes forward through one or more receivers containing a solution of basic lead acetate, lead carbonate being precipitated until the basic acetate has been entirely changed into the normal salt. The precipitate of lead carbonate having been separated from the solutions, the ammonium nitrate is recovered in the usual way, and the solution of normal lead acetate is reconverted into the basic acetate and used over again.

Instead of using a solution of lead nitrate, the ammonia may be absorbed in dilute nitric acid and the whole of the carbon dioxide may be absorbed in a solution of basic lead acetate. Instead of chalk, the carbonates of sodium, potassium, magnesium, barium, or strontium may be used, Also, by substituting other acids for nitric acid, other salts of ammonium may be formed instead of the nitrate.—L. A.

*Improvements relating to Paints suitable for Coating Iron and other Surfaces.* H. and B. Kolker and H. Naphtali, Breslau, Prussia. Eng. Pat. 7366, April 10, 1895.

The tar obtained in the manufacture of oil-gas is subjected to fractional distillation up to the temperature of 250° C. when about 11·35 per cent. will have distilled over. The remaining 88·65 per cent. forms a glossy black mass, having the consistency of honey and a specific gravity greater than that of water. It is dissolved by the aid of heat in about half its weight of volatile hydrocarbons, such as benzene and the like, and a paint is thus obtained which dries very rapidly, adheres well, and does not crack or fall off. It will penetrate through iron rust and prevent further oxidation of the iron. Manganese or lead driers may be added if desired. —L. A.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### PATENTS.

*Improvements in the Manufacture of Artificial Whalebone from Parchmentised Skin.* J. P. O'Donnell, London. From J. A. Schweitzer, Stains, France. Eng. Pat. 13,596, July 14, 1894.

Instead of destroying the nerve of the skin by the usual unhairing processes, the patentee shaves off the hair; he then dips the skin into a bath of potassium bichromate (10 per cent.), stretches it tightly on a frame, and leaves it to dry. It is then dipped into a bath of bisulphite of soda or lime (10 per cent.), again dried, and then cut into strips of imitation whalebone. The immersion in the first bath should last for 15—20 minutes, and in the second for from 48 to 72 hours, until the skins are quite green.—A. G. B.

*A New or Improved Tanning Process.* S. L. Evans, Sittingbourne, Kent. Eng. Pat. 5924, March 21, 1895.

The leather is placed for a short time, say 12—24 hours, after cleansing from lime, &c. in the colouring pits, in a dilute solution of borax or boracic acid. Bacteria, &c., are thus killed, and the action of the solution "upon the comparatively untanned hide is such that it can be introduced into strong liquors much more rapidly than is customary with advantage."—A. G. B.

*Improvements in or relating to the Tanning of Hides or Skins.* F. Prelli and B. Demo, Turin, Italy. Eng. Pat. 6692, April 1, 1895.

The prepared hides are agitated in a rotating drum, or otherwise, with syrupy extract of tannin, such as is obtained in commerce, of a specific gravity of about 20°, 25°, or 30° Beaumé, the proportion of extract used varying with the content of tannin therein. The temperature must not be allowed to rise above 40° C. The duration of the process is from 3 to 30 hours, according to the thickness of the hides. The hides need not be submitted to any plumping process, nor be degreased; indeed, the addition of an emollient substance, such as an oil, fat, solution of soap, &c., is to be recommended.—A. G. B.

## XV.—MANURES, Etc.

### PATENT.

*Improvements in the Preparation of Manures.* D. Blyth, Kilburn. Eng. Pat. 5517, March 16, 1894.

These consist in the addition of 50 to 500 lb. of magnetic oxide of iron, or any substance containing it, in a powdery state, to one ton of artificial or natural manure.—J. J. K.

## XVI.—SUGAR, STARCH, GUM, Etc.

*Decomposition of Beetroots.* Briem. Oesterr. Zeits. Zuckerind. 1895, **24**, 1.

The author communicates the history of different theories of this disease, the causes of which are ascribed to the nature of the soil, the attacks of animals and vegetables, and the infection of the seeds by bacteria. An enumeration follows of the different remedies that have been proposed to combat this disease.—J. L. B.

### *Investigations on Phoma Betæ.* Frank. Zeits. Rübenzuck. Ind. 1895, **45**, 157.

The fungus Phoma Betæ (this Journal, 1894, 264 and 822) appears to occur very frequently in soils reserved for the cultivation of the beetroot. It has practically no effect on the plants if they are properly thinned, and if the season be sufficiently humid. A drought is unfavourable to the so-called core and dry rot, and retards rather than promotes the development of the Phoma. But it does indirectly favour the disease, for the plants commence to droop and the pedicles and leaves are thereby weakened. The roots are thus rendered more susceptible to infection, which, however, results only in parts that are locally damaged. The fungus then confines itself to the living parts, and has a directly poisonous effect, possibly due to an enzyme, which may promote the circulation of the disease by natural means and by inoculation. Moreover, an active inverting enzyme is formed, not necessarily identical with the one above mentioned. The appearance and effect of Phoma Betæ, in addition to its being a constant specific attendant of the core and dry rot, is thus easily explained, as well as the influence of meteorological conditions.—J. L. B.

### *Phoma Betæ.* Frank. Zeits. Zuckerind. 1895, **45**, 271.

The fruit organs of Phoma Betæ, containing upwards of 160,000 spores, cause wide-spread infection of the fields in which this parasite occurs. Under favourable conditions of humidity and temperature the spores remain quiescent until brought in contact with beetroots or their juice. Phoma Betæ has hitherto only been observed on the red and white beet; when taken into the animal system it is destroyed without injury to the latter. It can also be eliminated by souring, or by slicing the roots. Only indirect methods can be employed to render the quiescent spores innocuous, such as the cultivation of beets in climatically favourable (acid humid) situations, where the deeper layers of the soil do not too readily dry up; by the early removal of diseased plants; and by the employment of seeds which have been disinfected with a decoction of lime and copper sulphate (this Journal, 1894, 822).—J. L. B.

### *Electrical Purification of Beetroot Juice.* C. Dammeyer. Elektrochem. Zeits. 1895, **2**, 34.

The author has introduced, with favourable results, electrical defecation of beetroot juice. The average composition of the first products, when obtained by electrical treatment in conjunction with an addition of 2 per cent. of lime, was 89·3 per cent. of sugar, 3·67 per cent. of organic non-sugar, 2·65 per cent. of salts, and 4·98 per cent. of water, whilst a parallel experiment of 14 days' duration, conducted in the same campaign, without electrical defecation, and with addition of 3 per cent. of lime, gave as the corresponding values 86·8 per cent. of sugar, 4·31 per cent. of organic non-sugar, 3·31 per cent. of salts, and 5·58 per cert. of water.

The numbers below, show that the after-products afford a higher yield when submitted to the new process. A indicates the average composition of second and third products, obtained in the usual manner, of the seven campaigns 1887–94; B, of similar products of the campaign 1894–5; and C, of the current campaign employing electrical defecation.

| — | Yield calculated from the Roots. | Polarisation of Sugar. | Ash. | Rendement. |
|---|---|---|---|---|
| A | 1·56 | 91·63 | 2·47 | 79·28 |
| B | 1·62 | 92·30 | 2·15 | 81·55 |
| C | 1·85 | 93·70 | 1·60 | 85·70 |

No inversion of juice is caused by using currents of varying intensity.—J. L. B.

### *Influence of Invert Sugar on the Formation of Colonial Molasses.* Prinsen-Geerligs. Chem. Zeit. Rep. 1895, 150.

The author, by detailed analytical and synthetical experiments, has confirmed the views which he previously put forward (this Journal, 1893, 365), to the effect that the amount of water in cane molasses is more than sufficient to dissolve the quantity of sugar present, and that the excess is concerned in the evolution of soluble compounds of invert sugar and salts, especially of organic salts. Definite states of equilibrium arise between cane sugar, invert sugar, organic salts; but, as these conditions vary considerably with temperature, concentration, &c., their expression by co-efficients of general application is impossible. If, however, the salts are removed by Dubrunfaut's osmose process, this state of equilibrium is changed, and cane sugar can crystallise out. The interaction between cane sugar and inorganic salts is slight, although considerable with organic salts, especially if these are derived from weak acids, or are combined with feeble bases such as ammonia. When solutions of cane sugar and neutral salts are boiled, a partial interchange between the two takes place, accompanied by the liberation of acid and subsequent inversion. Invert sugar and its products of decomposition, the so-called caramels, react more energetically with salts (principally organic) than cane sugar does, with the result that compounds are more quickly formed, and inversion thereby accelerated. The author does not agree with Gunning's theory that all bases present in molasses are necessarily melassigenic, but concludes that this is only the case with such bases as have entered into combination with the sugars. In order to prevent the formation of molasses, apart from physical causes, the quantity of salts in the raw juice should as far as possible be diminished by careful defecation and saturation, by the neutralisation of acids, and the precipitation of calcium salts with phosphoric or sulphurous acid. Calcium salts can be replaced by sodium salts, for the former, though less soluble, cause the syrup to become thick and slimy, and small impure crystals of sugar to separate.—J. L. B.

### *The Sugar of the Agave Americana.* W. E. Stone and D. Lotz. Amer. Chem. J. 1895, **17**, 368—371.

The sugar of the *Agave Americana* was investigated by G. Michaud and J. F. Tristan (this Journal, 1893, 940), who assigned to it the formula $C_{12}H_{22}O_{11}$. They also proposed the name *Agavose* for this sugar, the properties which they found it to possess differing from those of all other members of this group. The present authors point out that the properties assigned to agavose—with the exception of its optical inactivity—closely resemble those of sucrose. They have accordingly submitted the juice of the agave plant to a careful examination, and they find that the crystallisable sugar present is identical in its properties with sucrose. The uncrystallisable syrup from which the sucrose was separated contained invert sugar, and the presence of this in Michaud and Tristan's product would possibly explain the results which they obtained. (See also this Journal, 1894, 802.)—A. K. M.

### *The Carbohydrates of the Gum of Acacia Decurrens.* W. E. Stone. Amer. Chem. J. 1895, **17**, 196—199.

The author finds that the gum of *Acacia decurrens* does not essentially differ from gum-arabic, peach gum, or cherry gum, and that it affords another example of the occurrence of a galacto-araban complex. The gum is very hard and brittle, and in the form of transparent, amber-coloured masses; it dissolves slowly in cold water, more readily in a solution of caustic soda. Its aqueous solution has a slight acid reaction and a distinct levorotatory action on polarised light.

On distilling the gum with hydrochloric acid, it yielded 25·42 per cent. of furfurol, and when heated with nitric acid it gave 11·39 per cent. of mucic acid. These results indicate the presence of a complex carbohydrate of the galacto-araban character, and this is further confirmed by the examination of the products of hydrolysis. Thus by the action of dilute sulphuric acid on the gum the author has succeeded in obtaining arabinose and a second substance having a lower specific rotation, and which he believes to be galactose.—A. K. M.

*Gravimetric Estimation of Dextrose, Levulose, and Cane Sugar as Phenylglucosazone.* C. J. Lintner and E. Kröber. Zeits. Ges. Brauw. 1895, **18**, 153.

*See under* XXIII., *page* 690.

*Copper Cyanide Reaction for the Estimation of Glucose.* A. W. Gerrard. Pharm. J. and Trans. 1895, **25**, 913.

*See under* XXIII., *page* 690.

*Analysis of Sugar Ash.* F. G. Wiechmann. School of Mines Quarterly, 1895, **16** [2], 123.

*See under* XXIII., *page* 689.

### PATENT.

*Improvements in the Method of Purifying and Decolorising Saccharine, Amylaceous, and other Fluid Bodies.* David Blyth, Kilburn, Middlesex. Eng. Pat. 5518, March 16, 1894.

The liquid to be purified is filtered through a bed of magnetic oxide of iron supported on an impervious bottom, the passage of the filtered liquid taking place through holes in the bottom in which regulators are fixed. These regulators have covers made of compressed coke, or other conducting material, and are connected by insulated wires to a source of electricity with the object of causing electric currents to flow through the filter bed. Oxygen gas may also be forced into the filter bed.—L. A.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Influence of Water used in Brewing upon the Colour of Beer, and a simple Means of indicating the same.* F. Mierau. Wochenschr. f. Brauerei, **12** [18], 407—409.

After mentioning as an established fact of brewing practice, that waters containing in solution calcium bicarbonate never produce a light straw-coloured beer, whereas waters containing calcium sulphate are especially suited for such purpose, the author attempts to determine at what stage and under what conditions this behaviour is manifested, whether chiefly in the mash-tun or only in the copper. His test consists simply in boiling together, under identical conditions, hops and waters containing the various saline constituents of natural and artificial supplies; the decoctions are then compared for degree of colour and brilliancy after short and prolonged standing, and deductions drawn from changes in both conditions.

When a chalk water was compared in this way with distilled water, the latter was always found to give a paler and more brilliant decoction; and further, when a pale malt was mashed according to the infusion process with the same two waters, no marked difference of colour between the worts was perceptible, but when boiled for the same length of time with equal weights of the same hops, a considerable increase of colour was shown by the chalk-water wort over that made with distilled water; experiments on the large scale confirmed this.

Gypseous waters are known to yield pale beers and to debar the extraction of harsh rank-flavoured constituents from the hops, and when gypsum is present together with bicarbonate of lime, brighter and much paler worts result than from the water containing bicarbonate alone, so that water supplies containing calcium sulphate, whether natural or artificial, may contain considerable amounts of chalk, without high-coloured worts resulting.—G. W. A. T.

*The Difference between Mealy and Hard Malt Corns.* Wochenschr. f. Brauerei, 1895, **12**, 23.

Prior has communicated to the Bayr. Brauer Journal the results of experiments upon malts containing white, vitreous corns, which vitreous condition was not produced during kilning, but rather by incomplete modification of the corns upon the malting-floor.

The vitreous and mealy corns were separately mashed, and the worts obtained then analysed. The following are the main points deduced from the experiments:

The percentage of water was identical in both mealy and vitreous corns. The extract yielded was much greater from the mealy than from the vitreous corns, whilst the reducing sugars contained in the former were about 1 per cent. greater, and the cane sugar about 0·5 per cent. greater than in the latter. The fermentability was equal in both cases, but they were not strictly comparable, because of the presence of brown (caramelised) corns in the mealy corns, these lowering the fermentability. The total nitrogen was the same in each case, and although 0·54 per cent. more nitrogen was dissolved from the mealy than from the vitreous corns, the precipitates obtained on boiling their worts were equally rich in nitrogen. The mealy corns were completely saccharified in 15 minutes, whereas the vitreous ones were not saccharified after 60 minutes. The wort from the mealy corns also gave a better "break" than that from the vitreous corns.—T. A. G.

*Evenness of Temperature in Bulks of Stored Malt.* Wochenschr. f. Brauerei, 1895, **12**, 92—93.

At the last General Meeting of the Munich Research Station, it was pointed out by Brand that malt should never be stored whilst warm, but should be allowed to cool before being heaped up into bulk. The reason for this is, that a rancid taste is acquired, owing to self-heating of the malt, which, under certain conditions, may be so great as to cause ignition. The self-heating is really a maturing or oxidation process, in which oxygen is inspired by the malt, and carbonic anhydride respired, the rancid flavour produced being attributable to chemical changes thus brought about in the fatty constituents.

It is pointed out by Delbrück that not only carbonic anhydride, but also water, is respired, and that both a heap of barley and a heap of malt become damp when heating sets in. The water so produced naturally tends to travel from the warmer to the colder portions of the heap, so that portions quite out of contact with the air may increase their percentage of moisture.

Owing to the dryness of malt, and its consequent hygroscopicity, it does not "sweat" like stored barley, although in extreme cases, where malt has been stored very warm, the outside and cooler portions acquire so large a proportion of moisture that fungoid growths take place, and produce objectionable features of taste and smell. When, for any reason, the malt cannot be allowed to cool previous to storing, an endeavour should be made to so arrange matters that the temperature of a heap is maintained as regular as possible throughout.—T. A. G.

*The Sulphuring of Hops as a Means of Improving them.* F. Schönfeld, Wochenschr. f. Brauerei, 1895, **12**, 290—291.

A description is given of the kiln used for sulphuring hops, which is to all intents and purposes on the same principle as an ordinary malt kiln, and is provided with a stove for burning wood, upon which finely-powdered sulphur is sprinkled. The sulphurous fumes pass up through a shaft towards the wire floor carrying the hops to be sulphured, and being distributed by means of a suspended leaden plate, the fumes find their way through the hops, and so escape. The amount of sulphur to be used is determined readily by experience, and depends upon the appearance of the hops, their colour, age, &c. The author claims that sulphuring improves the appearance and aroma of damaged and discoloured hops, whilst the keeping properties are enhanced after such treatment. It is, of course, advisable to sulphur hops as soon after harvesting as possible, to arrest any formation of mould-growths, &c. at the outset. Hops should be purchased new, and immediately sent to the kiln to be sulphured.—T. A. G.

### *The Natural Pure Culture of Yeast.* M. Delbrück.

Zeits. für Spiritusind. **18**, 1895, 117 *et seq.*

The three essential points of Pasteur's aseptic method of pure fermentation and of Hansen's development of it—single cell cultures—are :—

1. The employment of a yeast of single species, and one free from fission fungi.
2. A sterile fermentable medium.
3. The prevention of contamination from external sources.

Strict adherence to these points would necessitate fermentation taking place in hermetically closed vessels, supplied with filtered air, which would entirely alter the system of brewing, or it would necessitate the frequent replacement of the infected yeast by a fresh pure culture.

The methods of treating yeast, employed by brewers and distillers, constitute a preferable and a "natural" system of pure yeast culture, compared with which the single cell method may be termed an "artificial" pure culture system.

In Germany "artificial" pure cultures are largely employed in breweries and in distilleries, whilst in the United States of America many brewers use the same yeast for six years or more without a change, and distillers, when anything goes amiss with their yeast, expose a suitably prepared mash to infection from the wild yeasts of the air and cultivate from this.

The author gives a list of the conditions of natural pure yeast culture, and also one of the chief racial characteristics of yeasts.

The simplest method of natural pure culture is that employed in distilleries, viz., the preparation of a mash of malt and rye, maize or potatoes, at a temperature of 147° F., which is then allowed to cool slowly to 117° F., whereby development of the lactic acid ferments is encouraged. When the quantity of this acid amounts to one per cent. the temperature is raised to check further production. After cooling again to 66° F., pressed baker's yeast is added at the rate of 1 kilo. per 100 litres. Fermentation proceeds for 20 hours, producing an apparent attenuation of 80 per cent., and a rise in temperature from 66°—88° F. Two-thirds of the still fermenting wort are then used to pitch an actual mash, whilst the other third is cultivated again in the manner just described. After about six cultivations the yeast attains its full vigour owing to the elimination of the fission fungi and weak yeasts of the baker's yeast. The conditions which aid in effecting this result are the nature of the mash, the absence of æration, the presence of lactic acid (which retards the growth of brewer's yeasts and bacteria), the high temperature of the fermentation, and the high percentage of alcohol present. From a mixture of a distillery yeast and a Frohberg yeast treated in this way, the Frohberg yeast was entirely eliminated after the fourth cultivation. The artificial system of culture is still, however, of value to distillers, as it provides them with certainty with a suitable yeast to begin with, but it is useless if not supplemented by the "natural" system.

In the top fermentation system of brewing, the different races of yeast rise to the surface at different times, the less attenuative yeasts ascending first. The removal of these different layers as they are formed, offers but little prevention against infection by moulds and bacteria, for which the employment of large quantities of yeast and the avoidance of a quiescent stage are more effectual.

In the bottom fermentation system, the mode of settling down of the various yeast races affords a means of separation and purification. The low temperature at which fermentation in this system of brewing is usually carried on, favours the development of wild yeasts. A mixture of 90 per cent. of Frohberg and 10 per cent. of wild yeast was allowed to ferment at 57° F. and at 41° F. In the first case after three cultures the wild yeast was entirely eliminated, whilst in the second the wild yeasts increased to 30·7, 37·5, and 59·7 per cent.

Top fermentation yeasts are less exposed to infection by wild yeasts on account of the higher temperatures employed in that system, and the author considers it would be of advantage to conduct fermentation at a higher temperature in the bottom fermentation system.

The first layer deposited after the commencement of the fermentation, consists of dying yeast cells and of cells not suited to the conditions of fermentation, the second layer of the best yeast and the third layer of wild yeasts mixed with the normal yeast.

The fourth portion, consisting chiefly of impurities, is carried with the beer into the storage vat. For pitching purposes the second layer alone is used, the others being discarded, thus constituting a natural system of pure culture.

An ideal method of conducting this process would be to carry on the fermentation in different vessels for intervals corresponding to the deposition of the different layers, and this is practically the American system, in which the fermentation is carried on in a series of four tuns, one above the other, the wort being run from one to the other according to the stage of the fermentation.

*S. apiculatus* and the Saaz and Frohberg yeasts differ in their power of converting certain carbohydrates into available sugars, that is in their content of invertins. The laws of natural pure culture find a ready application here, as the *S. apiculatus* yeasts being able to ferment dextrose only, subside first, and are then followed by the Saaz yeasts, which attack cane sugar and dextrose in addition. The Frohberg yeasts which ferment all but the dextrin subside last of all. Experiments on the differentiation of Saaz and Frohberg yeasts by means of the separation of the layers did not succeed so completely as was expected, although they demonstrated that the Saaz yeasts subside first.

In concluding, the author recommends that instead of rushing to a change of yeast immediately abnormal symptoms occur during fermentation, the brewer will endeavour to bring about such a series of physiological conditions as will be favourable to the development of the good yeasts, and enable them to overcome the wild forms.

—J. G. W.

### *Aluminium Vessels for the Transport of Beer.*

Wochenschr. f. Brauerei, 1895, **12**, 193.

The inventor of iron transport vessels, A. Holle, has recently made experiments upon aluminium as a material for the same purpose. It was found to be quite suitable provided the pressure to be resisted was not too great, and accordingly aluminium cannot be used when pasteurising is necessary. Further, the casks must be well riveted and not merely soldered. For ordinary unpasteurised beer the aluminium casks offer certain advantages. Pitching is not necessary, whilst owing to the light weight of the casks, a very considerable cost in freight is saved ; for instance, whilst an aluminium cask of 25 litres capacity weighs only 4·75 kilos., an iron one of equal capacity weighs about 8 kilos. and a wooden one about 20 kilos. Against these advantages must be placed the high price of aluminium, the high cost of manufacture, and the great care required in cleaning such casks. Greater strength can be secured by using stronger sheets of aluminium or by adding supports, but the cost of manufacture is correspondingly raised to such an extent as to neutralise any advantages attending its use.—T. A. G.

### *A Source of Danger to Beer caused by Careless Pitching of Casks.* E. Greber, Wochenschr. f. Brauerei, 1895, **12**, 27—28.

The author was led to investigate the cause of turbidity and unpleasant flavour possessed by certain returned beer, and eventually traced it to the casks in which the beer was contained. Both new and old casks were at fault, in so far that when taken to pieces blisters were found in the pitch which harboured quantities of mould, yeast, &c. Such blisters are produced when pitching is performed by machinery, which is apt to carry out the processat too low a temperature. No such defects were caused when the casks were pitched by hand, as in the old process.—T. A. G.

### *The Influence of Aëration on Fermentation.* Wochenschr. f. Brauerei, 1895, **12**, 24.

This influence is attributed by Bau to the fact that aëration causes a greater secretion by yeast of the enzyme which inverts maltose. Yeast which had not been aërated was carefully dried at 100° C., finely powdered and again dried for 6 hours at the same temperature. When added to maltose solution hardly a trace of glucose was formed in 24 hours whilst a similar solution with aërated yeast yielded a considerable amount of glucosazone melting at 204° C.
—T. A. G.

### *The Preparation of Saké, Shoyu, and Miso.* O. Kellner. Chem. Zeit. 1895, 97—98; 120—121, and 265.

These are three fermentation products which have been long and extensively manufactured in Japan. Saké is a drink, Shoyu a sauce, and Miso a porridge.

*Saké* is manufactured from well-cleaned rice. Over 58 per cent. of the entire cultivated area of Japan is devoted to the growing of water-rice, and also a portion of the non-irrigated land is devoted to mountain-rice, a variety of water-rice; besides this, another variety of rice is grown, which differs from the rest, in that its starch is pasty, and gives a brownish-red coloration in the iodine; this is, however, no tsuitable for saké-brewing.

The process of saké-brewing may be divided into four parts.

(1.) The preparation of a diastatic ferment. The rice is steamed until it attains the right consistency, the form of the grain being not quite destroyed, nor the starch cells fully burst. It is then spread on straw-mats, and allowed to cool to about 28° C. Spores of a mould (*Aspergillus Oryzae Cohn*), are mixed with the rice, and the mass is placed in a room at about 20° C., and left for 24 hours; during this time the temperature rises to 40° C.; it is then divided into small portions, and piled up in a warm part of the cellar. After 12—24 hours it is well kneaded and allowed to cool, and if necessary sprinkled with cold water, in order to hasten the cooling. In from 3 to $3\frac{1}{2}$ days from the steaming of the grain, the process is completed, and the rice is permeated with a fine mycelium; it is then *koji*. If the koji be allowed to remain longer at a high temperature, brown spores are formed, which may be preserved for a considerable time, and used in subsequent operations. In some factories it is customary to add wood ashes to the steamed rice at the time of sowing the mould. This is no doubt rendered necessary by the well-known deficiency of rice in mineral constituents. In distilleries pearl barley is substituted for rice. During the growth of the mould a large quantity of heat is produced and carbonic acid evolved; this must be accompanied by a loss of raw material. The author found that this loss amounted to from 13—20 per cent. of the dry rice, which chiefly fell on the carbohydrate constituents.

Koji contains a powerful ferment which converts starch into dextrose, and inverts cane sugar and maltose.

(2.) *The preparation of the yeast* is carried on as follows: A quantity of freshly steamed and cooled rice is mixed with koji and water to a thin paste, it is well mixed and placed in shallow tubs; after 24 hours it is kept stirred and at a temperature of 4°—12° C. In time saccharification takes place, and finally a gentle evolution of carbonic acid indicates the commencement of fermentation. The fermenting liquor is then collected in large vessels, when the temperature begins to rise and the yeast to increase; the rise of temperature is accelerated by bamboo tubes filled with hot water. In about 5 days the temperature has risen to 25°—30° C.; the liquor is then cooled by being again distributed amongst the shallow vessels. It is now *moto*; its composition varies exceedingly, the amount of alcohol varying between 3 and 14 per cent.; and it contains a quantity of unaltered starch. This stage occupies about 14 days.

(3.) *The primary fermentation* is effected by mixing a quantity of steamed rice, moto, koji, and water in a large vessel. The temperature rises to 20° C., and a characteristic, arrack-like smell is produced. After three days more moto and koji are added, and the whole is well roused every two hours; more moto and koji are subsequently added, and when the vigorous fermentation which takes place is completed, the saké is ready for the last and final stage of manufacture.

(4.) *The separation of the insoluble residue*, which is effected by filtration through hempen bags, which have been soaked in the juice of the unripe fruit of a kind of date-fig (*Diospyros Kaki*); the residue is pressed in a wooden press. The turbid saké is collected in casks, and falls bright in about 14 days. It is then sometimes sterilised, either by boiling, a method of great antiquity, or in more recent times by the addition of salicylic acid.

The refuse from the presses is sometimes distilled in a current of steam to recover the alcohol, and the residue is used for manure.

The finished saké is of the colour of Rhine wine, it contains 11—14 per cent. of alcohol and 2·5 per cent. of extract; it is drunk hot, and acts vigorously on the consumer. The whole process lasts over a period of seven weeks, but is liable to wide variation, caused by various external circumstances, such as the air-temperature, &c. It is throughout carried on in a most primitive fashion, and is capable of great improvement; the saké brewer is, however, most conservative, and will not use the thermometer. In 1888—89, there were 15,708 breweries, which had an annual output 4 million koku (1 koku = 40 gallons), and the consumption per head of population was $4\frac{1}{2}$ gallons. Each saké brewer has to take out an annual licence and pay a duty of 4 yen per koku.

*Shoyu* or bean-sauce, known also as soja or shoja. The raw materials are wheat, a small light yellow variety of the soja-bean, salt made from sea-water and water. About one quarter of the wheat is ground, steamed, mixed with koji, and put in a warm place. The rest of the wheat is roasted to a light yellow colour and ground in hand mills. The soja-beans are steamed and broken up. These three preparations are then mixed, and worked into small lumps, which are set in a warm room for some days. The mass becomes thus permeated with koji-mould; it is then mixed with salt and water in large fermenting vessels and periodically roused.

Owing to the addition of salt the fermentation proceeds very slowly, however in time the mass becomes liquid, and acquires a red colour and a fine aroma. In from 8 months to 5 years the sauce is ready, when it is separated from the insoluble residue in the same way as saké. To improve the flavour the products of different years are blended.

The finished shoyu has a sp. gr. 1·182—1·193, and contains in 1 litre 287·5—319·2 grms. of dry substance; 136·3—164·7 grms. organic matter; 150·8—154·5 grms. ash; 5·3—6·5 grms. of free acid calculated as acetic acid, and 7·2—14·5 grms. nitrogen. In 1888—89 there were 10,634 makers of this sauce with an annual output of 1·3 million koku, and a consumption per head of population of nearly $1\frac{1}{4}$ gallons.

*Miso* is both manufactured in large bulks in special factories and made at home. It is an important food, especially of the lower classes. The raw materials are 5 parts soja beans, 3—6 parts rice, or barley koji, and $1\frac{1}{2}$—2 parts salt, and 1 part water. The beans are steamed and broken up, mixed with salt and water, and koji added to the cooled mixture. If the miso be required soon, a large quantity of koji is used and the temperature kept up; if it be not required for some time the temperature is kept as low as possible, and less koji used. The finished product forms a stiff, brownish-red porridge; its composition varies greatly, usually containing 50 per cent. of water, 1 per cent. of alcohol, and a trace of free acid. The author considers the amount annually consumed is at least 30 million kilos.

In reply to a query in the Chem. Zeit., the author states that there are 4 well-defined varieties of miso.

1. *Shiro-miso* (white miso), made from large soja-beans, rice-koji, and salt; the mixture is made at 70°—90°; the product is ready for consumption in 3—4 days, and will not keep longer than 10 days.

2. *Yedo-miso* is also prepared from soja-beans, rice-koji, and salt; the mixture is, however, made at 35°—45° C.; the fermentation lasts 10 days in summer, and 1 month in winter. The finished product is reddish-yellow and keeps 4—15 months.

3. *Inaka-miso* (country-miso) made from barley-koji, well-boiled soja-beans, and a quantity of salt; the mixture is made in the cold, and the fermentation lasts 11—12 months, and the product keeps 1 year.

4. *Sendai miso.*—The steamed beans are made into a paste which is formed into prismatic pieces and dried for 1—1½ months. These are then washed with tepid water, rubbed through a fine sieve mixed with barley-koji, salt, and cold-water, and placed in a fermenting vessel. It is well-mixed every two months, and the fermentation takes 1—1½ years. The finished miso is distinguished by its fine aroma, sweet taste, and red colour.

Other special varieties are also made, and in poorer households the residue of the manufacture of shoyu is utilised for this purpose.—A. L. S.

### *The Inversion of Maltose and Isomaltose by Yeast.* Wochenschr. f. Brauerei, 1895, **12**, 23—24.

THAT maltose is converted into glucose by an aqueous solution of yeast has been recently demonstrated by Fischer (Ber. 1894, 2985 and 3479), but the inverting influence of yeast on maltose has been anticipated for some time. In 1892 Bau concluded (Wochenschr. f. Brauerei, 1802, 273) that the addition of yeast or invertin to wort causes an increase of cupric reducing power, not merely by inversion of the cane sugar present, but by acting upon the starch-transformation products. C. J. Lintner has also shown (Zeits. f. d. ges. Brauwesen, 1892, 106) that both maltose and isomaltose are changed into glucose by invertin. He concludes (*Ibid.*, 1892, 414) that the greatest formation of glucose is obtained by the direct addition of powdered yeast; that an aqueous solution of yeast is weaker, and precipitated invertase weakest in this respect. Isomaltose, moreover, is apparently more easily inverted than maltose. Lintner considers this inverting enzyme to be different to ordinary invertin, which is much more soluble. In conclusion, he attributes the presence of glucose in Munich lager beer to the inverting action of yeast on isomaltose during storage.

Changes during storage, due to enzymatic action, have been indicated by Krieger (Amer. Bierbrauer, 1894, 329), by Moritz (Institute of Brewing, 1891, 141), Düll (Chem. Zeit. 1892), and by Amthor (Zeits. f. d. ges. Brauwesen, 1892, 70).—T. A. G.

### *Further Researches on Invertin.* Wochenschr. f. Brauerei, 1895, **12**, 24. (Compare previous abstract.)

BAU has endeavoured to prevent inversion, whilst not quite inhibiting fermentation, by the addition of iodine solution. Bottom yeast, in presence of iodine, produced some fermentation of dextrose, and not of maltose, but this might possibly be due to the greater fermentability of dextrose. Bau considers that the presence of two enzymes has been established in yeast. They both invert cane sugar, whilst the second one ("dextrase"), which has not yet been obtained in a pure state, inverts maltose and isomaltose.

Melitriose, in solution, was converted into levulose and melibiose only at 25° C. in 24 to 72 hours, both by crude and purified invertin, and by bottom yeast. Melibiose remained unchanged.

No proof was obtained that melitriose, in a concentrated solution, yields three monoses, as stated by Scheibler.
—T. A. G.

### *The Preparation of Nuclein.* Wochenschr. f. Brauerei, 1895, **12**, 103.

NUCLEIN is prepared, according to Lasche, as follows:—

Fresh yeast is taken from the fermenting vessel and washed with sterilised, distilled water to remove foreign particles. It is then treated with 10 times its weight of 5 per cent. caustic soda and, after the yeast has been allowed to subside, the clear liquid is decanted and neutralised with hydrochloric acid. Excess of acid must be avoided, and before proceeding further, it is necessary that the liquid should be quite clear. The nuclein is precipitated from the clear liquid by means of 80 per cent. alcohol, and, after it has subsided, the dark coloured liquid is poured off and the precipitate washed with 80 per cent. alcohol until the washings are colourless.

The crude nuclein thus obtained can be used to demonstrate its germicidal properties. It can be purified from peptone and other albuminous bodies as follows:—To each lot of 1,000 grms. of nuclein, is added 1 grm. of antiseptic pepsin and the whole is digested in a ½ per cent. solution of hydrochloric acid at a temperature of 35° C. for about 40 hours, or until the biuret reaction is no longer exhibited. It is important that only sterilised vessels and sterilised water be used. The purified nuclein is then filtered off. It is soluble in alkalis, but precipitated by acids. It does not give the biuret reaction, but yields a precipitate with Millon's reagent. The alcohol used for washing the purified substance should not exceed 70 per cent. strength, or its germicidal properties will be diminished.—T. A. G.

### *Comparison of Steam- and Fire-boiling of Mashes and Worts.* Wochenschr. f. Brauerei, 1895, **12**, 169—170.

A NUMBER of experiments were conducted on the large scale with a view to comparing steam with fire as a means of boiling, and his results have been recently communicated by E. Jalowetz to the Vienna Research Station for Brewing and Malting. He confirms the experience of other investigators to the effect that no difference can be detected in the beers yielded by the two systems.

Exhaustive details are given of the processes employed, together with analyses of the malts, worts, and beers produced. Jalowetz expresses his opinion that steam-boiling, with a good copper, consumes about 20 to 25 per cent. less coal than fire-boiling, or as much as 40 to 45 per cent. when a badly-constructed fire-copper is employed.—T. A. G.

### *The Causes of Starch Turbidity in Beer.* Windisch. Wochenschr. f. Brauerei, 1895, **12**, 168—169.

STARCH turbidity may be due to defective malt, to too rapid mashing, or to overheating of the mash. If care be not taken in mashing a defective malt, the resulting wort may show a red or even violet colour with iodine, although it seldom happens that a malt is so bad as to give the violet reaction. Malt may be scalded by the too rapid introduction of hot water into the mash tun, or the "Dickmaische" may be overheated, so that diastatic action is unduly impeded. The author considers, however, that starch-turbidity is most probably to be attributed to coagulation of the albumin, which mechanically encloses particles of starch. These particles pass into the wort as starch, or in an improperly hydrolysed condition.

Starch turbidity has been observed, however, by the author when perfectly good malts have been used, and this has been traced in some cases to the employment of excessively high temperatures in the mash tun through relying upon inaccurate mash thermometers. Such instruments, which are naturally subjected to constant removal, agitation, and cleansing, are very liable to become erroneous and should therefore be frequently compared with a standard thermometer.—T. A. G.

*The Fermentability of Beers with Saaz and Frohberg Yeasts.* A. Munsche. Wochenschr. f. Brauerei, 1895, **12**, 45—47.

THE paper is mainly a resumé of experiments carried out by various workers upon comparative fermentations with Saaz and Frohberg yeasts. The author calls attention to the following points:—

(1.) It has been proved by Bau that invertin is present in beer (Wochenschr. f. Brauerei, 1892, 193).

(2.) The action of invertin or of other ferments occurring in yeast-extract, upon beer-wort has been established by Bau (*ibid.*, 1892, 273), and by Amthor (Zeitschr. f. d. ges. Brauwesen, 1892, 57), the latter of whom found that invertin slightly increases the cupric-reducing power of old beer, at the same time reducing its optical activity. Also Krieger pointed out (Amerik. Bierbrauer, 1894, Nr. 536) that the cupric-reducing power of lager-beer increases on storage, which fact he attributes to enzymatic action on the carbohydrates present.

(3.) The difference of fermentative attenuation of Saaz and Frohberg yeasts is due to the unfermentability of β-isomaltose (Lintner) by Saaz yeast.

The author concludes that, since maltose is, according to Fischer, inverted before it is fermented, as is also isomaltose, according to Lintner, that the reason why Saaz yeast is unable to ferment β-isomaltose is to be found in a similar direction. In other words, Saaz yeast possesses no inverting action towards the sugar β-isomaltose, whilst Frohberg yeast, on the other hand, both hydrolyses and ferments it.—T. A. G.

*The Vegetative Processes during the Secondary Fermentation of Low-system Beers.* P. Lindner, Wochenschr. f. Brauerei, **12**, 477—480.

BY adopting a simple method of drop-culture the author has overcome the faults and deficiencies of the plate and spore-formation modes of yeast examination (compare Wochenschr. f. Brauerei, **11**, No. 23), and by means of it has made a large number of experiments with material supplied by several mid-German breweries, in most of which apparatus for the pure cultivation of yeast was used, the remainder employing outcrops from the pure supplies of other breweries; in almost every instance two varieties were in use, one of high, the other of low, attenuating power, and were worked separately although the resulting beers might be subsequently blended.

By microscopically examining the several individual drop cultures during varying periods of incubation the ratio between normal and wild types could be readily observed and noted, and also their respective rates of reproduction. Yeasts of the Frohberg, Saaz, and Dortmund species were thus investigated, the beers produced from them comprising characteristic Munich and Pilsen samples, which were tested at ages varying from five days to 10 months. The results convincingly proved that from beer existing at an elevated temperature in presence of much oxygen and with diminished carbonic acid content, yeast may still derive much nutriment, which would, under ordinary trade conditions, be retained for the benefit of the consumer. Also, that the secondary yeasts of the German low-system breweries only begin to exercise their function in bottle. In support of these investigations and conclusions there are also recorded some entirely confirmatory results of work conducted on similar lines by F. Schönfeld, detailed tabular statements being given regarding nine breweries, including their methods of brewing and quality of product, type of yeast used, and rate of attenuation, length of the primary fermentation, the age of each sample when tested, and the ratio between the normal and secondary cells therein.—G. W. A. T.

*The Polarisation and Analysis of Black Beers, Worts, and Caramels.* John Heron. J. Fed. Inst. of Brewing, 1895, **2**, 110.

*See under* XXIII., *page* 691.

*Determination of the Dry Substance in Malt, Wort, and Beer.* H. Elion. J. Fed. Inst. of Brewing, 1895, **1**, 23.

*See under* XXIII., *page* 691.

*Case of Bacterial Infection by Air-sown Organisms.* H. T. Brown and G. H. Morris. J. Fed. Inst. of Brewing. **1**, 14—23.

THE authors have investigated a case in which infection was traced to direct contamination of beer with air-sown organisms. The beer of a certain brewery showed, year by year, an increasing tendency to become ropy, and the organism associated with the disease in this case was not the *Bacillus viscosus* of Van Laer, but a small coccus occurring in the dyad and tetrad form closely resembling *Pediococcus cerevisiæ* as described by Lindner, which, in the opinion of the authors is the more common form of ropy ferment in this country. By a process of elimination the conclusion was arrived at, that the source of infection was outside the brewery. Adjoining the fermenting room were some insanitary premises occupied by a pork butcher, and by means of a careful bacteriological examination, these were proved to be the source of infection.—J. L. B.

*The Nature and Amount of the Acids formed during the Malting of Barley, the Kiln-drying and Mashing of Malt, and the Boiling of Wort.* E. Prior. Wochenschr. f. Brauerei, **12**, 482—483.

THE following conclusions are given as deduced from researches conducted upon two different barleys:—The amounts of total acidity and of the individual acids produced vary in different barleys. Throughout the steeping of the grain and the working of it on the malt-house floors, the general tendency is for the total acidity to more or less increase at varying rates according to the stage of the process, the efficiency of the manipulation, and the regulation of temperature. Also the proportion of fixed and volatile organic acids, and of the normal and acid phosphates vary, following no rule, but depending upon interactions amongst themselves, and with the alkaline carbonates present in the steeping and sprinkling liquors.

At the kiln temperature of 50 R. (144·5° F.), the total acidity proportion is not uniform, the variation being ascribed to the influence of fluctuations of moisture in the grain.

Comparison between the embryo and endosperm shows that the former contains an amount of acids far in excess of the latter; calculating upon the dry substance of green malt, the relative increase of the volatile organic acids is about three times, and the fixed organic acids nearly four times, while the acid phosphates are approximately doubled.

So long as the temperature remains within limits favourable to development of acid ferments, a considerable production of organic acids occurs in the mash tun, which partly combine with lime and magnesia in the water, and partly transform the normal phosphates present into acid salts. Increase of acidity occurs during the decoction stages of wort treatment owing to decompositions between the acid phosphates and the calcium and magnesium salts of the organic acids, and also from attendant concentration of the wort; a further direct contribution coming from the hops during boiling in copper. At certain temperatures a decrease in acidity of the mash is possible, caused partly by reactions between calcium and magnesium phosphates and the free organic acids present, and partly by volatilization of organic acids during decoction.

Acidification does not occur in hopped boiled wort upon the cooler, even during its long detention there under unfavourable conditions.—G. W. A. T.

### *The Action of Ammonia on Dextrose.* W. E. Stone. Amer. Chem. J. 1895, **17**, 191—196.

By the action of ammonia gas on dextrose suspended in anhydrous alcohol, the author has succeeded in obtaining a white crystalline substance to which he assigns the formula $C_6H_{12}O_6NH_3$. The product is apparently stable under ordinary conditions; it has a sweet taste, is readily soluble in water, reduces Fehling solution, and in appearance closely resembles pure anhydrous dextrose. Its solution is alkaline and gives off ammonia when heated with caustic soda. Its specific rotation in aqueous solution is—

$$[\alpha]_D = 22^\circ \text{ to } 22{\cdot}7^\circ;$$

it does not exhibit birotation. It is fermentable, although less readily than dextrose, the presence of the ammonia group appearing to have a hindering action which extends also to the chemical reactions of the substance.—A. K. M.

### *Colouring Matters employed in Brewing.* R. E. Evans. J. Fed. Inst. of Brewing, 1895, **1**, 29—42.

The author discusses the employment and valuation of amber, brown and black malts, and of caramels for the coloration of beers. Caramel is prepared by heating glucose or cane sugar in large iron or copper pots. The sugar melts, and whilst the temperature rises a small amount of moisture is liberated. A violent reaction then occurs, accompanied by the evolution of steam and of irritating vapours. The mass now boils quietly and, at a certain stage in the process, only to be determined by experience, water is run in; when solution is complete the product is filtered through fine copper gauze. The colouring matter can be precipitated from its aqueous solution by strong alcohol as a tarry mass, which is generally again soluble in water. After treating the filtered alcoholic solution with animal charcoal to remove the last traces of colouring matter, ether precipitates a large quantity of a colourless oil which dries to a white mass; it is deliquescent, soluble in water, and unfermentable. About 30 per cent. of the dry substance in commercial caramel consists of the colouring matter and the remainder of this inert body. The colouring principle can also be isolated by adding a mineral acid to an alkaline solution of caramel. In this case it is insoluble in water, and yields yellow bromo- and nitro-derivatives.—J. L. B.

### *Dates as a Raw Material for Spirit Manufacture.* Zeits. für Spiritusind. **18**, 1895, 129.

Mesopotamian dry dates are, according to Lebuy, worthy of consideration as a raw material for the manufacture of spirit. According to his analysis they have the following mean composition:—

100 parts by weight consist of 85·1 parts of pulp and 14·9 of kernel. The pulp consists of:—Cane sugar, 0 per cent.; dextrose, 66·07; starch, 1·28; nitrogenous bodies, 2·97; fat, 1·03; gummy bodies, 4·26; cellulose, 4·97; mineral salts, 1·96; and water, 17·46 per cent.

According to this analysis 100 kilos. would yield 37—38 litres of 90° alcohol.

Lindet in commenting on this analysis says that, though these Mesopotamian dates contain no cane sugar, yet he has found in the flesh of Tunis dates 23 per cent. of dextrose along with 38 per cent. of cane sugar.—J. G. W.

### *Determination of the Extract of Malt in the Laboratory.* John Heron. J. Fed. Inst. Brewing, 1895, **2**, 116.

*See under* XXIII., *page* 690.

### *Analysis of Beer with some remarks on the Unfermentable reducing Residue.* G. H. Morris. J. Fed. Inst. Brewing, 1895, **2**, 125.

*See under* XXIII., *page* 690.

### *Synthethic Method of Preparing Ethyl Alcohol from Acetylene.* N. Caro. Chem. Ind. 1895, **18**, 226.

*See under* XX., *page* 676.

## PATENTS.

### *Improved Method of and Apparatus for Making Vinegar and Maturing Spirits.* R. H. Leaker, Bristol. Eng. Pat. 8652, May 2, 1894.

The inventor has already described his improved apparatus in Eng. Pat. 15,475 of 1893 (this Journal, 1894, 655). In the present patent he describes how old pattern acetifiers may be adapted to the manufacture of vinegar by his process. The old acetifying material is removed and substituted by a series of frames of light timber or other suitable material, which are covered wholly or partially with some absorbent material. The vessel is also provided with an air-tight cover. The process is then carried on substantially as previously described.—A. L. S.

### *Improvements in the Treatment of Rice or other Raw Grain, or other Starchy Substances, for the Production therefrom of a Material Suitable for Use in Brewing or for other Purposes.* F. E. V. Baines, London. Eng. Pat. 9880, May 21, 1894.

Rice (100 lb.) is treated with dilute sulphuric acid (15 gallons water and 8—10 lb. sulphuric acid) at 130°—150° F. for 2—3 hours. The acid liquor is then drawn off, and the rice washed with water, or the acid may be removed by adding the proper quantity of lime or strontia and washing the insoluble sulphate away. The rice then may be used immediately or dried and stored away. It is not greatly altered in appearance, but is whiter, and if boiled with water almost completely dissolves; it is also easily acted on by diastase at the ordinary mashing temperature. When dried it is more easily ground.

Hydrochloric acid may be substituted for sulphuric acid, when the proportions will be 15 cwt. rice, 250 gallons water, and 12½ gallons hydrochloric acid. Soda is convenient for neutralisation in this case, as the product, common salt, is easily removed by washing with water.

The amount of matter lost during this treatment is small, being about 4—5 per cent., and consists largely of impurities, together with some albuminous matter and starch.
—A. L. S.

### *Improvements relating to the Ageing or Maturing of Wine, Cognac, and other Alcoholic Beverages, and to Apparatus therefor.* H. H. Lake, London. From P. W. Sothmann, Grünberg, Silesia, Germany. Eng. Pat. 11,310, June 11, 1894.

A rapidly alternating induced electric current, which is produced by an induction coil and batteries of the usual kind, is passed through the spirit to be treated. In from 5 to 8 hours the spirit is said to be aged.—A. L. S.

### *Improvements in Apparatus for Treating Raw Grain for Brewing Purposes.* E. H. Ludlow, Langley Green, Worcestershire. Eng. Pat. 11,888, June 19, 1894.

The apparatus consists of an upright cylindrical vessel with conical top and bottom. In the upper part there are malt and grain inlets, and in the lower part an outlet valve for the mash when finished. There are also supplies of hot and cold water, a jacket for heating or cooling the vessel, and rakes of a special kind.—A. L. S.

### *Improved Preparations to be used in Brewing and in the Treatment of Finished Beer.* A. F. Spencer, Brighton. Eng. Pat. 12,196, June 23, 1894.

The preparation consists of a solution containing sodium sulphite, extract of *piptocalyx moorei*, borax or boracic acid, potassium phosphate, sodium sulphate, and magnesium sulphate.

It is intended to be a hop-substitute; a preservative and a yeast food.—A. L. S

*Improvements in the Manufacture of Alcohol.* R. Zdarek, Vienna, Austria. Eng. Pat. 13,492 July 12, 1894.

Cellulose, lignin, or cell-juice is boiled under pressure with dilute nitric and sulphuric acids, for from 2—9 hours. The acid liquid is filtered, neutralised, and yeast added; fermentation takes place and alcohol is formed, which may be separated by any of the ordinary distillation processes.
—A. L. S.

*Purifying and Ageing Brandies, Cognac, Whiskey, and Gin, and in Apparatus therefor.* F. Calmant. Eng. Pat. 3956, February 23, 1895.

In order to effect a change in spirits, similar to that produced by natural ageing, the inventor saturates the spirit with oxygen or ozone under a pressures of 15—20 atmospheres, and filters the saturated spirit through vegetable charcoal, sand, animal-black, or pumice stone, &c.—A. L. S.

*Improvements in or relating to the Manufacture of Stout and Porter.* A. Fraser, Alloa. Eng. Pat. 4627, March 5, 1895.

The inventor proposes to substitute oat malt for a portion of the barley malt commonly used in brewing stout and porter.—A. L. S.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

### PATENTS.

*Improvements relating to the Preservation of Alimentary and other Organic Substances.* H. H. Lake, London. From F. Delangle, Lyons, France. Eng. Pat. 6010, March 22, 1894.

It is claimed that the forcing of air into or through alimentary and other organic substances, prevents or retards their decomposition.—J. C. C.

*Process for Reducing the Proportion of Caseine contained in Milk.* G. Gaertner, Vienna, Austria. Eng. Pat. 8044, April 23, 1895.

The purpose is to produce a product suitable for the food of infants.

Two methods are proposed:—

Either (1), the milk is freed from a certain proportion of meagre milk containing little or no fat, by centrifugal separation, and the part thus removed replaced by another liquid containing no caseine, such as sweet whey, decoctions of amylaceous substances, &c.

Or (2), the milk is mixed with the liquid containing no casein, and then the mixture treated in the separator, so as to leave a milk containing relatively the best proportions of fat and casein.—J. C. C.

### (*B.*)—SANITARY CHEMISTRY.

### PATENTS.

*Improvements in Precipitation Tanks and in Means for delivering Water to Filter Beds, for the Purification of Sewage and Impure Waters.* F. P. Candy, Balham. Eng. Pat. 8671, May 2, 1894.

The first improvement described relates to what are known as the "upward flow" precipitation tanks, and consists essentially in making the inlet enter the tanks at such an angle that an horizontal rotatory movement is imparted to the liquid contents by the influx, thereby causing a more rapid diffusion. The second improvement claimed relates to the cleansing of "aërating filters," that is to say, filters in which a current of air is passing through the filtering medium while the liquid percolates through. In these filters it is necessary that the top layer be a very fine material, in order to spread the water evenly over the whole surface of the filter bed. The improvement consists in the employment of some water-distributing or -spreading arrangement for conveying the liquid as a shower to the filter-beds. A number of the usual forms of distributors or sprinklers are described for accomplishing this object.—S. P. E.

*An Improved Process for Purifying Sewage and Waste Water of a Putrescible Character.* Oscar Schmidt, Berlin. Eng. Pat. 9338, May 11, 1894.

Instead of filtering sewage through soil, finely-divided humus substances, such as lignite, turf, peat, &c., in a state of suspension, are continuously added to the sewage or waste water, and thoroughly mixed therewith by means of a mixing trough, after which a soluble salt of iron, aluminium, or magnesium is added in sufficient quantity to cause a rapid precipitation of the humus substance. For town sewage, about 1·5 parts of peat, &c. and 0·12 part of iron salt are required per 1,000 parts of sewage, but these proportions may have to be varied. The water thus treated clears rapidly when allowed to settle, and it is said to contain about 90 per cent. less of substances reducing permanganate, and from 80 to 90 per cent. less of nitrogen than the decanted unclarified sewage.—L. A.

*Improvements in Apparatus for Supplying Precipitating and Purifying Materials employed in the Treatment of Sewage and other Analogous Purposes.* J. E. Keirby, Manchester. Eng. Pat. 11,188, June 9, 1894.

Any of the well-known soluble precipitants used may, according to the present invention, be automatically delivered in solution of constant or varying strengths, and proportionately to the quantity of sewage under treatment. The apparatus consists of a cylinder containing an inner cage or perforated cylinder, which is made to revolve by suitable gearing. Within the cage the soluble iron salt or other precipitant is placed. It is gradually dissolved by a continuous stream of water, which enters the outer cylinder near the bottom. The outlet for the precipitating solution is also near the bottom, opposite the inlet, and consists of a swivel pipe movable in a vertical direction, the height of which determines the level of the water within the cylinder and consequently the amount of precipitant dissolved in a given time. The dissolved precipitant falls into a tank, through which the sewage passes in its course to the culvert. Within the tank a suitable float is placed, which, by means of a connecting rod, raises or lowers the swivel outlet, thereby automatically regulating the quantity of precipitant according to the amount of sewage passing through the tank.—S. P. E.

*Treatment of Potable Waters by Alkalinisation and subsequent Neutralisation, with a view to their Sterilisation and Purification.* H. J. N. Bergé, Brussels. Eng. Pat. 14,015, July 20, 1894.

The water is first sterilised by making it strongly alkaline with lime, and neutrality is then restored by treating the water with carbon dioxide or any other suitable reagent.
—L. A.

*Improvements in the Method or Process of Treating and Utilising Town Refuse.* C. Jones, Ealing, Middlesex. Eng. Pat. 14,927, August 3, 1894.

Good fuel, or selected refuse, is fed into a destructor gas producer until the interior is very hot, and then town refuse, either mixed with fuel or in alternate doses with fuel, is fed into the producer. Steam and air are forced through the fuel in the producer in the usual manner, and the gaseous products are led through a condenser, scrubber, and purifier into a gas-holder, to be used for gas engines or for any other useful purpose.—L. A.

*Improvements in the Treatment of Sewage, and in Apparatus therefor.* S. Pitt, Sutton (communicated from the Drainage Construction Co., Boston, U.S.A.). Eng. Pat. 5257, March 12, 1895.

The sewage is first collected in a suitable tank and submitted to a preliminary oxidation by blowing in compressed air, by which means also the bulk of the gaseous products are removed. The sewage is then driven through a force main to a strainer, containing broken stone, which holds back the coarser matters, after which it is distributed by suitable channels to the top of the filtering beds. The filters are constructed as follows:—An excavation is made 6 ft. deep and 10 ft. wide, and as long as desirable, and along the bottom pipes are laid and partly embedded, but the joints are left open to allow the effluent readily to pass away. The bottom of the filters (upon the drain pipes) are covered with about 8 ins. of broken stone, which affords free drainage for the effluent, and allows a distribution of the air which is introduced. Above this is a layer of coarse gravel. Clean sand is then placed above. Compressed air is forced into the bottom of these filter-beds, and meets the effluent as it percolates through. A suitable trap is provided at the outlet for the effluent, to prevent the air from passing out instead of through the filter. The filter-beds are preferably constructed in pairs in parallel lines, divided by an embankment, so that the flow may be easily diverted from one to another. From the filter the effluent passes to absorbing drains, or is conveyed to a reservoir, from whence it flows down the slope of the irrigation area. A modified form of filter is also described. An open tank or vessel with a false perforated bottom, upon which the filtering material rests. A current of compressed air is forced into the space between the bottom and the perforated bottom, from whence it rises through the filter, meeting the effluent as it passes through the filtering medium.—S. P. E.

*Improvements in Apparatus for Mixing Precipitants with Sewage and the like Liquids.* J. Berry, Manchester. Eng. Pat. 6632, April 1, 1895.

The object of this invention is to effect the mixing of the precipitant and sewage without the aid of mechanical means. The apparatus consists of a circular tank for holding the precipitant, through the bottom of which a pipe enters and projects some distance upwards, ending with a number of perforations in its wall, but closed at the top. Water for dissolving the precipitant or the sewage liquor itself enters by this pipe, and after percolating through the precipitant, passes out at the bottom of the tank into a channel surrounding the latter, and finally running from this to the sewage by means of one or more outlets.

—S. P. E.

*An Improved Method of and Apparatus for Purifying River Water.* V. Braunshausen, Paris. Eng. Pat. 7602, April 16, 1895.

A filter tank is divided into a number of compartments, each containing at the bottom a layer of large pebbles, and above these, in order, layers of gravel, small river pebbles, coarse river sand, finely ground vegetable carbon, small river pebbles, gravel, and, finally, a top thick layer of fine river sand. The water is purified by filtering through these materials, suitable arrangements being provided for distributing the water to the different compartments and for withdrawing the filtered water.—L. A.

## XIX.—PAPER, PASTEBOARD, Etc.

*A New Raw Material for the Manufacture of Paper.* W. Herzberg. Mitt. aus d. königl. tech. Versuchs. zu Berlin, **13**, [1], 24—29.

For some time past experiments have been made with the object of utilising the fibre of the Italian reed (*Arundo donax*) for the manufacture of paper and other textiles, and recently the firm of Hagemann, Dittler, and Co., of Ludwigshafen a/R., have patented a process for this purpose). (Delapierre prepared samples of paper from this plant in 1830 by macerating for three weeks in milk of lime and afterwards boiling for 12 hours (see Dingler's Polyt. J. 1832, p. 69; also Bull. de la Société d'Encouragement, December 1831).) Experiments upon the fibres of this plant show that a comparatively weak solution of caustic soda (4° to 6° B.) at ordinary temperatures softens the tissue sufficiently to allow the parenchyma and epidermis to be readily separated from the fibres, rendering them suitable for textile and paper manufacture. *Arundo donax*, the Italian reed, is related to the German reed, *Phragmites communis.* It is found chiefly in warm climates, and grows to a larger size and thicker than the *Phragmites*, being about 4 m. long with a diameter of about 20 to 30 mm. at the thickest parts of the stem. It very much resembles the young bamboo, for which it is frequently employed as a substitute. The surface is yellow, polished, and hard, and at almost regular intervals of about 30 cm., knotty protruberances are found (similar to those found in the bamboo) which are somewhat darker than the rest of the stem. When the cut end of the stem is treated with an acid alcoholic solution of phloroglucol, it turns to a carmine red, indicating the ligneous character of the fibres. For the removal of the ligneous matter a cold solution of caustic soda is employed. The stems are first crushed to facilitate the penetration of the liquor, which consists of a solution of caustic soda of 4°—6° B. After 4—6 days the tissue is sufficiently reduced to allow the fibres to be readily separated by the ordinary mechanical means. The fibrous pulp thus obtained is freed from the spent liquor by washing and pressing, and then thoroughly reduced to a uniform pulp in the Hollander. The pulp is bleached, washed, and further treated in the usual way. The fibre can not only be used for paper, but also for the manufacture of textile fabrics. With flax, hemp, jute, and in fact all dicotyledonous bast fibres, it is not difficult to remove the woody matter, but with monocotyledonous plants, to which *Arundo* belongs, the process of separating the various tissues is more complicated and requires different treatment. The stem is split into long strips by passing between heavy rolls, and is then washed with caustic potash solution. To separate the individual fibres for spinning purposes, the material is beaten upon wooden blocks and then treated in the usual way.

To produce a fine fibre it is better to allow the pulp to rot after leaving the liquor, as is frequently done with flax. The refuse or waste from the manufacture of spinning fibres may be employed in the production of paper. The prepared fibre is in the form of bundles of a dull greenish-yellow colour, having a length of about 35 cm., and still containing a considerable quantity of ligneous matter. At the Paper-testing Institute a number of samples of paper made from *Arundo donax* have been examined and tested. Tables are given with the breaking length in metres and the expansion or stretching power in percentage of their length, of six different samples of paper, sized and unsized. The results, with drawings illustrative of microscopical examinations, are given in the paper.—S. P. E.

### PATENTS.

*Improvements in or relating to Centrifugal Disintegrating and Mixing Mills or Apparatus Suitable for Use in the Manufacture or Treatment of Paper Pulp.* O. Zimmermann and G. Hagemann, Ludwigshafen a/R., Germany. Eng. Pat. 10,326, May 28, 1894.

This apparatus relates to a wet centrifugal mill with circulation vessel for disintegrating cellulose fibre and mixing paper pulp. As a substitute for knife-rollers and bed-plates there is a wet working centrifugal disc disintegrator, through which the pulp passes until it is sufficiently reduced. The apparatus is said to separate the fibres without cutting or crushing them, and is also suitable for mixing different pulps, as well as size, colours, &c.—S. P. E.

*Improvements in the Manufacture of Albumenised Paper.* R. Münch, Niederlahnstein a/R., Germany. Eng Pat. 12,978, July 4, 1894.

Albuminised paper is manufactured in a continuous manner, and at the same time the several difficulties that are experienced in manufacturing it by hand are overcome, such, *e.g.*, as unevenness in the layer of albumin, and in the limited size of the sheet produced. The process consists in passing the sheet of paper to be albuminised between several sets of rollers, whereby a layer of albumin is applied, the thickness of which depends upon the number of sets employed. Each set of rollers consists of three, arranged one above the other, the lower one of which dips into a trough containing a solution of albumin and carries it to the middle or distributing roller. The rollers are supported upon suitable standards, which also carry brackets for the roll of paper to be treated, and guiding and tension rollers of the usual type.—S. P. E.

*An Improved Machine or Apparatus for Washing Rags and other Fibrous Materials for Use in Paper-making.* J. Joiner, Bitton, Gloucester. Eng. Pat. 13,620, July 14, 1895.

By means of this apparatus the rags, when sufficiently washed, are automatically removed from the dirty water, and the sand and grit fall by gravity through a perforated false bottom, from whence they can be readily removed. The apparatus may be connected to and worked in conjunction with an ordinary washing Hollander.—S. P. E.

*Improvements in or connected with the Boiling of Esparto or Like Fibrous Material in the Manufacture of Paper.* J. P. Cornett, Claxheugh. Eng. Pat. 6999, April 5, 1895.

By this process a number of boilers or digesters is arranged in a series or battery, and so connected with each other that with the aid of pumps all cooling waters can be successively and immediately conveyed to the succeeding boiler in the series, to be used as a "hot-washing," and so on through the series of boilers in a continuous manner. Each boiler is filled successively with the same quantity of esparto, and requires the same boiling and subsequent hot-washing and cooling consecutively, until emptied and again filled. At the same time the cooling and washing waters are being passed forward in the process to meet the newly-boiled unwashed fibres, the blow-off steam from the boilers working under high pressure is conveyed direct into the boilers in which hot-washing is in progress and into the boiler which is being charged with esparto. This is effected by having the blow-off pipe of every boiler connected to a common exhaust main, which is also in communication with each boiler by another pipe entering below the high-pressure inlet-valve. By this means any one or more boilers working under high pressure can discharge its blow-off steam to any one or more boilers in which hot-washing is taking place. For description of the process as applied to a series of seven boilers suitable for treating 200 tons of esparto weekly, the patent itself may be consulted.—S. P. E.

*Improvements in the Manufacture of Waterproof Paper and Paper Board.* W. Teggin, Salford. Eng. Pat. 7698, April 17, 1895.

According to this specification one surface of plain paper is coated with a waterproof material, which, after drying will soften, and become adhesive when heated; such a material is pitch from cotton-seed oil. The material is applied by means of an ordinary spreading machine as used for manufacturing surface-coated papers, and allowed to dry. In contact with the surface thus coated, a plain sheet of paper is applied and the two passed between pressure rolls, one or both of which are heated in the ordinary manner. Any number of sheets may be thus superposed and passed between the rollers, thereby producing a paper or board of any desired thickness. For producing boards, the dry-coated sheets may be united by placing them between heated press plates. To produce a sheet of greater strength, a layer of woven fabric may be applied to the surface or between the layers.—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Synthetic Method of preparing Ethyl Alcohol from Acetylene.* N. Caro. Chem. Ind. 1895, **18**, 226—227.

Apart from its employment for heating and lighting, acetylene has probably a future before it in the synthetic formation of organic bodies, for which its constitution renders it specially adaptable.

Fr. Krüger has made repeated but unsuccessful attempts to prepare alcohol from acetylene, some of them by direct hydration, but the author, following up the same subject, has arrived at a process which, though as yet merely of theoretical interest, may, it is thought, indicate the way to its technical utilisation.

Acetylene is passed through a series of Woulffe's bottles containing concentrated hydrogen iodide, by which means and subsequent distillation, the compound $CH_3.CHI_2$ is obtained. This, on heating with KHO, partly retrogrades into acetylene, but about 45 per cent. is converted into ethyl alcohol and potassium acetate, acetaldehyde being apparently formed as an intermediate product. By using moistened silver oxide instead of KHO only a small proportion of acetylene is re-produced; nearly 90 per cent. of alcohol and potassium acetate being formed after boiling with KHO. Heating the di-iodide with water up to 140—150° C. in a tube also brings about the formation of acetaldehyde along with hydrogen iodide, ethyl iodide, and some unaltered di-iodide, but it is probable that by working on a large scale and removing the hydrogen iodide, the yield of aldehyde can be increased considerably beyond the 40 per cent. obtained by the foregoing method; in fact, 70 per cent. has been obtained on a small scale by removing the HI by means of zinc oxide and zinc dust, but this is not recommended for technical working, since the expensive reagent (HI) is not recoverable.

Mention is made of the experiments of Frank and Weyl on mice and rabbits proving that an atmosphere containing 4 per cent. of acetylene is not poisonous to these animals, even after more than half an hour of immersion.—C. S.

*Cinchonine and Cinchotenine* Z. H. Skraup. Monatsh. Chem. 1895, **16**, 159—179.

Cinchotenine is obtained by the oxidation of cinchonine with potassium permanganate with the formation of formic acid, as has been previously shown by the author (Annalen, **197**, 181 and 376). The following equation represents the change:— $C_{19}H_{22}N_2O + O_3 = C_{18}H_{20}N_2O_3 + H.COOH$. The reaction is general for the cinchona alkaloids, and has been investigated in the cases of cinchonidine, quinine, and quinidine.

Benzoyl-cinchonine and some of its salts are described, also benzoyl-cinchotenine which is obtained by oxidising it. The method of preparation and properties of benzoyl-cinchotenine ethyl ester, and of acetyl-cinchotenine ethyl ester are given in detail. From the properties of these derivatives it is concluded that cinchotenine is a mono-carboxylic acid derived by the oxidation of a vinyl group present in cinchonine, the relation between the two bodies being shown by the formulæ:— $C_{17}H_{18}N_2(C_2H_3)(OH)$ (cinchonine), $C_{17}H_{18}N_2(COOH)(OH)$ (cinchotenine). The vinyl group is split at the double linkage on oxidation, a carboxyl group being formed and formic acid liberated. Cinchonine readily adds a molecule of halogen acid, whilst cinchotenine appears to be a saturated compound. The paper concludes with a discussion of the relation of *cincholoiponic acid* and *mero-quinine* to the above compounds. Königs has found that cincholoipone by oxidation yields the last-named acid, whilst cincholoipone itself is formed by the oxidation of cinchotine, which occurs in considerable quantities in commercial cinchonine. Cincholoiponic acid is also formed by the oxidation of pure cinchonine.

—C. A. K.

*Apoquinine and its Ethers.* E. Lippmann and F. Fleissner. Monatsh. Chem. 1895, **16**, 34—44.

Apoquinine was first prepared by Hesse (Annalen, 1880, **205**), by the action of hydrochloric acid of sp. gr. 1·125 on quinine at 140°—150° C. Methyl chloride is evolved according to the equation:—

$$C_{20}H_{24}N_2O_2 + HCl = C_{19}H_{22}N_2O_2 + CH_3Cl.$$

Hence apoquinine should appear as the hydroxyl base of quinine, and its alkyl ethers should be quinine and its homologues. It is from this standpoint that the authors have studied the subject. They find that apoquinine is not the true hydroxyl base of quinine. but an isomeride, and that the action of hydrochloric acid is first to convert the quinine into an isomeride and then detach a methyl group, a reaction similar to that observed by Hesse in the case of cinchonine and other cinchona alkaloids. When quinine is heated with hydrochloric acid according to Hesse's method the reaction is only complete after prolonged heating (15 to 30 hours).

The product formed is completely soluble in alkali, but it is not a pure substance, containing only 72·5 per cent. of apoquinine and 27·5 per cent. of its hydrochloride; the hydrochloride could not be separated from the free base. This hydrochloride is readily obtained by heating quinine saturated with hydrochloric acid at 0° C., to 150° C. under pressure, for five hours; in its properties it closely resembles apoquinine. The authors regard Hesse's apoquinine as containing isomerides of quinine in addition to apoquinine and its hydrochloride. Apoquinine is obtained pure by heating quinine with hydriodic acid of sp. gr. 1·25—1·35 in sealed tubes for 24 hours; the hydriodide of the base is formed, from which the free base can be separated, and is obtained pure by recrystallisation from ether. It retains this and other solvents (wood spirit, chloroform, benzene) with great tenacity. Apoquinine crystallises in the regular system, gives none of the characteristic quinine reactions, melts at 210° C. with partial decomposition, after softening at 160° C. Analysis points to the formula $C_{19}H_{22}N_2O_2$; of its salts the acid oxalate, hydriodide and platinum double chloride are characteristic. The acid oxalate is almost insoluble in cold water, but dissolves in a large excess of hot water; it serves for the isolation of the base.

The ethyl ether of apoquinine is obtained by the action of ethyl chloride on the base in presence of sodium ethylate. It forms a crystalline powder, melting at 182° C., and is not identical with the ethyl cupreine obtained by Grimaux (this Journal, 1891, 850). Its acid sulphate is soluble with difficulty, as is also its platinum double chloride.—C. A. K.

### PATENTS.

*Production of Purified Sterilised Liquid Hæmoglobin.* Adolf Hommel, Zürich, Switzerland. Eng. Pat. 12,504, June 27, 1894.

Defibrinated blood is freed from gas at the ordinary temperature under reduced pressure, 20 per cent. of previously-boiled water containing alcohol or other volatile antiseptic, is added, and the mixture evaporated *in vacuo* at 30°—40° C. If the hæmoglobin is not completely dissolved out after 20 per cent. of water has been removed, more water is added, and the evaporation repeated. Under these conditions the blood does not decompose, and a clear deep-red liquid is obtained which is perfectly free from the micro-organisms circulating in the blood.—J. W.

*Production of Aromatic Iodo-Compounds.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 12,987, July 4, 1894.

When iodine, iodine chloride, alkali iodide and chlorine, or other iodising agent acts on hydroxytriphenylmethane and its analogues in alkaline solution, hydrogen atoms in the aromatic nuclei are replaced by iodine. In this way tri-iodo-aurine, tri-iodorosolic acid, and tetra-iodophenolphthaleïn have been obtained. These substances are strongly acid, and form well-defined salts.

Iodine can be made to act as a substituting agent in the case of secondary aromatic amines, such as diphenylamine, when a substance like mercuric oxide is present, which removes the hydriodic acid formed in the reaction. Thus, di-iodo-diphenylamine, di-iodo-carbazol, their acetyl and benzoyl derivatives have been prepared, and it is proposed to use them for pharmaceutical purposes.—J. W.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*Action of Light on Lead Bromide.* R. S. Norris. Amer. Chem. J. 1895, **17**, 189—191.

The fact that light darkens lead bromide has been mentioned by Wells (American J. Sci. **45**, 134). The action is much slower than in the case of silver salts, and as it takes place merely at the surface, it is difficult to obtain a product the whole of which is darkened. To overcome this difficulty, the author exposed thin layers of lead bromide between two pieces of plate-glass. After several days' exposure to light, the product was black, and on dissolving this in water, with the addition of a drop or two of nitric acid, metallic lead equal to about 1 per cent. of the original substance remained undissolved. Analysis showed that 2—4 per cent. of the bromine had been lost. In another similar experiment, the bromide was exposed to bright sunlight for two weeks. The product in this case was lighter in colour, and entirely soluble in acidulated water, the probable explanation of which is, that the lead at first reduced became oxidised on further exposure.

When lead bromide is exposed under water, the action of light is very slow. The fused bromide is darkened rapidly by light. Exposed in tubes containing either dry oxygen or hydrogen, the decomposition appears to take place with equal rapidity in both cases.—A. K. M.

### PATENTS.

*Improved Means for and Method of Separating Photographic Gelatin Films from their Supports or Bases, and Enlarging the same.* A. J. E. Hill, Kingston-on-Thames, and A. A. Barratt, Esher. Eng. Pat. 15,217, August 9, 1894.

For this purpose citric or a similar vegetable acid, and an alkaline fluoride in solution in water, are employed in forming the bath in which the plate is immersed, the film in due time leaving its support and expanding, after which it is washed and, if necessary intensified, &c.—J. C. C.

*Improvements in the Manufacture of Photographic Plates.* W. H. C. Clasen, St. Petersburg, Russia. Eng. Pat. 7893, April 19, 1895.

In this process a layer of resinous soap is applied to the plate, before the coating with chrome gelatin, which latter should contain chromate of ammonia to which salammoniac has been added. The object is to produce a film having a durable and fine grain, and it is stated that with a film made in the manner described it is possible to take 10 times the number of pulls as is now done without the grain losing its clearness.—J. C. C.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### *The Annual Report (Nineteenth) of Her Majesty's Inspectors of Explosives for* 1894.

From the report just published it is seen that during the year 1894 there have been only two deaths from accident during manufacture in explosives factories under the supervision of the inspectors, the average for the last 10 years being 4·6. Seven new factories have been licensed and three have become extinct. The following have been added to the list of authorised explosives, blasting amberite, cordite, collodion cotton, westphalite, and Von Förster's powder. The amount of foreign nitroglycerin blasting compounds imported during the year was 539,802 lb., which is a large decrease on the average of previous years. On the other hand, there is a large increase in the number of detonators imported, showing that in spite of the six factories at which detonators can be made in this country, a great percentage of this trade remains in foreign hands. Dr. Dupré, in his report to the inspectors, states that there has been an increase of work in his department during the year, partly due to a revival of activity among inventors of explosives, no less than nine new explosives and modifications of six explosives already licensed, having been submitted. Reference is made to the Order in Council prohibiting the use of sulphur and potassium chlorate in the same firework mixture. Such mixtures have in the past given rise to numerous accidents, even mere contact between the chlorate and sulphur having in one case led to an accident. A chlorate explosive, Schnebelite, after satisfactorily passing the preliminary examination failed, "like almost every chlorate mixture hitherto submitted," when put under a more prolonged and searching examination. Another chlorate mixture, Britainite, is still under examination. Reference is made to the serious explosion of nitroglycerin at Waltham Abbey on May 8th, and it is pointed out by Dr. Dupré and also in the body of the inspector's report, that this unfortunate occurrence can in no way be called a cordite explosion, and, indeed, furnishes valuable evidence of the relative safety of cordite, inasmuch as in buildings containing cordite, which were greatly shattered by the force of the explosion, not a particle of cordite caught fire or exploded. At the same time, in regard to this explosion and the one of gunpowder at Waltham Abbey on December 13th, 1893, the special committee, of which Col. Majendie was a member, states that the explosion brought "to light very grave defects in the system of discipline and precautions prevailing at Waltham Abbey, and the urgent necessity for a comprehensive revision of the regulations and for the adoption of disciplinary measures for their more rigorous enforcement." A brief account is given of the more interesting foreign explosions, from which it is evident this country enjoys a happy immunity from accidents during manufacture of explosives compared with America. Within five years, dynamite factories owned by one company have been blown up five times, and nine persons killed, and at another factory the "receiving mill" and two men were blown to atoms, this being the fifth explosion within three years. An interesting account is given of the accident on March 21st, 1894, whereby 15 lives were lost during operations to get rid of the wreckage and unexploded dynamite, and exuded nitroglycerin from the "Cabo Machichaco" which blew up at Santander in November of the previous year. By means of a pump 1,150 kilos. of fluid nitroglycerin were extracted, but then it congealed, and the pumps could not be used. The divers brought up clusters of crystals of frozen nitroglycerin, and it was while one diver was down that the explosion took place. Apparently all the nitroglycerin was destroyed by this explosion, but the affair shows the great difficulty and danger of dealing with nitroglycerin explosives which have been cast into the sea, either by the vessel having been wrecked through stress of weather or by explosion on board as in this case. An account is given of the principal outrages both at home and abroad, which unfortunately have been numerous, and grave in character. From experiments which have been made, it has been decided to raise the dividing line between a cap and a detonator, the distinction, being defined as follows: "A percussion cap to be one containing a charge not exceeding 0·5 grain of composition, or 0·6 grain of composition where the quantity of fulminate does not exceed one fourth of such composition; in any other case the cap will rank as a detonator." But it is pointed out that "where the caps are raised to a high temperature by the aid of artificial heat, or even still more decidedly when loose composition becomes intermixed therewith," the liability to explode *en masse* "undoubtedly presents itself in a very appreciable and even a formidable degree."—W. M.

### PATENTS.

*Improvements in Waterproofing Cartridges.* F. W. Oliver, Limehouse, London. Eng. Pat. 11,666, June 16, 1894.

This invention consists in the employment of "liquid celluloid" as a waterproof coating and cementing material in the manufacture of cartridge cases.—W. M.

*Improvements Relating to the Manufacture of Explosives.* H. H. Lake. Communicated from abroad by Dynamit-Actien Gesellschaft vormals A. Nobel and Co., Hamburg, Germany. Eng. Pat. 13,506, July 12, 1894.

The object of this invention is "to obviate, as far as possible, the dangerous secondary phenomena which still occur more or less frequently with ignitions of explosives, for instance, the formation of pointed flames." This is attained by using as carriers of carbon, particularly oxalates, tartrates, acetates, and hydrochlorates of the amido compounds of benzol, toluol, xylol, and naphthalene, or their substitution products, which contain carbonic acid and hydrochloric acid at the same time, or only one of these acids partially or entirely formed. These two acids "counteract the before-mentioned injurious secondary phenomena."—W. M.

*Improvements in Ammunition, and in Gun Barrels for Use therewith.* O. Rozvoda, Prague-Smichov, Bohemia. Eng. Pat. 7231, April 9, 1895.

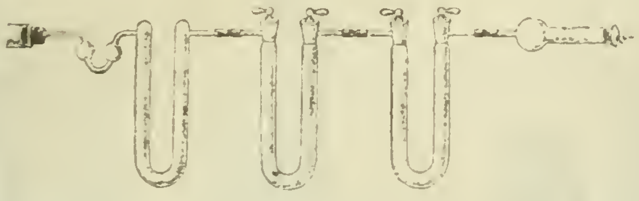
The object of this invention is to enable high explosives to be used as ammunition without danger to the gun. The inventor claims that this is attained by imparting an initial velocity to the projectile previous to the occurrence of the explosion, such initial velocity being generated by the aid of "compressed air, gases, steam, spring, or springs." The specification is accompanied by explanatory figures.
—W. M.

# XXIII.—ANALYTICAL CHEMISTRY.

## *APPARATUS, ETC.*

### *Suitable Apparatus for Absorption of Carbon Dioxide in Organic Analysis.* J. Bredt and W. Posth. Liebig's Annalen, 1895, **285**, 385—386.

The authors state that the "potash bulbs" in common use may be advantageously replaced by U-tubes containing fresh soda-lime. In order to indicate the rate at which the combustion is going forward, the little tube connecting the combustion tube with the calcium chloride tube contains a drop of water. The same soda-lime should not be used for more than two combustions at most.—T. E.



## *INORGANIC CHEMISTRY.—QUALITATIVE.*

### *New Method for the Separation of Copper and Cadmium in Qualitative Analysis.* A. S. Cushman. Amer. Chem. J. 1895, **17**, 379—383.

The author discusses the difficulties sometimes encountered in separating cadmium and copper, and describes a new method which he has devised for testing for cadmium in the presence of copper. The reaction depends upon the solubility of cadmium sulphide in acidified concentrated solutions of the alkaline chlorides, whilst copper sulphide is quite insoluble. The test may be carried out as follows:—About 2 c.c. of the solution containing the two metals is acidified with hydrochloric acid and about 20 c.c. of a saturated salt solution added; the solution is warmed, and hydrogen sulphide is passed through in excess. The copper sulphide is separated by filtration, and the filtrate collected in a dry test-tube. On cautiously adding water or dilute ammonia to the clear filtrate, a yellow line is formed at the junction of the two liquids, and is due to the separation of cadmium sulphide. The reaction is described as very sensitive.—A. K. M.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Separation of Nickel and Iron.* E. D. Campbell and W. H. Andrews. American Chem. J. 1895, **17**, 164—167.

To a nitric acid solution of the metals containing 20—25 c.c. excess of the acid, is added a warm aqueous solution of sodium pyrophosphate, 13 grms. of the latter being required for 1 grm. of metal present. The white precipitate of ferric pyrophosphate is redissolved by the cautious addition of a moderately concentrated solution of sodium carbonate, an excess of the latter being carefully avoided. The dull olive-green solution is filtered through asbestos into a half-litre flask, and the nickel is precipitated as brick-red nickel xanthate by the addition of a freshly-prepared solution of potassium xanthate. The flask is then stoppered, shaken at frequent intervals for 10 minutes, filtered through asbestos, and the precipitate immediately washed with a 1 per cent. solution of potassium xanthate. The nickel xanthate is dissolved off the filter with a little freshly-diluted fuming nitric acid (1 : 1), sulphuric acid (2 c.c. slightly diluted) is added, and the solution boiled until the former acid is expelled. The resulting nickel sulphate is dissolved in a little water, and ammonia added to precipitate any iron present; the latter is filtered off, redissolved, and reprecipitated, the second filtrate being added to the first. The nickel in the latter may either be deposited electrolytically in the presence of hydrogen disodium phosphate and excess of ammonia, or it may be determined volumetrically by means of standard potassium cyanide with an indicator of silver nitrate, followed by potassium iodide. —A. K. M.

### *Copper Assay at Lake Superior.* G. L. Heath. Eng. and Min. J. **59**, 1895, 369, 370.

In referring to the recent description by E. D. Peters, jun., of the iodide method (this Journal, 1895, 204), the author states that whilst it may be advantageously employed for the analysis of sulphide and other complex ores, it possesses no advantage over other methods for the assay of native copper. Each district finds out and utilises the method of analysis best suited for its ores and products. He describes the methods which give the best results with different classes of material. The blue colorimetric test is recommended for rapid working results with poor slags containing not more than 1·25 per cent. of copper. He refers to the green tint which sometimes appears, and attributes it to the presence of a trace of organic matter from the reagents, preventing the complete precipitation of the iron.

The electrolytic assay is said to be the best for native copper, refined metal, and various concentrated mill products. In valuing large lots of materials, the fire assay is recommended on account of the necessarily small quantity only which can be taken for analysis by wet methods. Recent improvements in the Lake Superior fire assay are then described, and this method, with care and judgment and with due attention to all the necessary corrections, becomes "as accurate a test as other well-known methods."—A. W.

### *Determination of Tungsten.* F. Cremer. Eng. and Min. J. **59**, 1895, 345.

If a small quantity of ore, after gently heating for some time with *aqua regia*, and washing well with water, gives an insoluble residue which appears yellow, the mineral may be profitably treated for tungsten.

The analysis is conducted as follows: Half a gram of the finely-powdered ore is gently heated with about 6 grms. of potassium pyrosulphate ($K_2S_2O_7$) in a porcelain crucible. The temperature is gradually increased until the highest attainable is reached, and it is maintained at this for half an hour. A platinum rod is introduced into the fused mass, so that when cool the cold cake can be lifted from the crucible and introduced into a beaker containing 100 c.c. of boiling dilute hydrocloric acid (2·5 parts of water and 1 part of acid). The crucible is also inserted for a short while. After frequent stirring and continued boiling, the fused mass is dissolved, with the exception of the $WO_3$ which remains in suspension. The whole is then considerably diluted with boiling water, and kept boiling. A few c.c. of a concentrated solution of cinchonine in hydrochloric acid are added, and after boiling for a few minutes longer, the yellow precipitate is allowed partly to settle, when it is filtered and washed with water containing a little cinchonine. The filter-paper and precipitate are dried in a platinum crucible, carefully burnt, strongly ignited, and weighed as $WO_3$ containing silica. The $WO_3$ is dissolved by boiling ammonia, and the insoluble residue weighed and deducted, the difference being $WO_3$. For very accurate results it is necessary to keep the filtrate from the $WO_3$ for at least 48 hours, and to collect the small quantity of precipitate which further separates.

Ferro-tungstens containing above 50 per cent. of W are powdered and treated in the above manner, but when they contain less than 50 per cent., a preliminary treatment is advisable. One grm. of the broken fragments or the drillings of the alloy is then dissolved with a gentle heat in 75 c.c. of hydrochloric acid (3·5 parts of water to 10 parts of acid). When effervescence ceases, the solution, after cooling, is filtered, and the residue, which need not be thoroughly washed, is finely ground in a mortar, dried, ignited, broken up with a glass rod, mixed with potassium pyrosulphate, and treated, as an ore, by the foregoing method.—A. W.

## ORGANIC CHEMISTRY.—QUALITATIVE.

### * DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. A. Lehne and A. Rusterholz. (*Continued from page 603.*)

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 129.<br>Alkali Violet. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre at first reddish-brown, then brighter; liquid faint brownish-red; on addition of water the original colour is restored.<br>*Dil.*:—Fibre greenish-blue; heated—fibre green, liquid yellowish. Carefully neutralised with soda—violet; with excess of soda—colourless. Fibre rinsed with water—again blue. | *Conc.*:—Fibre immediately reddish-brown, then yellowish-brown; on adddition of water—fibre green.<br>*Dil.*:—Fibre dark green; heated—yellow, liquid colourless. | *Conc.*:—Fibre at first dark brown, then reddish-brown heated—brighter, liquid brownish; on addition of water—fibre greenish-blue, liquid faint greenish.<br>*Dil.*:—Heated—same as dilute hydrochloric acid. | *Conc.*:—Warmed—fibre almost decolorised (dirty yellowish).<br>*Dil.*:—Warmed—fibre decolorised, liquid colourless. | The fibre considerably brighter shade on being boiled with this reagent. | On warming—fibre reddish-brown, liquid brownish. | Boiled—the colouring matter is extracted. The solution is decolorised on addition of soda-lye. | .. .. |
| 130.<br>Naphthyl Violet. [K.]<br>(*Animal fibre.*) | *Conc.*:—Fibre somewhat redder.<br>*Dil.*:—Liquid faint rose on boiling. | *Conc.*:—Fibre dark red; on addition of water—brownish.<br>*Dil.*:—Heated—fibre almost decolorised (dirty yellowish), liquid faint rose tint. | *Conc.*:—Fibre immediately bright green.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre dull violet-grey colour.<br>*Dil.*:—Fibre immediately dull bluish-grey. | No action. | On warming—fibre redder, liquid faint reddish-violet. | No action. | .. .. |
| 131.<br>Congo-Corinth B?<br>(*Animal and Vegetable fibre.*) | *Conc.*:—Fibre immediately greyish-blue, liquid colourless.<br>*Dil.*:—Fibre greyish-blue, liquid faint rose tint. | *Conc.*:—Fibre at first greyish-blue, then gradually brighter, liquid reddish; heated—fibre almost decolorised (sand-coloured).<br>*Dil.*:—Fibre immediately greyish-blue, liquid colourless; heated—fibre bright dirty reddish-violet, liquid yellowish. | *Conc.*:—Fibre immediately greenish-blue, liquid colourless.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre bright bluish-red, liquid colourless.<br>*Dil.*:—Fibre immediately bright bluish-red, liquid colourless; heated—liquid reddish. | Fibre dark red, liquid rose-tint; heated—dye strongly extracted. | Fibre immediately pale bluish-violet, then gradually decolorised. | On boiling—fibre redder, liquid faint rose tint. | Boiling water extracts the colouring matter and the fibre becomes redder. When concentrated sulphuric acid is added to the solution the colour changes to violet. |

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### DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

### VIOLET DYES.

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | StannousChloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 132.<br>Congo Violet [A.] Bordeaux COV [A.] Bordeaux Extra [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately dark bluish-violet, liquid colourless; on addition of water, the fibre again becomes redder.<br>*Dil.*:—Fibre immediately bluish-violet, liquid colourless; heated—liquid bright reddish-violet; with excess of soda-lye—almost colourless. | *Conc.*:—Fibre at first bluish-violet, and immediately afterwards reddish-brown, liquid the same; on addition of water—liquid rose, fibre towards the extremities decolorised, in other portions flesh-coloured.<br>*Dil.*:—Fibre immediately bluish-violet; liquid colourless; heated—fibre gradually almost decolorised (rose), liquid yellowish. | *Conc.*:—Fibre immediately dark bluish-violet, liquid faint bluish-violet; on addition of water—fibre somewhat redder, liquid faint reddish-violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately dark red, liquid colourless.<br>*Dil.*:—Fibre immediately dark red, liquid colourless; heated—liquid reddish; acidified—reddish-violet. | The colouring matter is extracted on boiling. | Fibre at first bluish-violet, then gradually decolorised. | No action. | ..  .. |
| 133.<br>Azo Violet [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately blue, liquid colourless.<br>*Dil.*:—Fibre immediately blue, liquid colourless on being heated. | *Conc.*:—Fibre immediately blue, quickly changing to brownish-red, liquid brownish; heated—fibre bright reddish-brown, liquid brownish-yellow. On addition of water—liquid yellow.<br>*Dil.*:—Fibre immediately blue, liquid colourless; heated—fibre reddish-violet, liquid yellowish. | *Conc.*:—Fibre immediately blue, liquid the same. On addition of water—both remain blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately reddish-violet, liquid colourless.<br>*Dil.*:—Fibre immediately bright reddish-violet; heated—liquid intense reddish-violet; acidified—blue. | Same as dilute soda-lye. | Fibre immediately blue, then by degrees decolorised. | Colouring matter extracted on boiling, yielding a reddish-violet solution, which changes to blue on addition of concentrated hydrochloric acid. | Treated with picric acid the fibre becomes black. Even dilute acetic acid brings about a change in colour from violet to blue. |
| 134.<br>Hessian Violet. [L.] [A.] [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately blue, liquid colourless.<br>*Dil.*:—Fibre immediately blue, liquid colourless; heated—liquid very faint rose-colour. | *Conc.*:—Fibre immediately reddish-violet, liquid faint dirty violet; heated—fibre almost decolorised (brownish), liquid brownish. On addition of water—fibre completely decolorised.<br>*Dil.*:—Fibre immediately blue, liquid colourless; heated—fibre at first dark brown, then bright brownish, liquid golden yellow. | *Conc.*:—Fibre immediately blue, liquid faint violet. On addition of water—liquid reddish-violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately reddish-violet, liquid colourless; heated—fibre Bordeaux-red. On addition of water—fibre again reddish-violet.<br>*Dil.*:—Fibre immediately reddish-violet; heated—liquid reddish-violet; acidified—violet. | Same as dilute soda-lye. | Fibre immediately blue, then decolorised by degrees. | Colouring matter immediately extracted on boiling, forming a rose-coloured solution, which on addition of concentrated sulphuric acid becomes blue. | The colour of fibre changed to blue by very dilute acetic acid. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | StannousChloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 135.<br>Diamine Violet N. [C.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately blue, liquid colourless. Original colour restored on rinsing.<br>*Dil.*:—Fibre immediately bluish-violet, liquid colourless. | *Conc.*:—Fibre at first dark blue, rapidly changing to chocolate-brown, liquid the same. On addition of water—fibre decolorised, liquid reddish.<br>*Dil.*:—Fibre immediately bluish-violet, liquid colourless; heated—fibre chocolate-brown. | *Conc.*:—Fibre immediately greenish-blue, liquid the same (faint colour). On addition of water—fibre navy-blue, liquid faint violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre somewhat redder, liquid colourless.<br>*Dil.*:—Fibre immediately redder, liquid colourless; heated—liquid faint rose; acidified—faint reddish-violet. | Same as dilute soda-lye. | Fibre at first blue, then gradually decolorised. | No action. | More persistent towards dilute acetic acid than the two preceding dyes. |
| 136.<br>Gallein. [B.] [By.] [M.] [D.H.]<br>Alizarin Violet.<br>Anthracene Violet.<br>(*Animal fibre.*) | *Conc.*:—Fibre at first reddish-violet, then dark red; heated—fibre brownish-red, liquid brownish.<br>*Dil.*:—Heated—fibre coffee-brown, liquid bright-brown; with excess of soda-lye—violet. | *Conc.*:—Fibre immediately dark reddish-brown, then coffee-brown, and finally brownish-yellow.<br>*Dil.*:—Fibre reddish-violet; heated—fibre yellow. | *Conc.*:—Fibre dark coffee-brown, liquid brownish; heated—fibre orange-brown, liquid brownish-orange.<br>*Dil.*:—Fibre reddish-violet; heated—fibre reddish-brown, liquid brownish; with excess of soda-lye—violet. | *Conc.*:—Scarcely any perceptible action.<br>*Dil.*:—No action. | No action. | Warmed—fibre reddish-brown, liquid brownish; boiled—fibre brown, liquid brownish-orange. | No action. | Chromium should be found in the ash. |
| 137.<br>Gallocyanin. [D.H.]<br>Violet solide. [D.H.]<br>Solid Violet. [D.H.]<br>(*Animal fibre.*) | *Conc.*:—Fibre and liquid blue; on addition of water—fibre as originally, liquid violet.<br>*Dil.*:—Heated—liquid intensely violet; with excess of soda-lye—almost decolorised (faint reddish-violet). | *Conc.*:—Fibre brown; heated—fibre brighter, liquid brownish. On addition of water—fibre decolorised.<br>*Dil.*:—Heated—fibre almost decolorised (dirty), liquid brownish. | *Conc.*:—Fibre unaltered, liquid violet; on addition of water—fibre bluish-red, liquid intensely bluish-red.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre black, liquid colourless; on addition of water—fibre violet-black.<br>*Dil.*:—Fibre darker; heated—fibre violet-black, liquid reddish-violet; acidified—bluish-red. | No action. | Heated—fibre decolorised, liquid colourless. | No action. | Boiling ammonium acetate solution extracts very little of the dye, forming a faintly bluish solution; on addition of concentrated sulphuric acid to the latter it becomes rose. The ash contains chromium. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 138.<br>Alizarine VI. [B.]<br>Alizarine No. 1.<br>[M. [illegible] N.]<br>Alizarine Ie. [By.]<br>Alizarine V. [Bi.]<br>Alizarine Ia<br>[L. and S.]<br>*(Iron Mordant.)*<br>*(Vegetable fibre.)* | *Conc.:*—Fibre dark brown, liquid yellowish; heated—fibre bright yellow.<br>*Dil.:*—Heated—fibre and liquid yellow; with excess of soda-lye—liquid violet. | *Conc.:*—Fibre dark brown, then by degrees yellow; liquid yellow.<br>*Dil.:*—Heated—fibre decolorised, liquid yellow; with excess of soda-lye it does not become violet. | *Conc.:*—Fibre red, liquid the same; on addition of water—fibre yellow, liquid yellowish.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Heated—liquid faint violet.<br>*Dil.:*—Heated—liquid faint violet; acidified—faint yellowish colour. | No action. | Fibre at first dark brown; warmed somewhat—fibre yellow, liquid the same, then fibre slowly decolorised. | No action. | The ash contains iron. |
| 139.<br>Archil.<br>*(Natural [illegible])* | *Conc.:*—Fibre somewhat redder: heated—fibre fuchsine red, liquid faint reddish tint; on addition of water—fibre again bluer, but not like the original tint.<br>*Dil.:*—Heated—fibre fuchsine-red, liquid bluish-rose; with excess of soda-lye—reddish-violet. | *Conc.:*—Fibre ponceau-red, liquid the same; heated—fibre brown, liquid brownish-red.<br>*Dil.:*—Fibre fuchsine-red—fibre reddish-brown, liquid brownish. | *Conc.:*—Fibre darker; heated—fibre dark dirty violet, liquid faint dirty violet; on addition of water—fibre and liquid reddish-violet.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Heated—fibre bluish-violet, liquid faint violet (dirty).<br>*Dil.:*—Fibre bluish-violet, liquid faint violet; acidified—bluish-rose. | Fibre bluish-violet; heated—liquid faint violet; acidified—bluish-rose. | In the cold—liquid rose; heated—fibre decolorised, liquid faint orange. | Little action. | Boiling ammonium acetate solution extracts the dye, forming a reddish-violet solution.<br>(See under magenta.) |
| | | | | BLUE DYES. | | | | |
| 140.<br>Victoria Blue B.<br>[B. [illegible] Bi.]<br>Victoria Blue BS.<br>[B.] [B.]<br>*(Animal fibre.)* | *Conc.:*—Fibre gradually bluish-black, then dark brown, and finally bright reddish-brown; on addition of water—fibre as originally.<br>*Dil.:*—Heated—fibre green, liquid faint yellowish tint; with excess of soda-lye—faint rose-colour. | *Conc.:*—Fibre at first black, then dark brown, and finally bright reddish-brown; heated—fibre dark green.<br>*Dil.:*—Heated—fibre yellowish-green, then by degrees yellow; liquid colourless. | *Conc.:*—Same as concentrated hydrochloric acid.<br>*Dil.:*—Same as dilute hydrochloric acid. | *Conc.:*—Heated—fibre dark brownish-red, liquid colourless.<br>*Dil.:*—Warmed—Fibre brownish-red, liquid colourless. | Heated—fibre violet-brown, liquid colourless. | Heated—fibre reddish-brown, liquid brownish. | Dye slightly extracted on boiling. | Night blue (B) behaves similarly to Victoria blue, only in the reaction with concentrated nitric acid, after heating, the fibre is not green, but olive, and finally yellow. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 141.<br>Bavarian Blue D S F. [A.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid faint bluish tint.<br>*Dil.*:—Heated—liquid blue; with excess of soda-lye—rose. | *Conc.*:—Fibre greenish, liquid blue; on addition of water—fibre yellowish-green.<br>*Dil.*:—Heated—fibre green, liquid blue; then by degrees—fibre moss-green, liquid green. | *Conc.*:—Fibre and liquid brownish-red. On addition of water—fibre again blue, liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre bluish-grey, liquid colourless; heated—fibre brownish-red.<br>*Dil.*:—Fibre brownish-red, liquid colourless. | Fibre decolorised, liquid colourless. On rinsing with acidified water the original colour is restored. | Colour destroyed on heating, liquid greenish-blue. | No action. | .. .. |
| 142.<br>Aniline Blue (soluble in spirit).<br>Gentiana Blue 6 B. [A.]<br>Spirit Blue. [B.] [L.]<br>Opal Blue. [B.]<br>Bleu de nuit.<br>Bleu lumière.<br>Fine Blue.<br>Hessian Blue. [L.]<br>(*Animal fibre.*) | *Conc.*:—Heated—liquid faint greenish tint. On addition of water—liquid faint violet.<br>*Dil.*:—Heated—liquid faint bluish tint. | *Conc.*:—Fibre blackish-blue, liquid somewhat blue; heated—fibre green, liquid greenish. On addition of water—fibre and liquid bright yellow.<br>*Dil.*:—Heated—fibre moss-green, liquid faint yellowish colour. | *Conc.*:—Fibre dark brown, then scarlet; liquid red. On addition of water fibre and liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre reddish-brown, liquid colourless.<br>*Dil.*:—Heated—fibre reddish-brown, liquid colourless. | Fibre decolorised, liquid colourless. On rinsing with acidified water the original colour is restored. | Colour not destroyed, even on boiling; liquid bluish-green. | No action. | .. .. |
| 143.<br>Alkali Blue. [A.] [B.] [C.] [L.] [M.]<br>Nicholsen's Blue.<br>Bleu soluble.<br>Soluble Aniline Blue.<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre darker, liquid colourless. On addition of water fibre again brighter (Navy blue).<br>*Dil.*:—Heated—liquid faint bluish tint. | *Conc.*:—Fibre dark greenish-blue, liquid colourless; heated—fibre green, liquid greenish. On addition of water—fibre yellow, liquid yellowish.<br>*Dil.*:—Heated—fibre moss-green, liquid greenish-yellow. | *Conc.*:—Fibre at first bluish-black, then dark brown, and finally reddish-brown; heated—liquid faint brownish-red. On addition of water the original colour is restored, liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre darker, then slowly becoming reddish-brown; liquid colourless.<br>*Dil.*:—Fibre by degrees becomes pale Bordeaux-red (bright). On rinsing with acidified water—fibre as originally. | Heated—fibre decolorised, liquid colourless. Fibre rinsed with acidified water—same colour as originally. | On boiling—fibre greenish-blue, liquid greenish. | No action. | Water blue, exhibits essentially the same reactions. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued*.

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 144.<br>Patent Blue Superfine. Extra B N. [M.]<br>(*Animal fibre.*) | *Conc.*:—Fibre at first green, then lemon-yellow; liquid yellowish; original colour restored on rinsing with water.<br>*Dil.*:—Fibre by degrees green, then yellow; heated—liquid bright yellow; with excess of soda-lye—greenish-blue; fibre rinsed with water—again blue (brighter than originally). | *Conc.*:—Fibre at once green, then yellow; rinsed with water—colour partially restored.<br>*Dil.*:—Fibre green; heated—slowly becomes yellow; and heated—fibre again bright green. | *Conc.*:—Fibre by degrees almost colourless; on addition of water—fibre and liquid bright yellow; on protracted rinsing with water—fibre bright green.<br>*Dil.*:—Fibre green; heated—gradually becomes greenish-yellow, liquid yellow; with excess of soda-lye—greenish-blue. | *Conc.*:—On addition of water after being warmed—liquid blue.<br>*Dil.*:—Liquid greenish-blue; acidified—faint yellowish tint. | Heated—liquid intensely blue; acidified—bright yellowish tint. | Warmed—fibre green, then orange-yellow; liquid intensely yellow; finally—fibre decolorised. | No action. | Boiling ammonium acetate solution extracts the dye; the solution on being acidified changes in colour to a bright yellowish shade. |
| 145.<br>Methylene Blue B. B G., [B.]<br>B B in powder extra D. [M.] [A.]<br>B B in powder extra [B.] [M.] [A.]<br>Ethylene Blue. [O.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre bluish-green, liquid greenish; on addition of water—the original colour is restored.<br>*Dil.*:—Heated—fibre bright greenish, liquid greenish-blue; with excess of soda-lye—at first violet, then reddish-violet. | *Conc.*:—Fibre green, liquid the same; heated—fibre darker; on addition of water—fibre bright greenish tint.<br>*Dil.*:—Liquid bluish; heated—fibre decolorised, liquid blue; with excess of soda-lye—yellowish. | *Conc.*:—Fibre yellowish-green, liquid greenish; on addition of water—the original colour is restored, liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre darker; heated—bluish-green, then bright reddish-grey, and finally almost decolorised; on addition of water—liquid rose. On rinsing fibre with acidified water the original colour is restored.<br>*Dil.*:—Fibre redder; heated—fibre almost decolorised, liquid violet. On rinsing fibre with acidified water the original colour is restored. | No action. | Cold—slowly decolorised. | Dye extracted on boiling. | Treated with a 3 per cent. solution of potassium dichromate, fibre at first violet, then decolorised. |
| 146.<br>Nile Blue B B. [B.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately bright orange, liquid faint orange; on addition of water—the original colour is restored.<br>*Dil.*:—Heated—liquid faint yellow; with excess of soda-lye—yellowish-rose. | *Conc.*:—Fibre immediately yellowish-olive, liquid olive-yellow; on addition of water—fibre dirty green.<br>*Dil.*:—Fibre dark green; heated—fibre violet, liquid reddish-violet; with excess of soda-lye—faint orange-yellow. | *Conc.*:—Fibre dark red, liquid faint orange-red; on addition of water—the original colour is restored, liquid green.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre immediately bright red; on addition of water after being heated—liquid rose.<br>*Dil.*:—Fibre immediately bright bluish-red: heated—scarlet, liquid rose; acidified—colourless; rinsed with acidified water—fibre as originally. | Fibre violet-blue; heated—violet; rinsed with acidified water—fibre as originally. | Fibre at first lemon-yellow; heated—colourless, liquid yellow. | Dye extracted on boiling. | .. .. |

DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 147.<br>Basic Blue. [D.H.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre dark violet, liquid violet. On addition of water—fibre as originally.<br>*Dil.*:—Heated—liquid faint violet; with excess of soda-lye—pale violet flocculent precipitate. | *Conc.*:—Fibre at first dark grey, then dark Bordeaux-red; liquid Bordeaux-red.<br>*Dil.*:—Heated—fibre dark violet-grey tint, liquid reddish-violet; with excess of soda lye—pale reddish-violet flocculent precipitate. | *Conc.*:—Fibre immediately black, liquid yellowish-grey; heated—fibre and liquid olive green. On addition of water—both violet-blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre dark grey; on addition of water the original colour is restored.<br>*Dil.*:—Heated—fibre dark grey, liquid colourless. | No action. | Heated—fibre and liquid brownish; then fibre decolorised, liquid reddish. | Little action. | .. .. |
| 148.<br>Fast Blue R. [A.] [B.] [C.]<br>Fast Blue 3 R. [C.]<br>Induline. [By.]<br>Induline. N.N. [B.]<br>Nigrosine (soluble n water). [A.] [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre more greenish, liquid bluish.<br>*Dil.*:—Heated—liquid faint bluish; with excess of soda-lye—bright reddish-violet. | *Conc.*:—Fibre black, liquid violet. On addition of water—liquid reddish-violet.<br>*Dil.*:—Heated—fibre dark grey, liquid deep dirty reddish-violet. | *Conc.*:—Fibre more greenish, liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre reddish-violet.<br>*Dil.*:—Slightly warmed—fibre reddish-violet, liquid colourless. Fibre rinsed with acidified water—again blue. | Heated—fibre reddish-violet, liquid faint reddish-violet; acidified—both blue. | Heated—fibre and liquid dirty green. | No action. | .. .. |
| 149.<br>Woollen Blue S. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre at first green, then orange-yellow; heated—liquid yellowish. On addition of water, the original colour is restored, liquid colourless.<br>*Dil.*:—Fibre bright bluish-green, liquid colourless. | *Conc.*:—Fibre immediately green, then orange-yellow. On addition of water, the original colour is restored.<br>*Dil.*:—Fibre bright green; heated—fibre greenish-yellow, liquid colourless. | *Conc.*:—Fibre olive-green, then orange-yellow; liquid orange-yellow. On addition of water—fibre almost decolorised, liquid yellowish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Slightly warmed—fibre decolorised, liquid colourless.<br>*Dil.*:—Cold—fibre at first bright grey, then gradually decolorised. Rinsed with acidified water—the original colour is restored. | Cold—fibre by degrees almost decolorised (bright grey). | Heated—fibre orange-yellow, liquid yellowish; after remaining for a protracted period—fibre colourless. | No action. | Boiling solution of ammonium acetate extracts the colouring matter somewhat. On adding soda lye to the solution it is decolorised. |
| 150.<br>Indoïn Blue B R. [B.] | *Conc.*:—Fibre dark greenish-blue, liquid bluish. On addition of water—fibre as originally.<br>*Dil.*:—Heated—liquid faint bluish tint; with excess of soda-lye—colourless. | *Conc.*:—Fibre immediately green, liquid intensely green. On addition of water after heating—fibre almost decolorised (deep dirty green).<br>*Dil.*:—Heated—fibre and liquid bluish-green. | *Conc.*:—Fibre greenish-black, liquid dirty moss-green. On addition of water—both blue. No rose-coloured margin, as in case of indigo.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—On addition of water after heating—liquid rose.<br>*Dil.*:—Liquid after remaining for a long time in the cold—faint rose. | No action. | Fibre bleached in the cold. | Dye strongly extracted in the cold. | The reaction with concentrated nitric acid serves to distinguish this dye from indigo. |

### DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE—*continued.*

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 151.<br>New Blue. [C.] [By.]<br>Naphthylene Blue R. in crystals. [By.]<br>Fast Blue 2 B. for cotton. [A.]<br>Fast Blue R. for cotton in crystals. [A.]<br>Cotton Blue R. [B.]<br>Metamine Blue B G. [L.]<br>Meldola's Blue.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre violet-grey, liquid reddish; on addition of water the original colour is restored, liquid bluish.<br>*Dil.*:—Heated—liquid violet-blue; with excess of soda-lye—rose. | *Conc.*:—Fibre and liquid at first violet, then violet-blue; on addition of water after heating—fibre almost colourless, liquid reddish-violet.<br>*Dil.*:—Liquid faint violet; slightly warmed—liquid intensely violet; on boiling, the fibre is almost decolorised (deep grey), liquid reddish-violet; with excess of soda-lye—brownish. | *Conc.*:—Fibre black, liquid blackish; on addition of water—both again blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre reddish-brown, liquid colourless; on addition of water—liquid rose.<br>*Dil.*:—Fibre immediately dark reddish-brown, liquid faint brownish; acidified—faint reddish-violet; rinsed with acidified water—fibre again blue. | Same as dilute soda-lye. | Fibre at first green, then slowly decolorised. | Little action. | .. .. |
| 152.<br>Blue fluorescent. [Bi.]<br>Fluorescirendes Blau. [Bi.]<br>Resorcinol Blue. [K. S.]<br>(*Animal fibre.*) | *Conc.*:—Fibre violet; on addition of water—fibre bright red.<br>*Dil.*:—Fibre at first violet, then pale reddish-violet, and finally bright red; liquid colourless; on rinsing, the original colour is slowly restored. | *Conc.*:—Fibre immediately red; on addition of water—brownish-orange.<br>*Dil.*:—In the cold—same as dilute hydrochloric acid; heated—fibre deep yellow. | *Conc.*:—Same as concentrated hydrochloric acid.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—fibre and liquid greenish-blue; on addition of water—fibre brighter.<br>*Dil.*:—Fibre immediately deep violet; slightly warmed—fibre almost decolorised (bright blue), liquid bluish; acidified—colourless; rinsed with water—fibre is not again rendered blue. | Heated—liquid faint bluish tint, fibre bright blue. | In the cold—fibre becomes gradually brighter. | No action. | Boiling solution of ammonium acetate extracts the dye, forming a blue fluorescent solution. |
| 153.<br>Naphthyl Blue. [K.]<br>(*Animal fibre.*) | *Conc.*:—Fibre redder; on cautious addition of water—again blue.<br>*Dil.*:—No action. | *Conc.*:—Fibre immediately bluish-red; on addition of water—bright dirty greenish colour.<br>*Dil.*:—Fibre brighter and redder; heated—fibre bright yellow, liquid colourless. | *Conc.*:—Fibre immediately bright green; on cautious addition of water—again blue.<br>*Dil.*:—No action. | *Conc.*:—Warmed—fibre greenish-blue, liquid colourless.<br>*Dil.*:—Fibre greyish-blue, liquid colourless; on rinsing with water—fibre as originally. | Same as dilute soda-lye. | In the cold—no action. | No action. | .. .. |

—A. R. L.

### *Modification of Renard's Method for the Detection of Arachis Oil.* H. Kreis. Chem. Zeit. **19**, 451—452.

In Rénard's method, as usually carried out, the fatty acids are precipitated by an aqueous solution of lead acetate. The lead compound formed is a viscous, sticky mass, and is difficult to completely exhaust by treatment with ether. By substituting an alcoholic lead acetate solution the precipitate is obtained in a much more workable form. The method is thus carried out: 20 grms. of oil are boiled with 10 c.c. of NaOH (40 per cent.) and 50 c.c. of alcohol (90 per cent.). After distilling off the alcohol, the fatty acids are separated by HCl, washed with hot water, and dissolved in 100 c.c. alcohol. When cool, run in with constant agitation, a solution of 15 grms. of lead acetate in 150 c.c. of alcohol. After two hours standing, filter through cotton fabric, reduce the residue to powder, pack it into a little paper cup, and extract with ether for six hours in a Soxhlet's apparatus. Then remove the residue from the paper and heat with 250 c.c. of HCl (5 per cent.) in a porcelain basin till the fatty acids float as a clear oil on the surface. By treatment with hot water $PbCl_2$ is removed. When cool, the fatty acids are dried between filter paper and dissolved in 100 c.c. of alcohol (of 90 per cent. strength). The vessel containing the solution stands in water at 15° C., if no arachis oil is present nothing separates after several hours' standing, if 5 per cent. be present a crystalline precipitate is formed as soon as the alcoholic solution has cooled to the temperature of the water.

For a quantitative estimation, the precipitate is filtered off and dried on a tared watch glass. Its weight when dry, multiplied by 110, gives approximately the percentage of arachis oil present in the original mixture.—R. B. B.

### *Detection of Glucose and Milk Sugar in Adulterated Peptones.* L. Ruizand. Rev. internat. des falsificat. 1895, **8**, 136.

When a solution of the peptone under examination is heated with neutral copper acetate, reduction results, if glucose alone be present. To detect milk sugar, 5 grms. of the peptone are dissolved in 45 c.c. of water, 5 c.c. of hydrochloric acid added, and the whole is heated on the water bath for two hours at 70°. After neutralisation with soda, the solution is heated with phenylhydrazine. The hot liquid is filtered to remove glucosazone, whilst on cooling, galactosazone separates from the filtrate. The latter is filtered, washed with cold water, and purified by repeated crystallisation; it can then be identified by the melting point, which should be 188°—191° C.—J. L. B.

### *Detection of Adulteration of Commercial Peptones.* L. Hugoueug. Rev. internat. des falsificat. 1895, **8**, 135.

The author states that he has examined two peptones adulterated with 32 per cent. of milk sugar. Phenylhydrazine serves as a means for the detection of sugars, whilst milk-sugar and glucose can be differentiated by the respective solubility and insolubility in hot-water of their phenylosazones. Milk-sugar, which is characteristic by its passive behaviour towards yeast, can be identified by Rubener's reaction, which consists in adding lead acetate to the hot dilute aqueous sugar solution, boiling, and dropping in ammonia. The solution becomes yellow, then orange-coloured, and finally red.—J. L. B.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Determination of the Affinities of Acids, Colorimetrically, by means of Potassium Bichromate.* J. H. Kastle and B. C. Keiser. Amer. Chem. J. **17**, 443—449.

The authors add to 1 c.c. of decinormal potassium bichromate solution 10 c.c. (or other measured quantity) of normal sodium acetate, formate, or other salt. Change of colour takes place, owing to the formation of normal chromate, involving a corresponding amount of decomposition of the sodium salt. The amount of this is measured by comparison with a second c.c. of the bichromate, to which, after dilution with water so as to correspond with the first, decinormal caustic soda is added till the tints exactly match, a point which can be determined with considerable accuracy. From the amount of bichromate converted into normal salt, is calculated the amount of sodium salt decomposed, and the ratio of the undecomposed to the decomposed salt gives a figure expressing the "affinity" of the acid concerned, on an arbitrary scale, the "affinity of potassium bichromate" being taken as unity.

The figures obtained for the relative affinities of acetic, formic, butyric, benzoic, crotonic, and monobromacetic acids agree fairly with those obtained by other observers, and by different methods; and for the most part the numbers obtained by the action of 1 c.c. of bichromate on 5 c.c. of the various salt solutions bear the same relation to one another as those obtained by using 10 c.c. and 20 c.c., &c., in each case.

The method is useless in the case of strong acids the salts of which are not decomposed by the bichromate, and no satisfactory results have been got with dibasic acids or acids of the lactic type; but the authors propose to carry out further determinations on as many acids as possible.
—J. T. D.

### *Determination of Formic Acid by Titration with Potassium Permanganate.* H. C. Jones. Amer. Chem. J. **17**, 539—541.

The solution containing formic acid is made alkaline with sodium carbonate, warmed and treated with excess of standard permanganate; it is now acidified with sulphuric acid, and excess of oxalic acid run in; the excess of oxalic acid is determined by permanganate, and thus the formic acid can be calculated. Trials with a solution of pure formic acid gave 24·7, 24·9, 25·1 per cent., whilst alkalimetric determination gave 25·1 and 25·3 per cent., and specific gravity determination gave 24·8.

It was found that oxalic and formic acids could not be determined together, by titrating first in acid solution the oxalic, and afterwards making alkaline and titrating the formic acid, as suggested by Saint-Gilles, for invariably the formic acid becomes partially oxidised in the acid solution.—J. T. D.

### *Estimation of Alkyl Groups attached to Nitrogen.* J. Herzig and H. Meyer. Monatsh. für Chem. **15**, 613—626.

The method adopted by the authors is, with slight modifications, that of Zeisel for the estimation of methoxyl groups. The substance (either the free organic base or its hydriodide) is heated with excess of hydriodic acid and ammonium iodide, whereby decomposition takes place with formation of the iodide of the alkyl group which was originally attached to the nitrogen atom of the base. The amount of alkyl iodide is determined by converting it into silver iodide by means of an alcoholic solution of silver nitrate. When several alkyl groups are present in the same molecule, the decomposition must in general be repeated several times. Thus a sample of caffeïne on the first decomposition gave 18·82 per cent. of methyl instead of 23·19 per cent., but a second and third decomposition yielded 2·60 and 0·66 per cent. respectively, a fourth decomposition giving nothing further. The apparatus used by the authors is specially adapted for these repeated decompositions, each of which takes about two hours to perform.—J. W.

### *Determination of Halogens in Organic Substances by the Method of Carius.* F. W. Küster. Liebig's Annalen, 1895, **285**, 340—348.

For heating the substance under pressure the best tubes are those made by Schott in Jena. "Combustion" tubing may also be used. Tubes of ordinary fusible glass are not suitable. The tube should be taken 50 cm. long, 12 mm. internal diameter and should have walls 2 mm. thick. Such tubes may be used for 10 or more analyses; when the length has diminished to 20 cm. they are no longer safe. About 0·5 grm. $AgNO_3$ and 15—20 drops of nitric acid (sp. gr. 1·5) are introduced into the tube, the substance to be analysed is then brought into it, enclosed in a smaller tube closed at one end and 9 mm. internal diameter and 2·5 cm. long. 0·1 to 0·2 grm. of the substance is taken, the quantity of nitric acid mentioned being quite sufficient for its complete decomposition. The tube after sealing before the blowpipe is wrapped in a sheet of filter paper (experience shows that this diminishes the chance of its bursting), and heated in a simple form of air bath for two hours to 320°—340°. After opening the tube the silver chloride formed, is washed out with water into a porcelain basin, digested with water for some time and filtered in a Gooch crucible, dried at 110°, and weighed. AgBr or AgI must be washed more carefully than is necessary with AgCl.

Volhard has proposed to simplify the method by using known quantities of $AgNO_3$ and titrating the excess at the end of the operation with ammonium sulphocyanide. This, however, yields erroneous results because the glass of the tube takes up considerable quantities of silver becoming dark brown. This is more especially the case with more fusible glass.—T. E.

### *Quantitative Determination of Furfurol.* B. Welbel and S. Zeisel. Monatsh. Chem. 1895, **16**, 283—311.

In presence of 12 per cent. hydrochloric acid, furfuraldehyde and phloroglucol very easily undergo condensation, forming a dark-coloured insoluble compound. The whole of the furfuraldehyde and of the phloroglucol is precipitated when the bodies are present in the molecular ratio 3 : 2. If excess of one or other of the substances be present however, it is partially precipitated. By using from 1·25 to 3 parts of (anhydrous) phloroglucol to one part of furfuraldehyde, the weight of the precipitate obtained bears a sufficiently constant ratio to the weight of aldehyde taken to allow of the reaction being used for its quantitative determination. The condensation product contains chlorine, which is only partially removed by washing with water. Methyl-furfuraldehyde from rhamnose gives no dark-coloured condensation product with phloroglucol.

The precautions to be taken in using this reaction for the quantitative determination of furfuraldehyde are as follows:—The aldehyde is dissolved in 12 per cent. hydrochloric acid and the requisite quantity of *pure* phloroglucol in $\frac{1}{20}$ n. solution added, together with so much strong hydrochloric acid that the whole solution shall contain 12 per cent. of it. After standing 40—48 hours at the ordinary temperature, the precipitate is filtered through a weighed asbestos filter, and washed with cold water, alcohol, and ether, until the washings are colourless, and finally dried at 100° to 120° in a current of hydrogen. Under these circumstances one part of furfuraldehyde yields 1·885 parts of the precipitate. Not less phloroglucol than 1·25 times, nor more than three times, the weight of the furfuraldehyde, must be used.—T. E.

### *Investigation of the Twitchell Method for the Determination of Rosin in Soap.* T. Evans and J. E. Beach. Amer. Chem. J. **17**, 1895, 59—67.

Twitchell's process (this Journal, **10**, 1891, 801) having been described by Lewkowitsch (this Journal, **12**, 1893, 505) as the best yet known, but as still inexact, the authors have studied it in detail by working with known mixtures of fatty acids and pure rosin. In etherizing, it was found best to dissolve the sample in absolute alcohol in a 100 c.c. cylinder surrounded by iced water. In the gravimetric process Lewkowitsch's recommendation to wash the petroleum ether layer with a large volume of dilute caustic potash, was followed with advantage. In the volumetric process the use of Twitchell's number (346) for the combining weight of rosin gave high results, and 328·9 was found to be more generally correct. Low results followed the standing over-night, both of the alcoholic solution saturated with hydrochloric acid prior to dilution, and also of the alcohol to which an addition of sulphuric acid had been made. Methyl alcohol also gave lower results than ethyl alcohol. These errors are probably due to decomposition rather than to a slight etherification of the rosin, since no rosin ethers could be isolated. The temperature during etherification must not exceed 20°, nor must the stream of hydrochloric acid gas be too rapid, or low results will be obtained. Check determinations with hydrated resin acids, and fatty acids from ordinary soap stock gave equally good results, showing that common rosin (with resin acid anhydrides) and the specially prepared fatty acids behaved exactly as would the products obtained in course of an ordinary analysis. Twitchell found 0·97 per cent. of unetherized matter in the fatty acids used, whilst Wilson (this Journal, **10**, 1891, 952) found 0·7, and Lewkowitsch 2·28 and 5·1 per cent. from stearic and oleic acids respectively. The authors' results more nearly agree with those of the two first named. Attempts to etherize rosin alone led to a loss only of 0·7 to 2·0 per cent. when ordinary alcohol was used, and of 6·6 to 7·3 per cent. with methyl alcohol. The combining weights of different samples of rosin examined ranged from 328·9 to 354·9, but they showed no relation to the grade of the sample as determined by colour. Lewkowitsch found that a loss of 10—15 per cent. of rosin occurred when the gravimetric process was used; but it is possible to separate the rosin gravimetrically, determine its combining weight, and use the resulting factor in the volumetric process. Experiments in this direction showed that the separated rosin had a much lower combining weight than that of the original sample, which points either to the presence of unsaponifiable matter in the rosin, or to partial etherization of the rosin. Reviewing Lewkowitsch's work, the only place in which so high a loss as 10 per cent. could occur, would be in the petroleum ether layer, from which saponifiable matter had been removed by caustic potash. In one experiment the evaporation of this layer left 9·7 per cent. of a gummy mass, smelling strongly of turpentine, whilst the rosin obtained from the alkaline extract was 86·8 per cent., making a total of 96·5 per cent.; corresponding to an actual loss of only 0·07 grms. In a second case the loss was 0·08 grms. Rosins dissolved in petroleum ether and saponified direct gave similar residues. The calculated combining weights of the saponifiable portions of several rosins agreed well, averaging 316, and would thus seem to confirm Maly's view, that colophony is essentially an anhydride of abietic acid. The authors are continuing their investigations of these points.—W. G. M.

### *Analysis of Sugar Ash.* F. G. Wiechmann. School of Mines Quarterly, 1895, **16** [2], 128—134.

The author propounds the following scheme of analysis:—10 grms. of the sugar are dissolved in warm water and the solution filtered, evaporated to dryness, and carbonised. The residue is boiled with water for an hour, the solution filtered, and the residue washed, ignited, and weighed as insoluble ash. The filtrate is evaporated to a small bulk, treated with ammonium oxalate, and the evaporation continued to dryness. The residue is heated to decompose oxalates, moistened with ammonium carbonate, dried, heated, and weighed as soluble ash. The sum of the soluble and insoluble ash represents the "total carbonated ash" The whole of the ash, soluble and insoluble, is dissolved in hydrochloric acid, and the solution evaporated to remove silica, which is filtered off and determined. The filtrate is precipitated with ammonia, ferric oxide and alumina (with some phosphate) being thrown down. The mixed precipitate is ignited and weighed. The filtrate is treated with ammonium oxalate, evaporated to dryness, the residue ignited, and the insoluble portion collected and weighed as carbonates of calcium and magnesium. The soluble portion is evaporated, treated with ammonium carbonate, gently ignited, and weighed as alkaline carbonates.

The determination of the mineral acids in the ash is made on another portion of 10 grms., which is carbonised, extracted with water, the solution being made up to 500 c.c. and 50 c.c. taken for determination of Cl. The residue left by the aqueous extraction is ignited, dissolved in hydrochloric acid, and the solution made up to 250 c.c. 100 c.c. of this solution are mixed with 200 c.c. of the aqueous extract, and the mixture is divided into equal portions. In one of these, sulphuric acid, and in the other phosphoric acid, are estimated in the usual manner. The author notes that a part of the alkali salts is left in the carbonised residue, even after washings therefrom have ceased to give a reaction for chlorine. In conclusion, he calls attention to the various existing methods of stating the results of analyses of sugar-ash, and advocates the system of returning the percentages of individual elements without reference to the form of combination in which they may occur. He appends a table of factors for converting the ordinary compounds, customarily returned in such analyses, into their constituent elements.—B. B.

### *The Copper Cyanide Reaction for the Estimation of Glucose.* A. W. Gerrard. Pharm. J. and Trans. 1895, **25**, 913.

When a solution of copper sulphate is added to a solution of potassium cyanide, a colourless stable potassium copper cyanide is formed according to the equation :—

$$CuSO_4 + 4KCN = Cu(CN)_2.2KCN + K_2SO_4.$$

This double salt is not attacked by alkalis, hydrogen sulphide, or ammonium sulphide. The addition of mineral acids causes a white curdy precipitate. If potassium cyanide be added to Fehling's solution, the blue colour disappears simultaneously with the formation of the double salt, and if now boiled with a solution of glucose, no precipitation of cuprous oxide results. If there be present twice the amount of Fehling's solution capable of being decolorised by the cyanide, the mixture will be blue, and when boiled with a solution of a reducing sugar, reduction takes place, together with a steady disappearance of the blue colour, and not accompanied with the deposition of cuprous oxide, in this respect behaving like Pavy's solution.

For the estimation of sugar, 10 cc. of Fehling's solution is boiled with 40 cc. of water in a porcelain basin. A 5 per cent. solution of potassium cyanide is added until the colour just vanishes, carefully avoiding excess; another 10 cc. of Fehling's solution is added, and into the boiling liquid urine or sugar solution is run in until the blue colour disappears. The volume of sugar solution thus required will contain 0·05 grm. of glucose. Solutions containing above 0·5 per cent. of glucose should be diluted 10 times before testing.
—J. L. B.

### *Determination of the Extract of Malt in the Laboratory.* J. Heron. J. Fed. Inst. Brewing, 1895, **7**, 116—118.

The author described a method of obtaining the normal extract from malt (this Journal, 1888, 267 . He states that it is frequently useful to determine the "highest available extract," and this is carried out in the following manner :—50 grms. of finely-ground malt are treated with 400 c.c. of water at 55°, so that the initial heat of the mashing may be 50°. The temperature is so arranged that at the expiration of an hour it has reached 70° ; after being raised to 88° for 15 minutes, then cooled to 15·5, the mash is made up to 515 cc. (considered as 500 c.c.), shaken, and the specific gravity determined. The extract is then calculated in the usual way.—J. L. B.

### *Gravimetric Estimation of Dextrose, Levulose, and Cane Sugar as Phenylglucosazone.* C. J. Lintner and E. Kröber. Zeits. ges. Brauw. 1895, **18**, 153—155.

The estimation of dextrose in presence of other reducing sugars is attended with considerable difficulty, and the authors propose to estimate it gravimetrically as phenylglucosozone. Maquenne (Comptes rend. **112**, 799) determined the amount of osazone formed from various sugars, but inasmuch as he had their differentiation only in view, his data were of no value to the authors.

1—2 c.c. of a 10 per cent. solution of dextrose is heated on the water-bath for 1—2 hours with 18—19 c.c. of water, 1 grm. of phenylhydrazine, and 1—1·5 grms. of 50 per cent. acetic acid. The osazone is collected on a tared filter, washed with 60—80 c.c. of boiling water, and weighed after drying for 3 hours at 105°—110°. Under these conditions 0·1 grm. of dextrose yields 0·1 grm. of osazone. If dextrin or maltose be present the heating should be continued for 2 hours, and the subsequent treatment being the same, 0·1 grm. of dextrose yields 0·104 grm. of osazone.

Levulose is more quickly converted into glucosazone than glucose; and, under similar conditions, 0·1 grm. of this sugar yields 0·143 grm. of osazone. Cane sugar is first inverted with hydrochloric acid; and after neutralisation the liquid is diluted with water to 20 c.c. and the osazone prepared; 0·1 grm. of cane sugar then yields 0·133 of osazone. The authors point out that these results are of considerable importance, since the estimation of dextrose in presence of maltose, isomaltose, and dextrins, is rendered possible, which otherwise could not be carried out without the aid of the polariscope and Fehling's solution.
—J. L. B.

### *Analysis of Beer, with some Remarks on the Unfermentable Reducing Residue.* G. H. Morris. J. Fed. Inst. Brewing, 1895, **1**, 125—139.

Heron (this Journal, **7**, 267) published a method of beer analysis, the results of which gave the fermented matter, maltose unfermented, dextrin unfermented, and undetermined matter. This method was subsequently elaborated by H. T. Brown and the author, and they estimated fermented matter, free maltose, free dextrin, combined dextrin, combined maltose, taking undetermined matter by difference. In consequence of the recognition of an unfermentable reducing residue in worts and beers, it was found necessary to express the results in a different manner. The author now estimates—

The matter fermented,
Low type malto-dextrins, calculated as maltose,
Combined maltose } constituting the normal
Combined dextrin } malto-dextrins,
Free dextrin,
Unfermentable reducing residue, calculated as maltose,
Undetermined matter (by difference)

by the following operations :—

*The original gravity* is determined in the usual way, and the fermented matter calculated from the degrees of gravity lost, corresponding to the "spirit indication."

*The original reducing power* is determined on from 3—10 c.c. of the beer, according to the strength and age. 200 c.c. are then evaporated to about one-half, to expel the alcohol, and the residue is made up to the original volume; it is then treated in the following manner :—

(*a.*) *Degradation with Cold Water Malt Extract.*—50 c.c. are placed in a 100 c.c. flask, and 2·5 c.c. of the malt extract added; the mixture is then digested at 55° for one hour. The liquid is boiled, cooled, and made up to 100 c.c. at 15·5. After filtering, the reducing power (in 5 c.c. or 10 c.c.) and the opticity are determined in the usual way.

50 c.c. of the malt extract are digested side by side with the above, then boiled, cooled, and made up to 100 c.c. The reducing power (in 3 c.c.) and the opticity are determined, and the result applied as a correction to the numbers obtained in (*a.*).

(*b.*) *Fermentation.*—In order to determine the low type malto-dextrins remaining unfermented, a second 50 c.c. of the residue are set to ferment with 0·25 grm. of pressed yeast at 20°. Fermentation ceases at the end of about 72 hours; the liquid is then cooled, a little alumina cream added, and the whole made up to 100 c.c. After filtration, the reducing power is determined in 5 c.c. or 10 c.c. of the filtrate.

(*c.*) *Fermentation in the Presence of Cold Water Malt Extract.*—It is necessary to correct the numbers in (*a*) and (*b*) for the unfermentable and reducing substances present in the beer. In order to do this, 50 c.c. of the residue are fermented as in (*b*), but with addition of 2·5 c.c. of cold water malt extract. When the fermentation is complete, the liquid is treated in all respects as in the last determination, and the reducing power (in 10 c.c.) and opticity are determined in the bright solution. Owing to the malt extract containing reducing and fermentable substances, it is necessary, to arrive at a correct result, to ferment 50 c.c. of the extract side by side with the above, and, after fermentation is at an end, make up to 100 c.c. and determine the reducing power and opticity of the residue.

The method of calculation is as follows :—

The low type malto dextrins are obtained by deducting the copper oxide, after fermentation, from the original reducing power, and calculating the difference into maltose. The combined maltose is arrived at by deducting the reducing power, after fermentation with cold water malt extract, from that after fermentation alone. The combined dextrin is calculated from the increase in reducing power after degradation with malt extract. The free dextrin is found from the opticity after degradation, less that due to the total maltose and the unfermentable residue. And the unfermentable residue is obtained from the reducing power after fermentation with cold water malt extract, the proper corrections for the malt extract itself being applied when necessary.

The author cites experiments to show that the unfermentable reducing residues present in worts and beers, to the average extent of 4·99 per cent. of the wort solids calculated as maltose, is derived solely from the malt. When 90 per cent. alcohol is added to fermented malt extract a substance is precipitated partially soluble in water. The soluble portion consisted of a gummy substance, which reduced Fehling's solution slightly, and was converted by the action of acid into a strongly reducing substance, it gave the furfurol reaction, and its solution caramelised on heating; the insoluble portion consisted of nitrogenous bodies and mineral matter containing phosphates. The portion of the extract soluble in 90 per cent. alcohol had a considerable reducing power, which was but slightly increased by the action of acid. It gave the furfurol reaction, and its solution caramelised when heated. The substance was lævo rotatory, and yielded a phenylosazone crystallising in groups of needles, melting at 175°.—J. L. B.

### *The Polarisation and Analysis of Black Beers, Worts, and Caramels.* J. Heron. J. Fed. Inst. of Brewing, 1895, **2**, 110—116.

The polarimetric analysis of black beers, worts, and caramels cannot be carried out unless these are previously diluted. The author points out that under these circumstances contraction takes place and that an error is thereby introduced. Besides this the actual error in reading is multiplied according to the amount of dilution. As an alternative method he suggests the use of a solution freshly prepared from perfectly dry bleaching powder to decolorise the liquids mentioned, prior to the polarimetric reading. Experiments are quoted showing that bleaching powder solution has no influence on the optical rotations of solutions of cane sugar, invert sugar, and dextrin-maltose.—J. L. B.

### *Determination of the Dry Substance in Malt, Wort, and Beer.* H. Elion. J. Fed. Inst. of Brewing, 1895, **1**, 23—29.

The author employs a cylindrical jacketed oven arranged horizontally, the temperature being maintained at 97° by steam or boiling water. The air within the cylinder is reduced by a water pump, to a pressure of 40—50 mm. and a small quantity of air previously passed through sulphuric acid is admitted. The material to be dried is placed in a small, wide, cylindrical, weighing bottle which can be fitted with an air-tight stopper (Zeit. angew., Chem. 1890, 291 and 321). Under these conditions the author claims that the substance is dried more quickly, and with less decomposition, than in a water-oven at the ordinary atmospheric pressure.—J. L. B.

## *ANALYTICAL AND SCIENTIFIC NOTES.*

### *A Laboratory Method for the Preparation of Potassium Ferricyanide.* Amer. Chem. J. **17**, 1895, 68.

The usual method for preparing ferricyanide (by adding chlorine or bromine water to potassium ferrocyanide) is unsatisfactory, by reason of the formation of ferricyanides of iron The author prefers to use potassium permanganate. 26 grms. of potassium ferrocyanide are dissolved in 200 c.c. of cold water, 8 c.c. of strong hydrochloric acid are added ; and then 2 grms. of potassium permanganate in 300 c.c. of water are introduced slowly. The solution should give the usual brown colour, but no precipitate, with ferric chloride solution. The excess of acid is neutralised with calcium or barium carbonate, and the solution is evaporated on the water-bath. The first crystals will be pure, and will show a large development of the plane $\infty P \grave{\infty}$ which rarely appears in crystals prepared by the older methods. The subsequent crystals may contain chlorides, but are readily purified by fractional crystallisation.—W. G. M.

### *The Influence of Magnesia Mixture on Glass.* L. L. De Koninck. Chem. Zeit. **19**, 450—451.

The ease with which the glass of the bottles used for reagents is acted upon by the reagents is a frequent cause of complaint. No mention has hitherto been made of the attack on glass by magnesia mixture used in the estimation of phosphoric acid. The author found that when this solution is stored in glass bottles, an efflorescence is formed on the sides which gradually becomes thicker. If rinsed off the sides by shaking the bottle, it appears as a scum on the surface, lustrous like mother-of-pearl. If this deposit be entirely removed from the glass by rubbing, and the bottle be thoroughly rinsed, the glass shows no sign of having been attacked.

In appearance and greasy feel the substance resembled talc powder. On drying at 100° C. it lost 13·5—18 per cent. of water, but in the air it again absorbed moisture. An analysis of the substance, brought to constant weight in air, gave :—

Water, lost at 100°, 13·43 ; water lost above 100°, 17·86 ; total 31·29 per cent. ; silica ($SiO_2$), 32·99 ; magnesia ($MgO$), 34·80; alumina ($Al_2O_3$) and traces of ferric oxide, 0·87 ; total, 99·95.

From this analysis the formula $18MgO, 11SiO_2, 35H_2O$ might be deduced, or possibly more simply $3MgO, 2SiO_2, 6H_2O$. The substance shows no definite crystallisation, nor does it influence a ray of polarised light. Although similar to talc in physical properties, in chemical constitution it resembles serpentine $3MgO, 2SiO_2, 2H_2O$ ; only differing in the amount of water present. This is particularly interesting as serpentine is a mineral of secondary formation, *i.e.*, it is the product of the alteration of a pre-existing silicate, and may perhaps result from the action of a solution containing magnesia on siliceous rocks.

Experiments were carried out with bottles made from various kinds of glass, and it was found that although some were much more readily attacked than others, the substance formed was the same in every case.—R. B. B.

# New Books.

CHEMISTRY OF URINE. A Practical Guide to the Analytical Examination of Diabetic, Albuminous, and Gouty Urine. ALFRED H. ALLEN, Past President of the Society of Public Analysts, &c. London: J. and A. Churchill, 11, New Burlington Street. 1895. Price 7*s.* 6*d.*

OCTAVO volume, bound in cloth, and containing, besides the preface and table of contents, 208 pages of subject-matter. The text is illustrated with 19 well-executed wood engravings. An alphabetical index terminates the work. The subjects treated of are as follows:—GENERAL COMPOSITION OF URINE. PRELIMINARY EXAMINATION OF URINE. DIABETIC URINE. ALBUMINOUS URINE. THE NITROGENOUS CONSTITUENTS OF URINE. COLOURING MATTERS OF URINE. APPENDIX. Very considerable stress is laid in this work on the analytical methods best adapted for the determination or detection of those substances the presence of which serves to characterise the urinary disorders under investigation.

CHEMISTRY, INORGANIC AND ORGANIC, WITH EXPERIMENTS. By CHARLES LOUDON BLOXAM. Eighth Edition, re-written and revised by J. MILLAR THOMSON, Professor of Chemistry, King's College, London, and ARTHUR G. BLOXAM, Director of Chemistry Department, Goldsmiths' Institute, New Cross, London. London: J. and A. Churchill, 11, New Burlington Street. 1895. Price 18*s.* 6*d.*

IN the preface to this work the Editors state that this Eighth edition "has been carefully revised and to a great extent re-written, the main object being to preserve as far as possible, within the limits of a single volume, the original character of the book as a text-book and work of reference."

The book is of 8vo size, bound in black cloth, and contains Preface, Table of Contents, 806 pages of subject-matter illustrated by 281 wood engravings, and a copious alphabetical index. The arrangement of the work somewhat differs from that of most other theoretical text-books of Chemistry, in that an additional chapter is added in the portion dealing with inorganic chemistry, devoted to sundry branches of "*Applied Inorganic Chemistry,*" and a similar one at the end of the branch devoted to Organic Chemistry, devoted to certain branches of "*Applied Organic Chemistry.*"

UEBER GEFAHREN FÜR DIE ARBEITER IN CHEMISCHEN FABRIKEN, UNFALLVERHÜTUNGSMITTEL UND ARBEITSBEDINGUNGEN. Eine durch den englischen Parlamentsbericht von 1893 veranlasste kritische Besprechung englischer und deutscher Industrieverhältnisse, von Dr. KONRAD W. JURISCH, Docent an der Königlichen Technischen Hochschule zu Berlin. Mit vier Tafeln. 1895. Price 6*s.* Berlin: R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstrasse 26.

THIS work consists of a full critical report "On the Dangers for Workpeople in Chemical Factories, with Means for Preventing Accidents, and a Consideration of the Working Conditions." It was occasioned by the appearance of the English Parliamentary Report of 1893, and it covers the ground both for the German and English Chemical Industries, and is thus more or less of a comparative character.

The book is contained in paper cover, contains 130 pages of subject-matter, four sheets of engravings illustrating items of plant, and a full Table of Contents serving also as Index. The following are the branches of Manufacture dealt with from the standpoint mentioned, and to give general illustration of the method of treatment in each case, the items under the first branch, *Chloride of Lime,* will be given:—I. General Remarks and Introduction. II. CHLORIDE OF LIME. Description of Manufacture. Protective Measures. Influences on Health. Medical Attention. Self-help on the Part of the Workpeople. Critique as to Results. Other Methods of Chloride of Lime Making. Special Recipes. Arrangement of the Works. Periods of Work, and Wages. Comparative Statistics. Age and Mortality. German Chloride of Lime Manufacture. III. SALT-CAKE AND HYDROCHLORIC ACID. IV. Sulphuric Acid. V. Caustic Soda. VI. Chlorate of Potassium and Sodium. VII. Carbonate of Soda. VIII. Sulphur. IX. Chrome Salts. X. Chemical Works in General. XI. Conditions of Labour in the Chemical Works of Germany. XII. Chemical Works of other States. XIII. Concluding Remarks. APPENDIX. Recipes for the Prevention of Accidents in Various Works.

HANDWÖRTERBUCH DER PHARMACIE. Praktisches Handbuch für Apotheker, Aertzte, Medicinalbeamte und Drogisten. Herausgegeben von A. BRESTOWSKI. Wien und Leipzig: Wilhelm Braumüller, k. u. k. Hof- und Universitäts-Buchhändler. 1895. London: H. Grevel and Co., 33, King Street, Covent Garden.

IN continuation of Vol. II. of this Dictionary of Pharmacy, Parts 21 and 22 are now issued. Part 21 begins with "*Stercoisomerie*" and concludes with "*Thymelæaceæ,*" the latter article being continued into Part 22, which ends with *Vitaceæ*. The conclusion of this article will be found in Part 23, yet to appear.

THE SCIENCE AND ART OF BREAD MAKING. Chemistry and Analysis of Wheat, Flour, and other Materials employed in Baking. By WILLIAM JAGO, Chemist to the National Association of Master Bakers and Confectioners of Great Britain and Ireland, &c. London: Simpkin, Marshall, Hamilton, Kent, and Co., Limited. 1895. Price 15*s.*

THIS is an 8vo volume, bound in cloth, and containing preface, table of contents, an introductory chapter containing definitions of the principles of heat, and of chemical principles. Including this chapter the work contains 637 pages of subject-matter and a carefully arranged alphabetical index. The text is illustrated by some 81 engravings. The general style and plan of the work will be gathered from the following synopsis of its contents:—Chap. I. Introductory. II. Description of Chemical Elements and their Inorganic Compounds. III. Description of Organic Compounds. IV. The Microscope and Polarisation of Light. V. Constituents of Wheat and Flour: Mineral and Fatty Matters. VI. The Carbohydrates. VII. The Proteids. VIII. The Enzymes. IX. Fermentation. X. Bacterial and Putrefactive Fermentation. XI. Technical Researches on Fermentation. XII. Manufacture and Strength of Yeast. XIII. Physical Structure and Physiology of the Wheat Grain. XIV. Chemical Composition of Wheat. XV. Chemical Composition of Flour and other Milling Products. XVI. Bread Making. XVII. Special Breads and Bread-Making Processes. XVIII. Bakehouse Design. XIX. The Machine Bakery and its Management. XX. Analytical Apparatus. XXI. Commercial Testing of Wheats and Flours. XXII. Determination of Mineral and Fatty Matters in Wheats and Flours. XXIII. Soluble Extract, Acidity, and Proteids. XXIV. Estimation of Carbohydrates, and Analysis of Bodies containing the same. XXV. Bread Analysis. XXVI. Adulteration.

JAHRESBERICHT ÜBER DIE LEISTUNGEN DER CHEMISCHEN TECHNOLOGIE, MIT BESONDERER BERÜCKSICHTIGUNG DER GEWERBESTATISTIK FÜR DAS JAHR 1894. Von DR. FERDINAND FISCHER. Mit 206 Abbildungen. Leipzig: Verlag von Otto Wigand. London: H. Grevel and Co., 33, King Street, Covent Garden. 1895. Price 24*s.*

ANNUAL Report of the progress and condition of Chemical Technology, with trade statistics, for the year 1894, especially as regards the German Empire. Fischer's Jahresbericht for 1893, contained 1209 pages of subject-matter. The present one for 1894, contains 1150 pages, whilst its complete alphabetical indexes for authors and subject-matter extend from page 1151 to 1199, *i.e.*, over 48 pages. An index of German Patents completes the volume, and it fills 9 pages.

The text is illustrated with 206 engravings referring to plant and apparatus. The following is an epitome of the subjects treated of in the volume classified, and the extent of each group denoted by the pages filled. GROUP I. CHEMICAL TECHNOLOGY OF FUEL (pages 5 to 133). II. METALLURGY (pages 135 to 343). III. ELECTRO-CHEMISTRY (pages 344 to 429). IV. CHEMICAL MANUFACTURES, INORGANIC (pages 430 to 567). V. CHEMICAL MANUFACTURES, ORGANIC (pages 568 to 734). VI. GLASS, POTTERY, AND EARTHENWARE; CEMENTS, ARTIFICIAL STONE, &c. (pages 735 to 789). VII. FOODSTUFFS (pages 790 to 977). VIII. CHEMICAL TECHNOLOGY OF THE TEXTILE FIBRES (pages 978 to 1065). IX. OTHER ORGANIC CHEMICAL INDUSTRIES (pages 1066 to 1150).

A comparison of the literature of this volume with that of the Jahresbericht for 1893 indicates the addition in the latter of a new group, viz., Group III., devoted to Electro-Chemistry.

# Trade Report.

## TARIFF CHANGES AND CUSTOMS REGULATIONS.

*From the Board of Trade Journal.*

### RUSSIA.

#### *Modification of Duty on Cream of Tartar.*

*Note.*—Gold rouble (100 copecks) = 3*s.* 2*d.* Poud = 36 lbs. avoirdupois.

A despatch, dated 18th June last, has been received by the Foreign Office from Sir Frank Lascelles, Her Majesty's Ambassador at St. Petersburg, in which it is stated that, by a decision of the Imperial Council, confirmed by His Majesty the Emperor on the 20th of May last, and promulgated in the "Official Gazette" of the 12th of June 1895, the following modification of the duty under section 95 of the Russian Customs tariff relating to cream of tartar is decreed.

The modification in question consists in a distinction being made between the raw and the semi-refined product, the latter now paying a higher rate of duty than the former:—

Section 95, point 1.—Cream of tartar, raw (unrefined), tartaric acid, lime, raw (unrefined), 60 copecks gold per poud.

Point 2.—Cream of tartar, semi-refined (not in powder), with its natural tinge, 75 copecks gold per poud.

### NORWAY.

#### *Tariff Changes.*

In a list of alterations made in the Norwegian tariff which came into operation on the 1st July last the following occur:—

| No. in Tariff. | Goods. | Rates. | |
|---|---|---|---|
| | | New. | Old. |
| | | | Öre per Kilog. |
| 365 | Oils, naphtha of petroleum and benzene. | Free | 7 |
| 419 | Salts and acids in general. Consequently alum, borax, lemon juice, potash, saltpetre, soda, vitriol, disappear from the tariff as duty-free goods. | " | 7 |

### SPAIN.

#### *Tariff Changes.*

A despatch, dated 1st July 1895, has been received at the Foreign Office from Sir H. Drummond Wolff, notifying alterations in the import duties on certain articles, and especially calling attention to the fact that the extra duty on foreign coal and coke is 1 peseta per ton, instead of 2½ pesetas as originally proposed.

The following are the alterations referred to:—

Art. 48. Sections 8 and 9 of tariff to be modified.

(8.) Naphtha oil, vaseline, and raw petroleum to pay 30 pesetas per 100 kilogs.

(9.) Benzine, gasoline, and refined petroleum, &c., 42 pesetas per 100 kilogs.

Art. 49. Foreign mineral coal and coke to pay an additional peseta per ton of 1,000 kilogs.

Coal employed for metallurgic and siderurgic purposes is exempted from this additional duty.

Art 50. The importation of phosphorus can only be made through the Matchmakers' Association, this association being obliged to supply other industries which used it at cost price.

Art. 53. The duty on powder and explosives created by Article 49 of the law of 5th August 1893 shall be regulated on the following scale:—

Ordinary sporting powder, 40 centimos per kilog.
Blasting powder, 10 centimos per kilog.
Dynamite and other explosive mixtures, including nitramite, 30 centimos per kilog.
An association of manufacturers may be formed to substitute for this duty a yearly contribution of at least 600,000 pesetas.

### VICTORIA.

#### *Tariff Decisions.*

Crucibles (injector) and lids made of fireclay, bound with metal, are assessed for duty at 20 per cent. *ad valorem* as fireclay goods.

Multiscript ink is dutiable at 10 per cent. *ad valorem* as writing ink.

Pepsine and diastase wine, "Chassaing's," is dutiable at 25 per cent. *ad valorem.*

Coal tar soap, "Jeyes'," is dutiable at 4*d.* per pound.

Dog soap, "Jeyes'," is dutiable at 2*d.* per pound.

Household, No. 1, white soap, "Jeyes'," is dutiable at 2*d.* per pound.

Perfect purifier soap, "Jeyes'," is dutiable at 2*d.* per pound.

Sublime toilet soap, "Jeyes'," is dutiable at 4*d.* per pound.

*Wharfage.*—Chloride of lime is dutiable at 3*s.* per ton of 40 cubic feet.

The following articles are free of duty,—

Drugs, &c. (*when not recommended*), viz.:—
- Euonymin, in 1 oz. bottles.
- Podophyllin, in 1 oz. bottles.

Extracts and essences—all extracts and essences entirely free from alcohol, and not coming under the heading of medicine or any other heading in the tariff shall from this date, 25th January 1895, be admitted as essences not containing alcohol.

Lactic ferment "Danish," for ripening cream.

Leather—The undermentioned descriptions of leather imported on and after 1st November 1894, may be admitted free of duty, viz.:—

Leather—kid dressed and tanned (known as Dongola).
Leather known as chrome-dressed glacé kid.
Multiscript composition.
Multiscript—perfect, "Herberts."
Powder—surgical dusting, "Jeyes'," is a disinfectant.
Purifier—perfect fluid, "Jeyes'," is a disinfectant.
Root-beer—"Hirés," an extract not containing alcohol.
Sanitas is a disinfecting fluid.
Yolkine is a dye.

## *GENERAL TRADE NOTES.*

### Decadence of British Trade through Trieste.

A despatch, dated June 4th last, has been received at the Foreign Office, from Mr. J. G. Haggard, Her Majesty's Consul at Trieste, with reference to the decline of British trade through Trieste, in which he reports that, in consequence of the very numerous applications from tradesmen and merchants in England for assistance in trade matters, and the consequent inquiries made by the Consulate, it has recently been prominently drawn to his attention how trade with England through Trieste is waning in many different directions through the high duties, and since the abolition of the free port.

Another important branch of British trade that has now become extinct is the importation of cement; in fact, export of the Austrian article has already commenced to British territory; but details seem unnecessary; there is generally a less demand through Trieste for English goods of almost all kinds, chiefly, perhaps, through increased home production protected by heavy tariffs and dues.—*Board of Trade Journal.*

### Adulteration of Olive Oil.

Her Majesty's Consul at Leghorn, in a report to the Foreign Office, dated April 23rd last, says that adulteration is still prevalent with a certain class of trade, as also the practice of selling a very inferior article and calling it Lucca oil. Only recently it was proved in one of the London police courts that a firm of oilmen, owning a number of shops, were in the habit of supplying their customers with a mixture of seed-oil with olive oil, the latter necessarily of the lowest quality.

Oil in so-called Florence flasks should be entirely avoided by consumers in England, since, through the unscrupulousness of some traders, these flasks have cotton-seed oil pure and simple, or some adulterated rubbish, put into them. As bearing upon this, it should be mentioned that the Italian Customs authorities hardly seem to appreciate the importance to Italy—the leading olive oil-producing country of the world—of prohibiting the adulteration of olive oil. For otherwise they would hardly permit the mixing of cotton-seed oil with common olive oil to be carried out in the entrepôt, or Government bonded warehouses (the cotton-seed oil being in bond), for the sole purpose of exportation. It is hardly necessary to add that export houses of repute here in the fine olive oil trade are not guilty of such a practice; as also that pure and fine Tuscan oil is exported hence, largely to London and other markets. Still, the only guarantee the public in England can have, lies in the name and standing of well-known firms of good repute, who, importing the article direct, are able to vouch for it, and who place it on the market. A practice followed by some second-rate concerns of supplying retailers with bottled oil bearing only the names of the exporters, not the names of the importers, is not to be recommended. It is too often a cloak for a cheap and nasty article, since the object is generally to make a larger profit than would be obtainable by selling fine Lucca oil guaranteed to be such by an importing firm of repute. It is, no doubt, owing to dishonesty in trade that many acquire a dislike for olive oil as food simply because a good part of what is sold is of very inferior quality, and perhaps also adulterated—stuff, in short, fit for soap-making or other industrial purposes, but not certainly for the table. (*No.* 1,550, *Foreign Office Annual Series.*)

### Olive Oil in Sicily.

More than one-fifth of the olive oil produced in Italy is made in Sicily, its manufacture being the chief industry in that island. The factories are usually small, employing from 10 to 12 men, and are of one storey only. Upon a platform constructed of heavy masonry and about one yard high, an edge-runner of stone weighing about 16 cwt. and 1 ft. thick, revolves slowly, the motive power being a horse or a mule. The olives, which should be perfectly ripe, are thrown by hand under the revolving stone, and, when crushed, are removed by means of a shovel. The output is about 1 cwt. of crushed olives in half an hour. The paste is next placed in soft, flat rush bags having a very small opening. About 15 such bags are piled one above the other, the openings being upwards. Pressure is then applied by means of a strong wooden screw worked by six or eight men. The pressure is at first applied very gently, then gradually increased. The oil runs through a trough into a tub more than half full of water. The coarser impurities are deposited at the bottom of the water, on the surface of which the oil floats. When the bags have been under pressure for about five minutes they are taken out, and their contents again placed under the edge-runner. This operation is repeated three times. The press-residues are then heaped up in a dark room to a depth of about 1 ft. 4 ins., and allowed to remain for three days, when they heat spontaneously. They are then brought to the press for a fourth and last time. The final residue, which amounts to about 70 per cent. of the weight of the olives, was formerly used for fuel, but much of it is now sent to larger oil-mills, where it is treated a fifth time. The crude oil is removed to a room where the temperature is as near 66° F. as possible. In about a week it loses its turbid appearance, and it is then transferred to other vessels, in which it is kept until required for sale or use. Although a few small steam oil-mills have been recently erected in Sicily, the greater bulk of the olive oil produced is made as described.—*Imperial Institute Journal.*

### The French Sugar Trade in 1894.

The "Journal Officiel" of the 14th June last, publishes detailed statements of the amount of sugar imported into and exported from France in the year 1894. From these it would appear that, according to the Customs declarations, 161,263,000 kilogs. were exported, or 153,443,000 kilogs. expressed in refined sugar.

During the same period 179,648,000 kilogs. were imported, of which 119,322,000 came from the French colonies; 59,330,000 were cane, 434,000 beetroot, and 562,000 "vergeoises" or bastard sugar. Of the foreign sugar, the Dutch Indies and Egypt together furnish by far the largest amount (over 56,000,000 kilogs.), and England supplies two-thirds of the beetroot and four-fifths of the vergeoises imported.—*Board of Trade Journal.*

### Russian Sugar Syndicate.*

Some interesting information has been lately published with regard to the Russian sugar syndicate (*Le Syndicat des Sucres*) taken from *Les syndicats industriels* of M. Yanjoul, professor of political economy at the university of Moscow.

The Government having refused to undertake the control of the sugar production, the parties concerned had resort to a private agreement amongst themselves. On the 28th April 1887, 171 manufacturers (out of a total of 219) formally signed at Kief, before a notary, an agreement to determine for the remainder of the season 1886–87, and the two following seasons, the maximum of sugar to be placed on the home market by each manufactory. This maximum was first fixed at 95 per cent. of the average production of the five years preceding, or at 66½ per cent. of the highest figure to which the production had attained during either of the seasons 1881–82, 1885–86. Any amount produced in excess to be exported. A committee formed by the syndicate was charged with the surveillance of the members; and would notify to them to stop the exportation as soon as the price of sugar, including duties, should reach 4 roubles 50 kopecks on the Kief Exchange.

This agreement was renewed in 1888 for two years, and in 1890 till the 1st September 1895. In 1888, the number of subscribers was 190 (out of 221), and in 1890, 193 (out of 223). Since the arrangement of 1888, the contingents of the members have been modified on a basis of production

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* "Bulletin Russe de Statistique Financière et de Législation," May 1895.

*Note.*—Dessiatine = 2·7 acres. Poud = 36 lbs. avoirdupois. Rouble (gold) = 3*s.* 2*d*, power, and this has increased the quota of 68 manufactories. In 1890, the duties having been increased by 15 kopecks, it was decided not to stop exportation till the prices should touch 4 roubles 65 kopecks. Finally, the convention was prorogued (on the 30th September 1894) for four years, to date from the 1st September 1895. The new arrangement permits of the following amendments :—

The Syndicate is obliged to form a reserve of 3,000,000 pouds to supply the market in the eventuality of a bad beetroot harvest or an exceptional rise in prices; exportation must cease if prices rise to 5 roubles in winter, and 5 roubles 25 kopecks in summer; the agreement authorises members to form groups for the collective exploiting of their share. In addition, if a factory be destroyed by fire it will have the right to cede to another the amount which it is authorised to sell in Russia. Finally, as in previous agreements, the syndicate has a right to compensation for any unfulfilled engagement; penalties are inflicted not only in the case of sales made over and above the authorised amount, but also in the case of any delay in the exportations.

M. Yanjoul goes on to say that the formation of the syndicate has shown beneficial results, it being an undeniable fact that without such an arrangement as was come to in 1887, the crisis would have developed into a catastrophe for a large number of factories. It is said that a third of the existing establishments would have been involved in ruin. Another point in favour of the syndicate is the stability in the price of sugars since 1887. Except in 1893 (following on the bad harvest of 1892), the prices of sugars have been, under the syndicate, infinitely more stable than during the antecedent period.

The object of the syndicate is not to limit, as do many other similar organisations, the production of the article in order to regulate the price of it; but, according to a document published by the syndicate itself, to divide fairly among the factories the exportation, which must be carried on at a loss, without diminishing the amount exported or the country's production of sugar.

It is on this basis that the syndicate of sugar is constituted. If the production imposes a loss on the export trade, the manufacturers are obliged to cover this loss by raising their prices in the country itself. So the foreign consumer's gain is the Russian consumer's loss. The manufacturers themselves are beginning to understand that the present is an abnormal state of affairs. A pamphlet published three years ago by the committee of the syndicate, on the sugar industry of Russia and Germany, came to the conclusion that it would be rash to found the future of the Russian sugar industry on the hope of an everlasting victorious competition with the German product on the Western markets. It appears desirable, says M. Yanjoul, in conclusion, to limit the production of sugar in Russia to the needs of the country's consumption.

The following figures are taken from the official statistics for the years given:—Area planted with beetroot, 1892, 255,410 dessiatines (*1891, 281,140*). Amount produced, 1892, 235,880,000 pouds (*1891, 266,081,000*). Number of manufactories, 1891–92, 226 (*1890-91, 223*). Amount of beetroot used, 1891–92, 262,556,000 pouds (*1890-91, 301,990,000*). Duty paid on native sugars, 1893, 30,042,819 roubles (*1892, 27,525,430*).—*Ibid.*

### German Bounties and Drawbacks.

The following are the principal bounties and drawbacks granted in Germany :—

According to the Imperial law of May 31, 1891, all sugar manufactured in Germany from beetroot, with or without the admixture of other raw materials, pays an excise duty (Verbranchs-steuer) of 9*s.* per cwt. This duty is collected when the sugar passes from the control of the revenue officers (under whose supervision the manufacture is carried on) into free inland commerce. Sugar which is exported from Germany, or deposited in a bonded warehouse under Government seal without leaving the control of the revenue authorities, pays no duty, but if it has once paid, the duty is not returned on exportation. In the case of manufactured articles, however, in the preparation of which German beet sugar is used, the Federal Council may order the refund, upon exportation, of the excise duty paid upon the amount of sugar which they contain. German beet sugar (waste) intended for feeding cattle, or for any purposes other than human consumption, is free of excise duty.

The law in question further provides that sugar of the three following classes—

(*a.*) Raw sugar containing at least 90 per cent., or refined sugar containing between 90 and 98 per cent. of pure sugar;

(*b.*) Candy, and sugar in hard white loaves, blocks, discs, sticks, or cubes, and crystallised sugar of any other description, containing at least 99½ per cent. of pure sugar;

(*c.*) All other varieties of hard dry sugar (with less than 1 per cent. of water), and containing at least 98 per cent. of pure sugar, except those included in class *b*;

when exported in quantities of more than half a ton (500 kilos.), should receive a bounty on exportation derived from the proceeds of the excise duty on sugar, amounting to—

| —— | Per Cwt. | Per 100 Kilos. |
|---|---|---|
| | *s.* *d.* | Marks pf. |
| Class A ........................ | 0 7½ | 1 25 |
| „ B ........................ | 1 0 | 2 00 |
| „ C ........................ | 0 10 | 1 65 |

if exported at any time between August 1, 1892, and July 31, 1895; or of—

| —— | Per Cwt. | Per 100 Kilos. |
|---|---|---|
| | *s.* *d.* | Marks pf. |
| Class A ........................ | 0 6 | 1 00 |
| „ B ........................ | 0 10½ | 1 75 |
| „ C ........................ | 0 8½ | 1 40 |

if exported between August 1, 1895, and July 31, 1897.

The bounty must be refunded if the sugar is taken from a bonded warehouse to a sugar factory, or is otherwise sold into the interior.

The import duty on foreign sugar is 18*s.* per cwt. (36 marks per 100 kilos.). When imported, however, for further treatment in a sugar refinery, one-half of the duty, viz., 9*s.* per cwt., is remitted, an amount corresponding to the excise duty to which it then becomes liable. It is proposed by the Government to increase both the excise duties and the bounties on sugar.

By the law of June 24, 1887, the excise duty or tax on consumption (*Verbrauchsabgabe*) on spirits amounts, within the limits of the States to which the law applies, to 2*s.* 4*d.* for every gallon (50 pf. per litre) of pure alcohol produced, provided that the total amount of spirits manufactured within those States in one year does not exceed one gallon (4½ litres) per head of the population according to the last census. Alcohol manufactured in excess of this amount pays 3*s.* 2*d.* per gallon (70 pf. per litre).

This duty is not levied on spirits intended for exportation, or which are to be used for purposes other than human consumption.

In case of the exportation of manufactured articles containing alcohol which has paid excise duty, the Federal Council can allow a drawback to be conceded to them at the rate of 2*s.* 4*d.* for every gallon (50 pf. per litre) of pure alcohol used.

Besides the excise duty, the so-called agricultural distilleries (*i.e.*, those which chiefly use grain or potatoes for the manufacture of spirits on a small scale), and distilleries of molasses and beetroot, pay a tax of 1*s.* 3*d.* per hectolitre (22 gallons) of vat-contents; and distilleries which use fruit, grapes, and wine in the manufacture of spirits pay a tax up to 10*d.* per hectolitre on such raw materials.

Distilleries not subject to these taxes pay a supplementary excise duty of at most 11*d.* per gallon of pure alcohol, which is also refunded on exportation.

The maximum import duties on spirits are:—

| —— | Per Cwt. |
|---|---|
| | £ *s.* *d.* |
| 1. On liqueurs | 4 10 0 |
| 2. All other spirits— | |
| (*a.*) In the wood | 3 2 6 |
| (*b.*) In bottles, stone jars, or other vessels... | 4 10 0 |

—*Ibid.*

### THE PRODUCTION OF FRENCH BRANDY.

During the course of a debate, which recently (19th June last) took place in the French Chambers, and which was reported in the *Journal Officiel*, the following statements were made with regard to the production of brandy in France. In the year 1850 the total production of alcohol of every sort was 891,500 hectolitres or 19,613,000 gallons; out of this total 815,000 hectolitres or 17,930,000 gallons were made from wine, cider, or from other fruit products; there remained, consequently, only 75,500 hectolitres or 1,661,000 gallons of trade brandy (*alcool d'industrie*).

In 1876 the total production of brandy had risen to 1,709,000 hectolitres or 37,598,000 gallons, of which 1,054,000 hectolitres or 23,188,000 gallons were trade brandy (*alcool d'industrie*), and 655,000 hectolitres or 14,410,000 gallons were made from wine, cider, or fruit.

At this date the phylloxera made its appearance, and, as a consequence, the amount of brandy made from wine decreased steadily, whilst on the other hand the production of trade brandy increased enormously, and quite out of proportion to the diminution which occurred in the production of wine brandy; indeed, for 1 hectolitre or 22 gallons of wine brandy which disappeared, no less than 3 hectolitres or 66 gallons of trade spirit made from corn, molasses, or beetroot took its place. Thus in the year 1886, out of a total production of 2,052,000 hectolitres or 45,144,000 gallons, no less than 2,000,000 hectolitres or 44,000,000 gallons were trade spirit (*alcool d'industrie*).

In 1889 there was so much over-production that the Chambers thought fit to decree by law of the 8th of July 1890 an import duty of 3 francs per 100 kilogs. on maize and on rice, with the view of diminishing the amount of brandy produced from farinaceous substances. As a consequence of the imposition of this duty the amount of brandy produced from this substance declined from 758,000 hectolitres or 16,676,000 gallons in 1889 to 392,000 hectolitres or 8,624,000 gallons in 1891. As far as the production of alcohol from maize and rice was concerned the object was attained, but the general situation did not change. It is true that there was a diminution of 350,000 hectolitres or 7,700,000 gallons from farinaceous substances, but on the other hand there was a corresponding increase in the amount of brandy produced from beetroot and from molasses. The fabrication of trade spirit was still further developed, and in 1893 the total production of alcohol had reached the extraordinary figure of 2,476,000 hectolitres or 54,472,000 gallons.

The consumption had at the same time augmented, but not in the same proportion. The following figures will speak for themselves:—

| —— | Hectolitres. | Gallons. |
|---|---|---|
| In 1888 there was a home production of. | 2,162,483 | 47,574,626 |
| In 1888 there was an importation of | 147,875 | 3,253,250 |
| Total | 2,310,358 | 50,827,876 |
| Of which consumed | 2,159,851 | 47,516,722 |
| Excess product remaining in hand. | 150,507 | 3,311,154 |

| —— | Hectolitres. | Gallons. |
|---|---|---|
| In 1889 there was an excess product remaining on hand of. | 147,000 | 3.234,000 |
| In 1890 the excess product was | 44,000 | 968,000 |
| In 1891 „ „ | 32,000 | 704,000 |
| In 1892 „ „ | 36,000 | 792,000 |

In 1893 the figures were as follows:—

| —— | Hectolitres. | Gallons. |
|---|---|---|
| Production | 2,476,000 | 54,472,000 |
| Importation | 144,000 | 3,168,000 |
| Total | 2,620,000 | 57,640,000 |
| Of which consumed | 2,295,000 | 50,490,000 |
| Excess product remaining in hand. | 325,000 | 7,150,000 |

As a natural consequence, the surplus stock of alcohol on hand on the 31st of December 1893 was found to be 2,980,895 hectolitres or 65,579,690 gallons. The amount in hand is no doubt serious, but it becomes all the more so in view of the vintage of 1893. The wine produced in the month of September 1893 would not in the natural course of things be made into brandy until the month of February or March 1894. As the amount of wine turned into brandy increases, by so much will the trade brandy (*alcool d'industrie*) be put on one side, and the natural brandy will regain its original position. The situation is regarded in France as very serious for the departments of the North, where the greater part of the trade brandy is now produced.—*Ibid.*

### THE SWISS ALCOHOL MONOPOLY.

The United States Consul at Zurich reports as follows:—

In order to better regulate the manufacture and sale of alcohol, prevent adulteration, restrict consumption among the poorer classes, and, at the same time, create a much needed revenue for the cantons, the Federal Government, by virtue of the authority vested in it by the federal constitution, on December 23rd, 1886, enacted a law by which the right to manufacture and sell alcohol became the exclusive privilege of the Federal Government. This law was immediately put in operation.

The manufacture of alcohol is under the supervision of the "Federal Alcohol Administration," and the sales thereof are made by that authority. None but pure spirits are sold to the manufacturers and rectifiers of beverages, druggists, &c., and the product of home distillers is invariably given the preference. All spirits obtained otherwise than from the distillation of the grape, wines, pomace, lees of wine, apples, pears, cherries, plums, prunes, &c., are subject to the federal monopoly and can only be sold by the Government. Such, however, as are obtained from the distillation of the above-named home products are free and can be sold by the parties producing them.

The Government obtains its alcohol supplies by contract with Swiss distillers, whose distilleries must be under Government control. Agricultural home corporations, distilling from grains and potatoes, are given the preference.

Foreign spirits are imported exclusively by the Government; so-called *Qualitaets-Spirituosen*, *i.e.*, liquors containing not over 72 per cent. of alcohol, and imported by others, pay a monopoly tax of 80 francs per 100 kilos. (16 dols. per 220 lb.), plus a customs duty of 20 centimes (3·86 cents) for each alcoholic degree.

Exported articles, in the manufacture of which alcohol is consumed, receive a drawback in a proportion equal to the quantity of spirits used, provided that the quantity consumed for any one shipment is not less than 20 litres (23 quarts); for less quantities, no drawback will be paid.

All sales of alcoholic spirits, except in quantities of not less than 40 litres (12·3 quarts), by licensed wholesale dealers, is prohibited by law. Swiss farmers, however, are allowed to sell the products of their own stills, when distilled from fruits of their own farms, in quantities of not less than 5 litres (5·28 quarts).

The execution of the law devolves upon the federal council, with the assistance of the respective cantons. For the purposes of supervision and execution, the federal council appoints ten supervisors for a term of not more than three years, whose duties are: (1) To take charge of the product of Swiss distillers, distilling on contract with the Swiss Government, and to control the output; (2) to periodically take account of the administration's stock; (3) to supervise exports subject to drawbacks; (4) to supervise the denaturalisation of spirits; (5) to keep a record of, and report upon infringements of the law; (6) to perform the administration's office and other work. The country is divided into nine supervising districts, with one supervisor at its head.

Strict supervision is kept over distilleries, as to the location of premises, apparatus used, cleanliness, working hours, kinds of materials used for distillation, &c., and the supervisors must at all times have free access to the distilleries during the distilling period. The distilling period is limited to from seven to eight months of each year, beginning any time after the 15th of September. All the distillery establishments must be closed and sealed by May 15.

The net revenues of the alcohol administration are distributed among the cantons in a ratio proportionate to their population, as shown by the latest census, but each canton is held duty bound to set aside 10 per cent. of such net revenue for the exclusive purpose of restricting alcoholism and for the support of institutions created for the purpose of curing and redeeming drunkards.

Alcohol is purchased from contracting distillers in quantities of not less than 150 nor more than 1,000 hectolitres (3,965 and 26,417 gallons) at a time, and at a price fixed from time to time by the federal council, which, however, can not be lower than 130 francs (25 dols.) nor higher than 150 francs (28·95 dols.) per hectolitre (26·417 gallons) of proof alcohol, cash, exclusive of packages.

Four kinds of spirits are sold for the manufacture of beverages:—

(1.) Wine spirits, 95 per cent., monopoly brand "A. V. W.," similar in quality to the best absolutely neutral German wine spirits, distilled from filtered potato spirits, at 175 francs per 100 kilos. (33·76 dols. per 220 lb.) net, or 142·50 francs per hectolitre (27·50 dols. per 26·417 gallons), 95 per cent. naked. (100 kilos. spirit at 95 per cent. are equal to 122·7 litres of 95 per cent., or 116·6 litres proof.)

(2.) Prime spirits, monopoly brand "A. V. P.," 95 per cent., corresponding in quality with the finest German potato spirits, at 170 francs per 100 kilos. (32·87 dols. per 220 lb.), or 138·53 francs per hectolitre (26·74 dols. per 26·417 gallons), 95 per cent. naked.

(3.) Fine spirits, 95 per cent., monopoly brand "A. V. F.," same quality as rectified German or Austrian spirits, at 167 francs per 100 kilos. (32·23 dols. per 220 lb.) net, or 136·08 francs per hectolitre (26·26 dols. per 26·417 gallons), 95 per cent. naked.

(4.) Crude spirits of various degrees of strength, say, as a rule, from 90 to 95 per cent. from the product of domestic distilleries, at 143·35 francs per hectolitre (27·67 dols. per 26·417 gallons), 100 per cent. without package.

Spirits used in the arts, for technical purposes, or in the household as fuel, are sold at cost by the Government, after being denaturalised and thereby made unfit for drinking purposes.

To denaturalise alcohol, two methods are resorted to, viz., the absolute and the relative. The absolute method is applied to spirits to be used as fuel in lamps or other utensils in the trades or households, and is denaturalised by the addition of coal-tar oil, pyridine bases, pyroxylic spirit, or other similar substances, to the pure alcohol.

The alcohol administration changes its method of mixture from time to time, so as to prevent renaturalisation.

Alcohol consumed in the arts or in industrial pursuits is denaturalised so as to avoid neutralisation of its usefulness.

For instance, if alcohol is wanted for the manufacture of vinegar, acetic acid is the mixture; for varnish, camphor, turpentine, or shellac; for perfumery, a solution of castor-oil soap; for other industries, naphthaline, pyroxyline, benzine, nitric acid, ether, &c. Spirits with relative denaturalisation are sold only to bonâ fide, well-known manufacturers in possession of a federal finance department's licence, who must, upon receiving the spirits, subscribe to an obligation agreeing to use it only for their own account. They are, in addition, subjected to a strict control, and must at all times be prepared to show conclusively the quantity of denaturalised spirits consumed in their establishments.

Denaturalised spirits are sold as follows:—Absolute, for fuel and other similar purposes, 94 to 95 per cent., at 55 francs per 100 kilos. (10·62 dols. per 220 lb.) net, or 45·25 lb. per hectolitre (8·73 dols. per 26·417 gallons), 95 to 94 per cent. naked. Relative, for industrial purposes, per 100 kilos. (220 lb.) net—wine spirit, 66 francs (12·74 dols.); prime spirit, 58 francs (11·19 dols.); fine spirit, 53 francs (10·23 dols.); and crude spirit, 45 francs per hectolitre (8·68 dols. per 26·417 gallons), 100 per cent.

Orders must be sent to the alcohol administration at Berne, and will be filled from one of the federal depôts nearest to the point of the parties ordering the same.

The penalties for infractions of this law vary as to circumstances from, say, 200 to 10,000 francs (39·60 dols. to 1,930 dols.), or 30 times the value of the amount involved. For a second offence, the penalty can be doubled, and, in addition thereto, imprisonment not exceeding six months can be imposed.

The net profit on the sale of spirits by the federal alcohol administration was, for the year 1894, about 5,000,000 francs (965,000 dols.), which sum was divided among the cantons according to law.—*U.S. Consular Reports, June* 1895.

### FREE ALCOHOL FOR MEDICINES.

It is reported from Washington that two trial cases under the free-alcohol section of the Tariff Act have been prepared, one of them based on the claims filed by Sharp and Dohme, of Baltimore, manufacturing druggists, and the other by a hatter. A trial is expected in the autumn. Both the Department of Justice and the Treasury consider a verdict for the claimants to be a foregone conclusion. The free-alcohol section was introduced as an amendment to the Tariff Act by Senator Hoar, of Massachusetts. It was passed with little discussion, and at the time was considered by the officials to be inoperative, but druggists have a different idea, and the claims referred to are the upshot. Commissioner Miller estimates that 9,000,000 gallons of alcohol are annually used for manufacturing, exclusive of that used in bitters, cordials, and other preparations. On this basis the loss of revenue, in the event of a decision against the Government, would amount to nearly 10,000,000 dols. yearly, and should the manufacturers of proprietary medicines likewise recover by judgments through the Court of Claims, it might reach 15,000,000 dols.—*Chemist and Druggist.*

### MANUFACTURE OF SULPHURIC ACID IN ITALY.

*Ettore Candiani. Chem. Ind.* 18, 152—183.

Until the year 1856 the manufacture of sulphuric acid on a large scale was practically unknown in Italy, but since then the output has been steadily increasing, until in 1879 it reached 1,000,000 kilos., worth about 1,143,000 frs. This, however, did not nearly meet the demand, and large quantities were still imported from France. In 1880 further progress had been made, the output amounting to 12,870,000 kilos., and in the same year the first Glover and Gay-Lussac towers were erected.

Up to 1880 all sulphuric acid in Italy had been made from Sicilian sulphur in a very primitive way, by heating the sulphur on iron plates by means of wood fires. These, however, soon had to make way for properly constructed kilns, and the sulphur was replaced by pyrites. At present all factories in Italy use pyrites; some, however, in addition make small quantities of pure acid for laboratory purposes from sulphur. Pyrites is found in many parts of Italy, the most important mines being those of Torea and Fré St. Diedier, and latterly very important beds have been discovered in Sicily. The percentage of sulphur varies between 43 and 48, and, as in other countries, the burnt ore is treated for the recovery of copper.

The price of labour varies between 2·50 and 3·50 frs. a day, and that of coal between 32·50 and 40 frs. a ton.

Great difficulties were experienced in making suitable bricks for the Glover and Gay-Lussac towers, but these are being overcome.

Concentration is usually done in platinum vessels, but last year two works introduced Negrier's system, with very good results.

All factories use lead-chambers of the usual pattern, a trial, in one instance, of Barbier's system, which dispenses with lead-chambers, having given unsatisfactory results.

Liquid sulphurous anhydride and fuming sulphuric acid are not manufactured in Italy, there being no demand for them, but a certain amount of sulphuric acid is used for making saltcake for glass-works.

Many works only make enough sulphuric acid for their own manufacture of artificial manure.

The following contains a list of all Italian sulphuric acid works, with their lead-chamber space (in cubic metres), those only making for their own consumption being marked with the letter D:—

| | | |
|---|---|---|
| Guiseppe Candiani, Milano | 10,000 | |
| „ „ Barletta | 4,000 | |
| Antonio Biffi, E. C., Milano | 10,700 | |
| Ing. L. Vogel, E. C., Milano | 9,000 | D |
| A. Eredi Curletti, Milano e Treviglio | 10,000 | D |
| „ „ Loreo | 4,000 | D |
| Carlo Erba, Milano | 3,000 | |
| Societa Di Romano, Romano | 2.500 | D |
| Polenghi E. Cirio, Seengnago | 2,000 | D |
| Vertua, A., Quinzano | 2,000 | D |
| Alvergno E. Gramignola, Cremona | 2,000 | D |
| Banco Di Genova, Vercelli | 2,000 | D |
| Sclopis E. Co., Torino | 9.000 | |
| Dinamite Nobel, Avigliana | 10,000 | |
| Societa Colle E. Concimi, Torino | 2,000 | D |
| Steariņeria Italiana, Genova | 2,000 | D |
| Ularchi E. Co., Pesira | 3,000 | D |
| Ducco E. Aiettis, Rifredi | 5,300 | |
| Societa Per L'Allume Romano, Civitavecchia | 2,000 | |
| Walter E. Co., Napoli | 1,500 | |
| Nascio Aveline, Messina | 2,000 | |
| Magni E. Co., Vincenza | 5,000 | |
| Conte Carnerini, Palazzolo | 3,000 | |
| Lanza, Torino | 1,200 | D |
| Bertelli, M., E. Co., Milano | 1,200 | D |

The following list gives the import and export of sulphuric acid during the last six years, and, as will be seen, last year the export exceeded the import:—

| — | Import Value. | | Export Value. | |
|---|---|---|---|---|
| | 100 Kilos. | Lire. | 100 Kilos. | Lire. |
| 1889 | 3,006 | 21,042 | 197 | 1,379 |
| 1890 | 3,120 | 21,840 | 346 | 2,422 |
| 1891 | 8,062 | 56,434 | 840 | 5,880 |
| 1892 | 4,519 | 31,643 | 435 | 3,045 |
| 1893 | 1,441 | 10,087 | 1,072 | 7,504 |
| 1894 | 599 | 4,193 | 860 | 6,020 |

—J. R.

### WATERPROOFING BRICKS AND SANDSTONE.

At a recent meeting of the Australian Association for the Advancement of Science, Professor Liversidge read a paper on the "Waterproofing of Brick and Sandstone with Oils." Experiments were made with the view of ascertaining the length of time that brick and sandstone are rendered waterproof or protected by oil. The oils used were the three commonest and most readily obtainable for such purposes, viz., linseed oil, boiled linseed, and the crude mineral oil known as "blue oil," used for preserving timber. The weatherings were made upon a flat portion of the laboratory roof, fairly exposed to the sun and weather. Good, sound, machine-made bricks were experimented on. The amount of oil and water taken up by the sandstone was very much less than that absorbed by the brick, although the area of the sandstone cubes was much greater than that exposed by the bricks. Equal amounts of raw and boiled oils were absorbed; the blue oil, however, was taken up in much greater quantity by both brick and sandstone, but by the end of 12 months the whole of the 13½ oz. of blue oil had apparently evaporated away, and the brick had returned to its original weight. The bricks treated with raw and boiled oils remain unchanged. After the second oiling in November 1890, and exposure for nearly four years and two months, they had practically retained all their oil, inasmuch as they had not lost weight, and were also nearly impervious to water. It was noticeable that the sandstone cubes treated with raw and boiled oils returned to their original weights, but do not appear to have lost the beneficial effects of the oils, being also practically waterproof.—*Engineering and Mining Journal.*

### A NEW REFRACTORY SUBSTANCE.

A correspondent of the *Colliery Guardian*, says, under the name of apyrite, Herren Schiffer and Kircher, of Grunstadt, in Rhenish Bavaria, work a mineral containing about 93 per cent. of silica, and consequently very refractory. When mixed with water, it forms a plastic and adhesive mass, which, after desiccation, becomes firm and resisting, while its volume does not change when exposed to the fire. Moreover, it is scarcely attacked by metals and scoria in fusion, which either do not stick to the surfaces made with it, or are easily removed without the least detriment to the furnace. In the neighbourhood of the mines apyrite, tempered with water, is used instead of lime mortar, and also for plastering. Slightly damped, this substance is punned so as to supersede firebrick lining, as in the case of various furnaces, and a large foundry cupola can thus be lined in a day by two men, while such a lining last longer than one of the same substance made up into bricks. For repairs to the firebrick lining of furnaces, apyrite is also very useful, while its low price, and the fact that it is a good non-conductor of heat, recommend it in the case of blast-furnaces, puddling and heating furnaces, foundry cupolas and crucible furnaces. The following is the composition of two qualities, the pure and the rich:—$SiO_2$, 92·37 and 90·95; $Al_2O_3$, 5·1 and 9·45; $Fe_2O_3$, CaO, MgO, and $K_2O$ together, 0·37 and 1·05; and $H_2O$, 1·73 and 2. Among other ironworks apyrite is used at those of de Wendel at Hayange, Moyeuvre and Styring-Wendel in Lorraine, those at Esch-sur-l'Alzette in the Grand Duchy of Luxemburg, belonging to the Rothe Erde Company, and those of the Luxemburger Bergwerks of the Saarbrucken-Hutten-Actien-Gesellschaft at Burbach in Rhenish Prussia.

### PETROLEUM IN GALICIA.

The Austrian Minister of Finance, according to *Le Monde Economique*, reports that during late years the production of petroleum in Galicia has increased by 600,000 quintals yearly, while the importation of Russian petroleum into the dual state has diminished by 400,000 quintals, and that of the United States has been reduced to 89,000. The excise on petroleum has increased by two millions of florins yearly. A company formed at Fiume is engaged in active prospecting for petroleum in the Carpathians, and also in Croatia, where enormously rich springs are found.—*Board of Trade Journal.*

### LIQUID FUEL.

The use of petroleum as a liquid fuel for steam engines appears to be gradually increasing in oil-bearing countries, where the cost is small, and it is said to have been introduced for this purpose into some of the vessels of the Russian Navy. It has been stated that petroleum, when burned in a suitable furnace, will give out twice as much heat as a like weight of coal, but this assertion has been found to be somewhat incorrect. The specific gravity of crude petroleum is about 0·87 and it consists of 85 per cent. of carbon, 13 per cent. of hydrogen, and 2 per cent. of water; its average evaporative efficiency, as shown by a number of samples tested, is about 20,000 thermal units, while that of carbon is 14,500 units. The petroleum oils produced by distillation from the crude liquid give much higher results, approaching almost twice the efficiency of coal. These oils, however, are far too dear; their specific gravity is little more than 0·7, and they ignite at about 86°. Therefore, although it might be quite possible to use them in an oil engine, they would be utterly unsuitable for boiler work on account of their dangerous character. The form of petroleum oil best adapted for producing steam is *astaki*, that is the thick residue left in the stills after the lighter benzine and paraffins have been driven off. It is, weight for weight, nearly 50 per cent. better than coal as a heat-producer, but it has the disadvantage of being double the price in most countries, on account of carriage. In the Mediterranean and Black Seas, where the price of coal is as much as 2*l.* 10*s.* a ton, it would be advantageous to use *astaki*, as it can be had at Batoum almost for the cost of loading it. To utilise this fuel properly, marine boilers should be constructed so as to be able to burn either the oil or coal indiscriminately; by this means vessels on their voyages would be in a position to use whichever kind was the cheaper and more easily obtainable. Many methods have been invented for spraying and burning liquid fuel. Steam and compressed air have been employed, but the great secret lies in so arranging that the flame will not put itself out and prevent the oil from being properly consumed. The jet of oil should enter near the grate bars, but the precise height is a matter of adjustment. Instead of "spraying," the oil might be driven in by heavy pressure through very fine nozzles, needled if desired. This device has been employed in oil engines, and there does not seem to be any objection or difficulty in adapting it to furnaces. If this could be effected it would get rid of several serious objections to the use of liquid fuel at sea, and petroleum, in spite of its cost, might be employed largely on our ocean steamers, where the saving of space is of very material importance.—*Imperial Institute Journal.*

### SALE OF CHILIAN NITRATE FIELDS.

In a report to the Foreign Office, dated May 21st last, Mr. Joseph W. Warburton, Her Majesty's Consul-General at Valparaiso, states that the nitrate grounds and works belonging to the Chilian Government were offered for sale on the 15th May last, but only three were disposed of, for a total amount of 108,092*l.*

The nitrate trade has been much depressed, owing to the opening of new works and the over-production of nitrate, and some of the smaller works have been closed.

It is not the present intention of the Government to offer again for sale any of those lots which remain unsold.—*Board of Trade Journal.*

### NITRATE OF SODA.

The consumption in Europe for the first six months of the past three years has been as follows:—

| — | 1893. | 1894. | 1895. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Continent ............ | 451,000 | 503,000 | 559,000 |
| United Kingdom ..... | 71,000 | 85,000 | 81,000 |
| | 522,000 | 588,000 | 640,000 |

whilst the consumption of the world for the 12 months ending 30th June 1893, 1894, and 1895 has been:—

| — | 1893. | 1894. | 1895. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Continent ............ | 643,000 | 734,000 | 805,500 |
| United Kingdom ..... | 104,000 | 114,000 | 110,000 |
| United States ........ | 100,000 | 100,000 | 100,000 |
| | 847,000 | 948,000 | 1,015,500 |
| The shipments for the same period have been............... | 766,000 | 1,004,000 | 1,109,000 |

W. MONTGOMERY & CO.

### AMERICAN SHIPMENTS OF IRON ORE.

It is a fact worthy of note that iron ore is now being shipped from New York City to Rotterdam, Holland, for the use of furnaces making iron for basic steel purposes. It is likely that before long shipments will also be made to England. This ore, from the Port Henry ore beds, in the northern part of New York State, contains over 1·70 per cent. phosphorus and about 61 per cent. iron. It is, therefore, eminently suited for the manufacture of basic pig, Thus far, about 1,500 tons have been shipped.—*Engineering and Mining Journal.*

### TRIAL OF CORNSTALK CELLULOSE.

In some recent tests of the Marsden American cellulose and English cocoa cellulose, made at Indian Head proving grounds, the results were in favour of the former. The Marsden material is made of the pith of cornstalks. It was made into a cofferdam and shipped to the proving grounds. A cofferdam of the English product was also made and it was sent to the proving grounds. There the two were set up side by side, and a 6-in. and an 8-in. shell fired into each. The interior of the dams was then filled with water, and it was found that both practically held all the liquid. After a short time, however, a few drops of water were seen to trickle through the cocoa cellulose, but none penetrated the cornstalk product.—*Ibid.*

### GERMAN TRADE WITH INDIA.

The direct importation of pharmaceutical articles from Germany into Madras in 1894 shows a decrease over 1893. The total value of all German imports has also fallen by about 12 per cent. The following figures give details:—

| — | Alkali. | Brushes. | Chemicals. | Medicines. | Dye-Goods and Extracts. | Ether. |
|---|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ | £ |
| 1893 | 6,019 | 491 | 45,471 | 844 | 720 | .. |
| 1894 | 8,539 | 290 | 33,733 | 263 | 4,190 | 165 |

—*Chemist and Druggist.*

### GLASSWORKS IN GENOA.

The "Vetraria di Sarazna" glassworks (reports the British Consul at Genoa) have lately enlarged their factory. The daily output is now 30,000 bottles and demijohns, and their three furnaces (Siemens') work night and day for ten months out of the twelve. The demijohns are white or black—the white ones for acids, the black ones for wine and oil. The bottles are of four colours: green, gold black, olive black, and white. They vary in capacity from ⅓ litre to 2¼ litres. The bulk of the works output is used in Italy, but shipments have been made to Massowah, Chili, and Hayti. The workmen, who number over 500, are Italians, but the leading blowers are Germans and Austrians. They are paid by the piece, and the average daily earnings of a glassblower is 8*s.*, of his assistant 4*s.*, and of a boy 2*s.*

They work eight hours out of the twenty-four, and dwellings are provided rent free for those who have no homes in Sarzana. Women are also employed to cover the demijohns with wickerwork, for which they are paid at the rate of 1½*d.* per demijohn.—*Ibid.*

### Cyanide of Potassium for Brazil.

For some years past it has been found possible to work certain gold mines in Brazil at a small profit by means of the cyanide process. Worked by any other known process they would be profitless, and would have to be abandoned. It is manifest, therefore, that it is for the interests of the country that the materials needed for this process should be admitted and transported to the mines on the easiest possible terms. Recently one of the mining companies in Minas Geraes imported a large quantity of cyanide of potassium for the purpose of working up some poor gold-bearing material. The duty on the chemical is high, but even with this it was possible to secure a small profit. When the cyanide was despatched on the Central Railway, however, the officials of that road classified the article as an explosive, and obliged the senders to pay the special rate charged on dynamite, which so increased its cost as to destroy every chance of using it at a profit. The company have appealed against this classification, which, if upheld, will necessitate the suspension of many small mining enterprises in Minas Geraes.—*Ibid.*

### Inspection of Factories and Workshops.

The official report of the Chief Inspector of Factories and Workshops for the year 1894 is a bulky volume of 520 pages, and its contents are largely statistical, yet it contains overwhelming evidence of the care with which the State protects the health and lives of British artisans. Special rules have been made for the protection of the operatives in the following "dangerous" trades, namely:—

- White lead.
- Red and orange lead.
- Yellow lead.
- Electric-accumulator works.
- Paints and colours.
- Lead smelting.
- Enamelling of iron-plates.
- Chemical-works.
- Bichromate-works.
- Lucifer-match works.
- Dinitro benzole.
- Earthenware.
- Quarries.
- Flax-spinning and linen-factories.
- Tinning and enamelling of metal hollow-ware and cooking-utensils.

The committee of inquiry upon the brass trades is expected to report shortly. The various inspectors report favourably of the establishment of local offices at Birmingham, Sheffield, Manchester, and elsewhere, but evidently need proper clerical assistance in order to render the office of proper use to the public. Mr. Knyvett, Birmingham, reports at length on the subject of the apathy of the workpeople in the enamelled-iron plate trade, and the sad results in some cases, despite the care and trouble taken by the employers. Mr. Johnson, Newcastle-on-Tyne, reports that the special rules in the white-lead trade are beginning to have good effects, and the same result is reported from Sheffield by Mr. Dodgson. The latter gentleman, however, alludes in strong terms to the "vile condition" of many of the local tenement factories, and thinks it irremediable without legislation. Mr. Sedgwick, Walsall, shows that he had to prosecute before he could get the operatives in an enamelled-iron plate works to wear the necessary cambric respirators. As to the eight hours' movement, the reports show that Kynoch and Co. (Limited), Birmingham, two pottery firms at Stoke, and one chemical firm at Glasgow have adopted it with success; but, so far as the reports serve to indicate, the movement does not appear to be spreading at all rapidly or generally.—*Ironmonger.*

### Tinplate-making Abroad.

The American Consuls have been instructed by their Government to report upon the manufacture of tinplates, for the benefit of the firms who are engaged in that trade in the United States. These inquiries, it may be remarked, are the outcome of a request made by a firm of consulting engineers at Pittsburg, who told their Government that the progress of the industry had been "much held back by the cost of producing the sheets; the bulk of the tinplates produced in the United States is made from sheets exported from Wales, and simply coated with tin here." The questions put to the Consuls by the Department of State were:—

(1.) State whether sheets are of iron or steel.
(2.) Purpose to which sheets are put.
(3.) Size of billet used, and cost of same.
(4.) How many rollings.
(5.) Kind of mills used to do rolling.
(6.) Number of men at each mill, or at each stage of process, and wages paid.
(7.) Special method used in cleaning and surfacing sheets.

In response, the reports furnished by the Consuls are very full and instructive, although they are of relatively slight interest to those who are not actively engaged in the manufacture of tinplates. From Austria it is reported that a fine quality is produced, by processes very different from that in use in Wales; but although the quality is alleged to be superior to that of the English plates, the latter are sold in Austria, and have a more brilliant surface than the home made article. In Belgium the trade has died out, the last factory having been closed in 1875. In France a considerable business is still done, there being eight concerns which make tinplates. In Germany there are six makers, who are syndicated, and sell through a central office at Cologne. From England and Wales the consular reports are long and well done, but naturally they give nothing which would be news to our readers. In all the reports there are evidences of the want of practical technical knowledge, but considering that the United States Consuls must depend upon other persons for their information, they report well and with singular freedom from glaring errors. Our own tinplate-makers might do worse than peruse the reports. If they cannot procure them elsewhere our own copy is at their service.—*Ibid.*

### German Trade with New South Wales.

The German Consul in Sydney, in his annual report on the trade of New South Wales, which has just been published, makes some interesting remarks concerning the progress of German direct trade with the colony. He points out that, mainly in consequence of the financial crisis of two years ago, the colony's imports have decreased greatly all round. While, however, the total value of the imports in 1894 decreased by about 12½ per cent. compared with 1893, the imports from Germany only decreased by 7½ per cent. Entering into details, the Consul reports as follows concerning pharmaceutical articles:—"The reputation of German chemicals has considerably increased within recent years, the complaints formerly made on the ground of slovenly appearance of the goods having been generally taken to heart in Germany. The first condition of success in creating a trade with New South Wales is to supply always the best goods, and a uniform quality. It is a great error to think that goods of doubtful quality can be shot out into the Australian market with impunity. In addition to fine chemicals, such as alkaloids, glucosides antipyrin, salicylic acid, &c., New South Wales imports almost exclusively German glycerine, and large quantities of German caustic soda, potash, cyanide, and aniline colours. There is a big field in the colony for the sale of medicine-bottles, but it is exploited mainly by American makers, who supply goods of excellent workmanship and quality. German bottles are not at present made to suit English dispensing methods, and in cheap perfume bottles the Belgians undersell the Germans. Photographic papers are mostly imported from Germany, the three-star brand being especially popular. Mounts are also mainly of German make, but in lenses and plates Britain rules the market. Cameras are also entirely British. This is an article in which German makers might do a big trade by studying English taste and habit. Efforts were made some time ago to introduce German cameras in New South Wales, but they were unsuccessful, as the German cameras were not of the measurements required here and were much clumsier in appearance and heavier than the British article.—*Chemist and Druggist.*

### Experiments on the Rusting of Metal Structures.

Mr. E. Guber, a member of the American Society of Civil Engineers, recently examined a large number of iron and steel bridges, with a view to ascertaining the best means of preserving such structures from rust. In all cases rust was found beneath the paint. In some instances the amount was very little, but in others the condition of affairs was much worse. In most cases the rust occurred in spots. The smoother the surface the less the rust, plates being generally much freer than angles, and eye-bars were also usually clean. Parts that had been heated in the process of manufacture also showed less rust than others. In cases in which the metal had been oiled in the shops there was much less rust under the paint than where this precaution had been omitted. As the rust spots under the paint were no worse in the old bridges than in the new ones, it was concluded that the corrosion was not proceeding actively. Iron oxide paint seemed to get tougher and more adherent with age, save where the coating was very thick, as in cases in which the repainting had been done at short intervals. It was then comparatively soft, and could be easily removed. In the case of the bridges which had been painted with red lead, the paint was universally brittle and very easily removed; and in the case of one painted with white lead as a finishing coat, the paint was cracking wherever exposed to the sun.—*Engineering and Mining Journal.*

### Report on Metric Weights and Measures.

The Select Committee appointed to inquire whether any, and what, changes in the present system of weights and measures should be adopted, have agreed to the following report, which has been published as a Parliamentary paper:—

They have, in the first place, received evidence from witnesses representing many different interests—(1) official, (2) commercial, (3) manufacturing, (4) trade, (5) educational, (6) professional.

They have also received from numerous corporations, school boards, and other public bodies resolutions without exception in favour of the adoption of the metrical system.

Your committee find that almost all the witnesses express a strong opinion as to the complicated and unsatisfactory condition of our present weights and measures, and of the distinct and serious drawback to our commerce, especially our foreign trade, which this system entails, differing as it does from the system (metrical) now adopted by every European nation except ourselves and Russia, as well as by far the majority of non-European countries with which this kingdom trades. The evidence, however, goes further to show that not only is our foreign trade in every branch seriously handicapped, but that the home trade would be benefited if more simple and uniform standards of weights and measures than those now existing were adopted.

Moreover, strong evidence was brought forward as to the serious loss of time incurred by English school-children in having to learn the complicated system of tables of existing weights and measures, and the urgent need of the adoption of a simpler system. It was stated that no less than one year's school time would be saved if the metrical system were taught in place of that now in use.

Evidences from competent witnesses proved to the satisfaction of your committee that a compulsory change from an old and complicated system to the metrical had taken place in Germany, Norway and Sweden, Switzerland, Italy, and many other European countries without serious opposition or inconvenience; that this change was carried out in a comparatively short period; and that as soon as the simple character of the new system was understood it was appreciated by all classes of the population, and no attempt to use the old units or to return to the old system was made.

In the United States, where a system founded on the English units exists, a commission is at present engaged in an investigation of the same character as that with which your committee is charged, and the Federal Government has this year passed an Act rendering the metrical system compulsory for pharmaceutical purposes.

Your committee believes that the adoption of the metrical system by England would greatly tend to render that system universal.

Your committee recommend:—

(*a.*) That the metrical system of weights and measures be at once legalised for all purposes.

(*b.*) That after a lapse of two years the metrical system be rendered compulsory by Act of Parliament.

(*c.*) That the metrical system of weights and measures be taught in all public elementary schools as a necessary and integral part of arithmetic, and that decimals be introduced at an earlier period of the school curriculum than is the case at present.

The Select Committee was constituted as follows:—Sir John Barran, Mr. Burt, Mr. Crombie, Mr. Woods (in the place of Mr. C. Fenwick), Mr. Alban Gibbs, Mr. Godson, Sir Edward Hill, Mr. Justin M'Carthy, Sir Samuel Montagu, Mr. Jasper More, Sir Albert Rollit, Sir Henry Roscoe, Mr. James Stevenson, Mr. Stewart Wallace, Mr. Webster, Mr. Whiteley, and Mr. Wrightson.—*Chemical Trade Journal.*

### Alum Deposits in New Mexico.

A large deposit of alum has been opened on the Gila River, New Mexico, U.S.A. It is reported to be of great commercial value, and is now being worked with proper railway facilities. These alum beds, along with those of gypsum and soda known to exist in the State, are probably destined to become the most productive properties in New Mexico.—*Chemist and Druggist.*

### Phosphates in Tunis.

Since Tunis became a French protectorate, its mineral resources have been examined, and one of the results has been the discovery of large beds of phosphates which can be advantageously worked. The exploration of some of these beds has been undertaken by two English companies, which are preparing to operate on a large scale. The present difficulty is to find cheap transportation, but work has been begun on a railroad which will give the mines a direct outlet to a seaport, and enable them to put their product on the market at a low price. Other companies have applied for concessions also, so that a large output is probable.—*Engineering and Mining Journal.*

### Sampling of Imported Lead Ores by Contract.

Under the provisions of the latest approved Act, the rate on lead ore and lead dross is three-fourths of a cent per pound; and it is provided that silver ore, and all other ores containing lead, shall pay a duty of three-fourths of a cent per pound on the lead contained therein, according to sample and assay at the port of entry, the method of sampling and assaying to be that usually adopted for commercial purposes by public sampling works in the United States. The Treasury Department has determined that the sampling and assaying of these ores shall be done by contract, which probably will be let to the lowest bidder. The department already has solicited proposals, which will be opened on July 20th. The service is to be the same as that usually adopted for commercial purposes by public sampling works in the United States, and bidders must state, under oath, the facilities under their control for performing the service, and the method, in detail, which they propose to use. Bidders, at their option, may submit bids for the entire business of sampling and assaying lead ores imported at all of the ports in the United States, or for one port only, or for several ports. Contracts will be made for the term of one year, from July 1st, 1895, to June 30th, 1896. The work will be done under such supervision as the department may deem advisable, and the contractors will be held responsible for the results of their sampling and assay.—*Ibid.*

### PATENT OFFICE.

*Twelfth Report of the Comptroller-General of Patents, Designs, and Trade Marks, with Appendices, for the Year* 1894. (*C.*—7750.) *Price* 2½*d.*

This annual report is issued by the Comptroller of the Patent Office in pursuance of the requirements of the 102nd section of the Patents, Designs, and Trade Marks Act, 1883 (46 & 47 Vict. cap. 57).

Thefollowing statement shows the total number of applications for patents, designs, and trade marks, and amount of gross receipts and expenditure in each year, from 1884 to 1894 inclusive:—

| Years. | Patents. | Designs. | | Trade Marks. | Gross Receipts. | Gross Expenditure. |
|---|---|---|---|---|---|---|
| | | Single. | Sets. | | | |
| | No. | No. | No. | No. | £ | £ |
| 1884 | 17,110 | 19,515 | 238 | 7,104 | 103,827 | 64,123 |
| 1885 | 16,101 | 20,388 | 337 | 8,026 | 88,509 | 77,739 |
| 1886 | 17,176 | 23,717 | 324 | 10,677 | 106,754 | 109,567 |
| 1887 | 18,051 | 25,734 | 309 | 10,586 | 124,279 | *81,577 |
| 1888 | 19,103 | 25,923 | 316 | 13,315 | 149,623 | 83,924 |
| 1889 | 21,009 | 24,370 | 335 | 11,316 | 172,820 | 79,286 |
| 1890 | 21.307 | 22,235 | 318 | 10,258 | 192,600 | 83 240 |
| 1891 | 22,888 | 21,673 | 277 | 10,787 | 203,520 | *103,180 |
| 1892 | 24,169 | 19,269 | 258 | 9,101 | 199,859 | *96,822 |
| 1893 | 25.116 | 19,174 | 306 | 8,675 | †174,878 | *95,103 |
| 1894 | 25,386 | 21,230 | 1,025 | 8,013 | 181,855 | *96,092 |

* Including expenditure on account of new offices and buildings.
† The diminution in the gross receipts was caused by a reduction in the amount of renewal fees.

It is stated in the report that, while the number of applications for patents in the year 1894 continued upon an ascending scale, being 270 above that of the previous year, this increase was considerably less than that of the normal average of the preceding seven years. The number of applications for patents has, however, more or less annually increased, from 17,176 in the year 1886 to 25,386 in 1894, being at the rate of 48 per cent.

The number of readers frequenting the Patent Office Library during the year showed an advance upon that of the previous year, 113,374 persons having availed themselves of its use. The lighting of the library has recently been improved by the employment of incandescent gas-burners.

The construction of the new warehouse and sale branch adjoining the main building, mentioned in the last report, was completed by the end of the year. This building contains room for about six miles of shelving, as well as a photographic studio for the reproduction of drawings attached to specifications of patents. A new block is now in course of construction on the south side of Staple Inn.

## BOARD OF TRADE RETURNS.

### SUMMARY OF IMPORTS.

| Articles. | Six Months ending 30th June. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 9,937,729 | 8,953,000 |
| Chemicals and dyestuffs | 3,822,881 | 3,681,933 |
| Oils | 3,532,983 | 3,762,156 |
| Raw materials for non-textile industries. | 19,243,954 | 17,852,883 |
| Total value of all imports | 211,004,995 | 203,663,288 |

### SUMMARY OF EXPORTS.

| Articles. | Six Months ending 30th June. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 13,900,849 | 13,142,219 |
| Chemicals and medicines | 4,438,571 | 4,168,178 |
| Miscellaneous articles | 13,949,705 | 15,350,266 |
| Total value of all exports | 106,883,475 | 106,117,516 |

### IMPORTS OF METALS FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Copper:— | | | | | |
| Ore | Tons | 34,781 | 43,003 | 231,723 | 269,464 |
| Regulus | „ | 38,518 | 43,768 | 898,476 | 1,091,233 |
| Unwrought | „ | 29,340 | 24,210 | 1,239,009 | 1,004,879 |
| Iron:— | | | | | |
| Ore | „ | 2,328,428 | 2,045,864 | 1,597,017 | 1,361,055 |
| Bolt, bar, &c. | „ | 22,989 | 19,930 | 204,822 | 156,146 |
| Steel, unwrought | „ | 4,173 | 4,114 | 41,303 | 40,457 |
| Lead, pig and sheet | „ | 85,815 | 78,498 | 793,397 | 760,659 |
| Pyrites | „ | 329,130 | 296,812 | 561,952 | 494,295 |
| Quicksilver | Lb. | 3,499,761 | 3,387,615 | 274,917 | 302,827 |
| Silver ore | Value £ | .. | .. | 1,383,970 | 954,033 |
| Tin | Cwt. | 382,649 | 371,116 | 1,359,770 | 1,152,407 |
| Zinc | Tons | 24,522 | 28,899 | 379,310 | 423,362 |
| Other articles | Value £ | .. | .. | 972,563 | 942,183 |
| Total value of metals | | .. | .. | 9,937,729 | 8,953,000 |

### IMPORTS OF OILS FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut........ Cwt. | 123,767 | 175,871 | 149,812 | 202,211 |
| Olive ............. Tuns | 14,611 | 7,200 | 495,985 | 253,083 |
| Palm ............. Cwt. | 581,268 | 628,855 | 645,465 | 659,979 |
| Petroleum ........ Gall. | 72,253,839 | 82,994,282 | 1,133,024 | 1,507,039 |
| Seed ............. Tons | 13,719 | 20,076 | 314,246 | 404,343 |
| Train, &c. ........ Tuns | 9,765 | 8,817 | 170,845 | 148,959 |
| Turpentine ....... Cwt. | 93,273 | 137,549 | 102,139 | 147,659 |
| Other articles .. Value £ | .. | .. | 521,467 | 438,883 |
| Total value of oils ... | .. | .. | 3,532,983 | 3,762,156 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 32,865 | 22,331 | 60,006 | 42,302 |
| Bristles.......... Lb. | 1,324,714 | 1,743,652 | 198,866 | 237,360 |
| Caoutchouc...... Cwt. | 169,697 | 173,825 | 1,885,871 | 1,980,266 |
| Gum :— | | | | |
| Arabic......... „ | 26,762 | 33,144 | 67,733 | 72,032 |
| Lac, &c. ....... „ | 69,194 | 63,828 | 363,660 | 351,125 |
| Gutta-percha .... „ | 30,087 | 26,814 | 306,669 | 233,971 |
| Hides, raw :— | | | | |
| Dry............ „ | 248,992 | 242,007 | 583,005 | 549,126 |
| Wet ........... „ | 269,818 | 409,021 | 543,228 | 810,468 |
| Ivory............ „ | 4,849 | 5,275 | 195,446 | 218,074 |
| Manure :— | | | | |
| Guano......... Tons | 19,440 | 27,183 | 93,318 | 220,783 |
| Bones.......... „ | 44,825 | 38,154 | 212,003 | 167,648 |
| Nitrate of soda... „ | 83,558 | 82,752 | 790,574 | 684,830 |
| Phosphate of lime „ | 175,051 | 173,307 | 317,444 | 316,162 |
| Paraffin.......... Cwt. | 325,752 | 369,908 | 336,691 | 362,424 |
| Linen rags....... Tons | 81,632 | 11,078 | 82,745 | 107,821 |
| Esparto.......... „ | 106,318 | 89,309 | 472,860 | 382,188 |
| Pulp of wood .... „ | 133,351 | 122,858 | 662,182 | 657,502 |
| Rosin............ Cwt. | 750,405 | 792,161 | 161,201 | 191,116 |
| Tallow and stearin „ | 927,275 | 1,075,234 | 1,203,476 | 1,275,430 |
| Tar ..............Barrels | 17,410 | 14,725 | 11,768 | 6,910 |
| Wood :— | | | | |
| Hewn ......... Loads | 1,035,484 | 890,454 | 1,773,618 | 1,555,943 |
| Sawn .......... „ | 1,647,619 | 1,680,553 | 3,709,935 | 2,419,580 |
| Staves ......... „ | 57,075 | 40,586 | 253,078 | 200,272 |
| Mahogany ..... Tons | 31,177 | 20,960 | 250,602 | 158,641 |
| Other articles....Value £ | .. | .. | 4,704,672 | 4,650,909 |
| Total value ....... | .. | .. | 19,243,654 | 17,852,883 |

Besides the above, drugs to the value of 451,855*l*. were imported, as against 421,157*l*. in the first six months of 1894.

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass........... Cwt. | 58,282 | 52,983 | 213,012 | 198,601 |
| Copper :— | | | | |
| Unwrought ..... „ | 184,422 | 255,995 | 410,800 | 555,602 |
| Wrought........ „ | 150,134 | 156,797 | 412,880 | 405,366 |
| Mixed metal .... „ | 157,837 | 153,845 | 352,169 | 316,342 |
| Hardware ..... Value £ | .. | .. | 900,852 | 861,055 |
| Implements....... „ | .. | .. | 591,626 | 587,003 |
| Iron and steel..... Tons | 1,271,396 | 1,286,481 | 9,065,039 | 8,994,321 |
| Lead ............. „ | 25,305 | 22,786 | 277,971 | 263,019 |
| Plated wares... Value £ | .. | .. | 122,007 | 136,712 |
| Telegraph wires „ | .. | .. | 883,741 | 226,260 |
| Tin ............... Cwt. | 59,211 | 56,100 | 224,752 | 188,097 |
| Zinc .............. „ | 88,591 | 96,708 | 62,745 | 61,503 |
| Other articles .. Value £ | .. | .. | 383,255 | 348,338 |
| Total value ......... | .. | .. | 13,900,849 | 13,142,219 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 4,086,700 | 3,245,300 | 88,270 | 77,496 |
| Military stores.. Value £ | .. | .. | 601,923 | 1,174,445 |
| Candles.......... Lb. | 8,834,200 | 11,662,100 | 155,456 | 193,187 |
| Caoutchouc ..... Value £ | .. | .. | 542,282 | 561,997 |
| Cement.......... Tons | 226,881 | 185,946 | 373,395 | 299,361 |
| Products of coal Value £ | .. | .. | 642,931 | 843,806 |
| Earthenware ... „ | .. | .. | 709,046 | 851,256 |
| Stoneware ...... „ | .. | .. | 78,675 | 75,104 |
| Glass :— | | | | |
| Plate........... Sq. Ft. | 662,456 | 652,050 | 35,084 | 35,627 |
| Flint........... Cwt. | 40,554 | 45,113 | 92,980 | 99,319 |
| Bottles......... „ | 335,936 | 320,001 | 159,618 | 151,555 |
| Other kinds.... „ | 74,462 | 104,374 | 59,740 | 81,122 |
| Leather :— | | | | |
| Unwrought .... „ | 69,005 | 82,201 | 626,065 | 682,889 |
| Wrought ..... Value £ | .. | .. | 115,337 | 143,012 |
| Seed oil.......... Tons | 34,223 | 27,026 | 718,382 | 538,652 |
| Floorcloth ..... Sq. Yds. | 10,380,600 | 12,247,600 | 381,796 | 434,249 |
| Painters' materials Val. £ | .. | .. | 709,518 | 743,981 |
| Paper ........... Cwt. | 459,476 | 454,561 | 718,227 | 714,244 |
| Rags............. Tons | 27,182 | 24,512 | 153,003 | 149,654 |
| Soap............. Cwt. | 298,963 | 319,062 | 316,380 | 333,741 |
| Total value .......... | .. | .. | 13,949,705 | 15,350,266 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 65,316 | 92,361 | 45,016 | 54,333 |
| Bark (tanners', &c.) „ | 134,695 | 134,974 | 47,752 | 54,295 |
| Brimstone........ „ | 243,422 | 286,400 | 55,390 | 54,533 |
| Chemicals...... Value £ | .. | .. | 753,838 | 591,967 |
| Cochineal ........ Cwt. | 2,101 | 2,268 | 12,246 | 15,346 |
| Cutch and gambier Tons | 15,729 | 11,870 | 330,023 | 262,252 |
| Dyes:— | | | | |
| Alizarin ...... Value £ | .. | .. | 123,549 | 144,182 |
| Aniline and other „ | .. | .. | 122,858 | 190,155 |
| Indigo ........... Cwt. | 52,272 | 67,175 | 1,033,542 | 1,175,344 |
| Nitrate of potash . „ | 139,824 | 112,754 | 130,355 | 104,817 |
| Valonia........... Tons | 12,852 | 19,799 | 162,474 | 216,429 |
| Other articles... Value £ | .. | .. | 1,005,838 | 818,236 |
| Total value of chemicals | .. | .. | 3,822,881 | 3,681,933 |

### EXPORTS OF DRUGS AND CHEMICALS FOR SIX MONTHS ENDING 30TH JUNE.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 2,708,606 | 2,991,559 | 782,858 | 743,798 |
| Bleaching materials „ | 595,707 | 681,934 | 236,902 | 245,860 |
| Chemical manures. Tons | 178,307 | 155,049 | 1,293,297 | 1,077,437 |
| Medicines....... Value £ | .. | .. | 491,121 | 502,215 |
| Other articles ... „ | .. | .. | 1,634,393 | 1,598,868 |
| Total value .......... | .. | .. | 4,438,571 | 4,168,178 |

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### APPLICATIONS.

11,813. S. T. Wellman and C. H. Wellman. Improvements in melting furnaces. Complete Specification. June 18.

11,815. J. B. Terrace. Improved Bunsen flame. June 18.

11,888. W. P. Gibbons and G. B. A. Gibbons. Improvements in apparatus for charging gas retorts. June 18.

11,934. J. Birchall and J. Astley. Improvements in the furnaces of ovens, kilns, or similar structures. June 19.

12,093. D. Halpin and J. B. Alliott. Improvements in apparatus for cooling and evaporating liquids. June 21.

12,134. A. Dunolly. Improved means for automatically charging gas retorts with coal. June 22.

12,184. A. W. Stokes. Improvements in apparatus for determining volumetrically the amount of fat in milk or other articles. June 24.

12,320. C. A. Jensen. — From A. Sinding-Larsen. Process for preventing the chemical action of acids and other corrosive liquids on metal containers, conduits, and the like. June 25.

12,383. E. Hart. Improvements in condensing and cooling apparatus for acid vapours. June 26.

12,395. A. J. Boult.—From M. E. Strauss. Improvements in or relating to anti-freezing attachment for faucets, valves, and the like. Complete Specification. June 26.

12,528. C. Linde. Process and apparatus for liquefying gases or gaseous mixtures and for producing cold, more particularly applicable for separating oxygen from atmospheric air. June 28.

12,584. J. Foster. Improvements in and relating to evaporating apparatus, part of the improvements being applicable also to other purposes. June 29.

12,819. W. Southcott. Improvements in appliances employed for ensuring complete combustion of fuel in boiler furnaces. July 3.

12,936. R. J. White and C. W. Clayton. An improved valve for retaining liquids or gases under pressure. July 4.

13,075. M. A. Champion. Improvements in apparatus for the distillation of water. Complete Specification. July 6.

13,134. J. Foster. Improvements in and relating to evaporating apparatus. July 8.

13,158. J. S. Rigby. Improvements in or relating to apparatus for decomposing chlorides of sodium and potassium. July 8.

13,160. A. L. G. Dehne. Improvements in filter presses. Complete Specification. July 8.

13,188. A. Barr and W. Stroud. Improvements in apparatus for the production of high vacua. July 9.

13,317. A. Goodwin and T. Clay. Improvements in apparatus for raising or forcing liquid and semi-liquid substances. Complete Specification. July 10.

13,486. K. Zimmermann. Improvements in the means for preventing and removing incrustations in or from steam generators. Complete Specification. July 13.

### Complete Specifications Accepted.*

### 1894.

13,857. G. Fletcher. Improvements in multiple-effect and other vessels for evaporating liquids. June 12.

14,014. E. J. Barbier. Improvements in or relating to condensing towers. June 26.

15,773. J. L. Osborn.—From C. Neuhaus. Improvements in apparatus for burning liquid fuel. July 10.

16,043. W. Spencer. Improvements in kilns for burning or calcining limestone or like substances. July 17.

16,235. A. Crerar.—From W. R. Boon and 'O. A. Hancock. An improved process of and apparatus for evaporating or concentrating saccharine and other liquids. July 3.

17,212. T. Glover and J. Brock. Concentrating and evaporating vessels. July 17.

### 1895.

7390. J. Laidlaw. Improvements in centrifugal machines for separating fluids of different densities.

10,625. H. B. Watson and J. S. Watson. Evaporating apparatus applicable for obtaining fresh from salt water or analogous purposes. July 3.

## II.—FUEL, GAS, and LIGHT.

### Applications.

11,815. J. B. Terrace. *See* Class I.

11,820. H. Gardner. From La Soc. Française de L'Heliogene. Improved method of combining air and gas for incandescent lighting purposes. June 18.

11,848. H. H. Lake.—From E. N. Dickerson. Improvements in processes and apparatus for the utilisation of combustible gas. Complete Specification. June 18.

11,887. H. Gardner.—From La Soc. Française de L'Heliogene. An incandescent irradiator for gas without the preliminary admixture of air. June 18.

11,883. W. P. Gibbons and G. B. A. Gibbons. *See* Class I.

11,966. A. B. Willway. Improved construction and arrangement of container for ether saturation of oxygen for limelight. June 19.

12,020. S. Hersey and Kirkham, Hulett, and Chandler, Lim. Improvements in apparatus for washing or scrubbing gas. June 20.

12,110. M. B. Jones. Improvements in promoting perfect combustion. June 22.

12,245. A. Sweetser. Improvements in apparatus for the production of oxygen gas. June 21.

12,314. J. H. Exley. Improvements in apparatus for generating acetyline gas. June 26.

12,356. T. Thorp and T. G Marsh. Improvements in apparatus for the production of heating and illuminating gas. June 26.

12,560. W. Wheatley and J. M. Somerville. Improvements in or connected with the manufacture of carburetted water gas and the apparatus therefor. June 29.

12,702. J. S Zerbe. Using hydrocarbon oils and gases for fuel purposes. July 1.

13,230. F. Mayer. Improvements in apparatus for the manufacture of oil-gas. Complete Specification. July 9.

13,510. J. Green. An improved method or process for use in obtaining hydrogen gas from water and means for obtaining by the aid of such method or process carburetted hydrogen and other combinations of hydrogen, and apparatus for use in such method or process. July 13.

### Complete Specifications Accepted.

### 1894.

13,114. E. Daus. Improvements in the manufacture of heating and illuminating gas. July 10.

13,299. J. B. Taylor. Improvements in the manufacture of fuel. June 26.

17,873. H. T. Blake. Dowson gas enricher. July 10.

19,689. W. G. Smith. Manufacture of night-lights. July 3.

22,036. W. H. Biggs and R. R. Greenhow. Manufacture of artificial fuel. June 26.

22,452. H. A. Allport and A. Crossley. Improvements in coke ovens and in the method of removing and utilising the products of combustion from such coke ovens. June 26.

23,662. J. Henderson. Improvements relating to gas retorts and such like apparatus. July 3.

### 1895.

6158. F. L. Slocum. Improvements in and relating to scrubbing or purifying of gases and in apparatus therefor. June 26.

9556. C. C. Walker. Apparatus for washing and scrubbing gas. July 3.

10,145. A. Guéguen. Gas retorts. June 26.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Application.

12,527. F. J. Bergmann. A process for the extraction of distillation products from sawdust, wood waste, and the like. Complete Specification. June 28.

### Patent Abandoned.

### 1891.

17,221. E. Binney. *See* Class XIII.

## IV.—COLOURING MATTERS and DYES.

### Applications.

11,757. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of chemical compounds suitable for the production of colouring matters in bulk or on fibre. June 17.

11,843. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of dyestuffs. June 18.

12,094. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of purpurine-sulpho acid. June 21.

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* *See* Note (*) on previous page.

12,119. C. Rattner. An improved method or methods of producing lakes or analogous colouring matters. June 22.

12,162. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Process for the partial or total destruction of beta-naphthol on the fibre by oxidation by means of persulphates. June 22.

12,221. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters dyeing yellow with mordants. June 24.

12,303. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of poly-azo dyes of the benzidine and analogous series. June 25.

12,442. Brooke, Simpson, and Spiller, Lim., and W. S. Simpson. Improvements in colouring matters. June 27.

12,465. A. Zimmermann.—From The Chemische Fabrik auf Actien vormals E. Schering. Production of y-oxy-piperidinecarboacids, their nitriles, and derivatives therefrom. June 27.

12,529. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Improvements in the manufacture of azo colouring matters. June 28.

12,607. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of new brown to black azo colouring matters dyeing direct on cotton. June 29.

12,608. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of azo colouring matters. June 29.

12,667. H. E. Newton.—From The Farbwerke vormals F. Bayer and Co. The manufacture or production of derivatives of hydroxyanthraquinone. July 1.

13,032. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Improvements in the production of blue, bluish-black, or greenish-black polyazo dyes on vegetable or animal fibre. July 5.

13,210. C. M. Pielsticker. Improvements in the method of and apparatus for manufacturing Paris green. July 9.

13,291. J. Weller and W. Brauns. Improvements in the manufacture of colouring matters. Complete Specification. July 10.

13,460. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new nitrosamine compounds suited for use in the preparation of diazo compounds and of azo dyes. July 12.

### Complete Specifications Accepted.

1894.

16,530. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters dyeing blue with mordants. June 26.

16,559. G. W. Johnson.—From Kalle and Co. Manufacture or production of ortho- and para-oxy-ortho-toluic acids and meta cresol. July 10.

17,048. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of a yellow basic colouring matter. July 17.

17,049. O. Imray.—From The Farbwerke vormals Meister, Lucius and Brüning. Manufacture of yellow basic dye-stuffs. July 17.

17,133. E. Straub.—Manufacture of hydrazo compounds from aromatic nitro hydrocarbons. July 10.

18,588. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of new condesation products, and colouring matters derived therefrom. July 17.

18,589. O. Imray.—From The Society of Chemical Industry in Basle. Manufacture of basic orange-yellow colouring matters. July 19.

1895.

8661. G. W. Johnson.—From F. von Heyden. The manufacture and production of benzo sulphonimides or their nitro or halogen substitution derivatives. June 26.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

12,012. H. Schirp. Improvements in the treatment of wool with hot gases and vapours of muriatic acid and sulphuric acid, and in the apparatus used therein. Complete Specification. June 20.

12,218. R. W. E. MacIvor and J. Chester. Improvements in the treatment of rhea or ramie (boehmeria tenacissima) and china grass (boehmeria nivea). June 24.

12,366. S. Hopkinson and W. P. Kinsman. Improvements in apparatus employed in the preparation of slivers from cotton and woollen waste. June 26.

12,645. C. F. Fecker. Improvements in the preparation of wool for underclothing. Complete Specification. July 1.

12,857. G. Philips. A process for the acidulation of wools, woollen rags, or tissues intended to be carbonised or bleached. July 3.

13,232. O. Duckworth and H. Pettit. Improvements in apparatus for drying yarn. July 9.

13,325. L. Boccard. Improvements in the manufacture and production of decorated woven fabrics. July 10.

13,370. W. Jackson. A new or improved textile fabric. Complete Specification. July 11.

### Complete Specifications Accepted.

1894.

14,363. H. S. Close and W. O. Roff. Improvements in or in connection with retting flax, jute, or other similar fibrous materials, and eliminating the gummy or other matter therefrom, and utilising the resultant residuals. July 10.

14,788. J. S. Lenton and R. B. Caldicott. Manufacture of textile fabrics, and apparatus therefor. July 3.

16,785. G. Jacober and A. Rabourdin. Manufacture of filamentous products from cellulose. July 17.

17,205. A. Dicktus. Treatment of wool and other textile materials with liquids, and apparatus therefor. July 10.

17,370. G. Riche and A. Rivet. A process and apparatus for separating burrs and other foreign matters from wool. July 17.

1895.

10,918. F. Raschig. A process for washing crude wool. July 10.

10,988. J. H. Lenton and R. B. Caldicott. Manufacture of textile fabrics, and apparatus therefor.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

### Applications.

12,398. J. Helouis and C. de Saint Père. An improved process of dyeing with photographic mordanting. June 26.

12,439. F. W. Golby.—From N. Piveteau. A mordant for use in dyeing stuffs black. June 27.

12,746. N. Browne.—From A. Koebig. Method and apparatus for spreading colours on both sides of paper simultaneously. Complete Specification. July 2.

12,857. G. Philips. *See* Class V.

### Complete Specifications Accepted.

1894.

16,252. J. W. Sanderson. Process of indigo dyeing, and apparatus employed therefor. July 3.

16,987. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Process for the production of red tints by combining on the fibre paranitraniline with mixtures of beta-naphthol and its sulphonic acids. July 10.

17,172. J. Pritchard and F. A. Blair. Apparatus for dyeing yarns and slubbings or rovings, or otherwise treating the same with liquids. July 17.

1895.

10,004. C. M. White.—From T. B. Bowers. A new or improved machine for washing or dyeing wool, cotton, rags, waste, or the like. June 26.

11,087. H. H. Lake.—From H. Schweitzer and E. N. Dickerson. An improved process of printing on aniline black. July 10.

## VII.—ACIDS, ALKALIS, AND SALTS.

### Applications.

11,786. B. von Schenk. Improvements in the manufacture and production of polysulphides of potassium and sodium. June 17.

11,947. J. S. Wallace and F. L. Ball. Improvements in or connected with the manufacture of carbon dioxide. June 19.

12,082. R. Matthews. An improvement in the obtainment of sodium or potassium nitrate. June 21.

12,316. J. D. Darling. Process for utilising nitre-cake and other acid sulphates. Complete Specification. June 25.

12,320. C. A. Jensen.—From A. Sinding-Larsen. *See* Class I.

12,370. P. Cannell-Bunn. Improvements in the treatment of metallic oxides. June 26.

12,729. R. Addie. Process for extracting cyanides from blast-furnace dust and other crude salts containing cyanogen. July 2.

12,953. The Chloride Electrical Storage Syndicate, Lim., and J. G. A. Rhodin. Manufacture of chloride of lead. Complete Specification. July 4.

13,120. S. Trivick. Improvements in and relating to the manufacture of cyanides. July 8.

13,171. J. D. Darling. Improvements in the manufacture of sulphuric acid and by-products, and in apparatus adapted to such manufacture. Complete Specification. Filed July 8. Date applied for January 8, 1895, being date of application in United States.

13,456. W. Raydt. An improved process for obtaining carbonic acid from gas-mixtures in the dry way, and apparatus therefor. July 12.

13,461. T. T. Best, A. Kay, and J. Brock. Improvements in the manufacture of chlorine from hydrochloric acid gas. July 12.

### Complete Specifications Accepted.

1894.

14,894. C. P. Peak, J. Peak, H. Peak, and A. G. Haddock. Manufacture of soda crystals or washing soda. July 10.

16,014. R. Louvenherz. Method of producing solid persulphate of sodium. July 10.

16,320. E. Bücke. Process and apparatus for obtaining magnesium manganite and hydrochloric acid from the double chloride of manganese and magnesium, or for utilising certain residual liquors produced in the manufacture of chlorine. July 10.

17,112. N. McCulloch. A new or improved method for oxidising the proto salts of iron to the persalts. July 17.

21,447. J. Y. Johnson.—From N. Basset and W. de Baranoff. Treatment of alkaline salts or the salts of alkaline earths. July 3.

1895.

4856. N. P. Pratt. Improvements in or relating to the manufacture of sulphuric acid. July 17.

### Patent Abandoned.

1891.

17,130. F. Perez-Gutierrez. A process for moulding common salt (chloride of sodium) by melting it previously. July 10.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

13,104. W. Illingworth. Improvements in machines for casting pottery ware. July 6.

13,151. F. G. Schluder and W. G. Verstandig. An improved process and means for producing clear plate glass in cuvette furnaces. Complete Specification. July 8.

13,520. F. S. Tomey. An improvement in the manufacture of thermometer tubing. July 13.

13,522. W. Illingworth. Improvements in or applicable to ovens or kilns for firing pottery ware and the like. July 13.

### Complete Specifications Accepted.

1894.

13,797. J. Slaytor. Improvements in moulds for casting balls of glass or like materials. July 17.

15,792. W. L. Pilkington. Production of corrugated sheet glass, and apparatus employed therein. June 26.

1895.

7914. C. D. d'Enghien, A. D. d'Enghien, and S. D. d'Enghien. Improvements in kilns or ovens for firing terra-cotta and other like materials. July 17.

9714. W. L. Wise.—From T. Lefevre and L. Michau. Manufacture of glass plates. June 26.

9801. J. A. Baker, W. K. Baker, and G. S. Baker. Machines for treating plastic material. June 26.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

11,930. H. Sadin. Employment of schist in the manufacture of bricks for building purposes. Complete Specification. June 19.

11,957. T. Rowe and E. Snook. New or improved material for paving, building, and like purposes, and process for producing the same. June 19.

12,242. E. M. Arndt and G. de Bruyn. Improvements in the manufacture of artificial stone. June 24.

12,382. J. J. Bloomfield. Improvements in the manufacture of plaster. June 26.

12,391. W. Joy. Improvements in arrangements for drying slurry by the waste heat from cement kilns. June 26.

13,073. C. A. Allison.—From The Marguetelle Mosaic Company. An improved substitute for wood and the like. July 6.

13,154. M. B. Church. The manufacture of an improved compound for coating and decorating walls and other surfaces, and for the production of casts or mouldings and for analogous purposes. Complete Specification. Filed July 8. Date applied for April 2, 1895. In lieu of revoked patent No. 21,199 of 1891.

### Complete Specifications Accepted.

1894.

14,934. A. Muirhead and G. Hackford. Manufacture of artificial stone and the like. July 10.

17,208. F. H. Lenders.—From C. Bertin. An improved composition forming a substitute for stone, marble, plaster, and the like. July 10.

18,210. G. S. Cory. An improved composition for roads, pavements, and floors. July 10.

1895.

4048. G. von Breymann-Schwertenberg. Improved portable solid structures or blocks for building purposes. July 10.

10,744. J. F. de Navarro. Apparatus for treating cement-making materials. July 10.

## X.—METALLURGY, MINING, Etc.

### Applications.

11,813. S. T. Wellman and C. H. Wellman. *See* Class I.

11,894. F. S. D. Scott. A gold-saving machine, suitable for the treatment of auriferous sand, alluvial deposits, pulverised ore, and the like. June 19.

11,958. J. A. Mays. Process of and apparatus for reducing lead from lead and zinc sulphide ores. June 19.

12,010. J. P. L. Bentham and J. Judge. The utilisation of certain by-products in blast-furnaces to increase the economical production of pig-iron. June 20.

12,011. H. F. Kirkpatrick-Picard. Improvements in or relating to the treatment of ores. June 20.

12,018. L. Mond. A process and apparatus for reducing certain metallic oxides by means of amalgams of alkaline metals. June 20.

12,038. T. Shepherd. A new or improved alloy. June 20.

12,088. S. Learoyd and G. Jarmain. Improvements in or relating to alloys of aluminium and the hardening and tempering thereof, and to their application. June 21.

12,102. A. de Courcy Scott. Improved process and apparatus for treating ores and liquors containing gold or silver, or both. June 21.

12,174. M. Gledhill. Improvements in the manufacture of steel plates. June 22.

12,224. A. V. Newton.—From A. Nobel, Sweden. Improvements in the manufacture of armour plates. June 24.

12,290. J. J. Crooke. Improvements in and relating to the extraction of gold and silver from its ores. Complete Specification. June 25.

12,291. J. J. Crooke. Improvements in and relating to the extraction of silver from its ores. Complete Specification. June 25.

12,448. R. W. Papineau and The Technical Association of London, Lim. An improved method of obtaining solidity in casting aluminium and its alloys, and other metals and alloys. June 27.

12,452. H. E. Fry, J. David, and C. le Doux. Improvements in the extraction of lead with silver, gold, or other metals from galena or sulphides of lead and zinc, and from mattes and refractory ores. June 27.

12,455. A. A. Dickson. Improvements in the reduction of metallic sands and pulverised ores. June 27.

12,668. J. A. Mays. Process and apparatus for separating metals from substances containing zinc oxide. July 1.

12,692. A. J. Boult.—From P. A. Gasse, France. Improvements in or relating to the treatment of refractory ores. July 1.

12,974. H. L. Sulman and F. L. Teed. Improvements in obtaining metals from their ores, oxides, or compounds. July 4.

12,990. C. L. Jackson and D. Horsburgh. Improvements in casting and moulding metal. July 5.

13,072. C. Rainey. Improvements in dry concentrators for the treatment of ores. July 6.

13,204. W. Galbraith. Improvements in or relating to the manufacture of compound armour plates and other plates or bars. July 9.

13,254. J. B. Torres. Improvements in metallurgical furnaces for the reduction and refining of ores and metals. July 9.

13,534. E. A. Ashcroft. Improvements in the treatment of zinc-bearing ores and zinc-bearing products. July 13.

13,536. M. Crawford.—From R. Keck. Improvements in treating slimes from ores of the precious metals. July 13.

13,537. M. Crawford. A process for precipitating gold and other precious metals from solutions used for extracting such metals from their ores. July 13.

### Complete Specifications Accepted.

1894.

14,327. A. F. B. Gomess. Manufacture of aluminium and aluminium alloys, and electro deposition of same. July 7.

14,481. A. Mieg. Manufacture of tungsten articles and apparatus therefor. July 3.

15,891. R. A. Smith. A new metallic alloy. July 3.

17,820. W. P. Thompson.—From O. Nicolai. An improved solder for soldering aluminium, aluminium alloys, and other metals. July 3.

25,016. M. Crawford. Process of extracting precious metals from their ores. July 10.

#### 1895.

7351. O. Imray.—From W. E. Corey. Manufacture of compressed carbonised steel and armour plates and other articles therefrom. June 26.

8536. E. D. Kendall. Process for the recovery of gold and silver from solutions. July 10.

9072. E. E. Lungwitz. New or improved process and apparatus for reducing or smelting ores. July 3.

11,478. J. Y. Johnson.—From L. Pelatan and F. Clerici. Apparatus for the electrolytical separation of precious metals from their ores or other materials containing them. July 17.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

11,728. W. Shaw. Improvements connected with galvanic batteries and switches therefor. Complete Specification. June 17.

11,752. E. Andreoli. Electro deposition of gold and silver. Complete Specification. June 17.

11,832. A. J. Boult.—From N. H. Edgerton. Improvements in or relating to secondary batteries. June 18.

11,864. P. Ribbe. An improved plate for electric accumulators or storage batteries. Complete Specification. June 18.

11,944. C. Raleigh. Improvements in the electrolytic deposition of metals and in means applicable therefor. June 19.

12,244. J. C. Graham. Improvements in electro deposition. June 24.

12,312. A. G. Saunders. Improvements in stamp batteries. Complete Specification. June 25.

12,417. C. H. Weise. Improvements in the manufacture of positive plates for secondary electrical batteries. Complete Specification. June 27.

12,420. C. H. Weise. Improvements in the manufacture of plates for secondary electrical batteries. Complete Specification. June 27.

12,521. J. B. Torres. Improvements in and connected with the electrolysis of oxides, salts, and other compounds. June 28.

12,622. A. Müller. Improvements in secondary or accumulator cells. Complete Specification. June 29.

12,651. R. Heathfield and W. S. Rawson. Improvements in electrolytical apparatus. July 1.

12,954. The Chloride Electrical Storage Syndicate, Lim., and G. A. Grindle. An improvement in secondary voltaic batteries. Complete Specification. July 4.

13,081. J. G. Vine. The earth battery. July 6.

13,090. S. Z. de Ferranti. Improvements in electrolytic cells. July 6.

13,255. J. B. Torres. Improvements in apparatus for the electrolysis of oxides, salts, and other chemical compounds. July 9.

13,425. C. Oppermann. An improved process for the electro deposition of aluminium alloys. July 12.

13,434. Siemens Bros. and Co., Lim.—From Siemens and Halske. Improvements in the electrolytical production of zinc from its ores and apparatus therefor. Complete Specification. July 12.

### Complete Specifications Accepted.

#### 1894.

11,327. A. F. B. Gomess. *See* Class X.

17,369. L. Epstein. Secondary voltaic batteries. July 17.

#### 1895.

7108. O. Imray.—From La Société Anonyme Raffinerie. *See* Class XVI.

8011. G. Hübener. Improvements in the electrodes or plates of electric storage batteries. July 10.

9806. R. Comboul. Improvements in diaphragms for use in electrolytical apparatus. July 10.

10,836. C. Payen. Storage batteries. July 17.

10,929. E. Hermite, E. J. Paterson, and C. F. Cooper. Apparatus for electrolysing chloride solutions. July 17.

10,930. E. Hermite, E. J. Paterson, and C. F. Cooper. Apparatus for electrolysing chloride solutions. July 10.

### Patent Abandoned.

#### 1891.

18,097. C. N. Souther. Improvements in galvanic batteries. July 10.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

11,788. F. J. White. Improvement in the manufacture of palatable oils. June 18.

11,948. V. Camiz and A. Bettoni. Improvements in apparatus for the recovery and purification of waste oil. Complete Specification. June 19.

11,972. J. Peters. A mixing and purifying machine for the manufacture of hot neck grease. June 20.

12,512. Read, Holliday, and Sons., Lim., and T. Holliday. Improvements in the manufacture of soap. June 28.

13,107. F. B. Aspinall and The Electrical Oil Refining Co., Lim. Improvements in the treatment of cotton-seed and other oil. July 6.

13,119. E. S. Wilson and Stewart, Bros., and Spencer. Improvements in the manufacture of soap. July 8.

### Complete Specifications Accepted.

#### 1894.

17,396. M. Evans. Improvements in bar soap. July 17.

#### 1895.

11,411. M. H. Wilson. Improvements in soap. July 17.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

11,766. H. H. Lake.—From F. Rosé and Co. Improvements relating to the production of curriers' black and to the utilisation of the same for lamp-black paint and the like. June 17.

12,249. J. Bibby. Artificial rubber. June 25.

12,788. J. Timpson. Improvements in or connected with whitewash or colouring compositions. July 2.

13,457. G. Rockliffe. An improved anti-fouling composition. July 12.

### Complete Specifications Accepted.

1894.

16,664. R. Hutchinson. Improvements in treating bulby tree-gum. July 3.

17,113. N. McCulloch. A new oil-improved process for making red oxide of iron pigments from hydrated peroxide of iron. July 17.

1895.

9713. M. J. Volcker and M. W. G. Bergmann. Process of tanning with mineral agents. June 26.

9953. C. Heitemeyer. A new or improved process of and apparatus for liming, bateing, or tanning hides and skins. June 26.

11,037. A. Seymour-Jones. Improvements in machines for treating hides and skins. July 10.

### Patent Abandoned.

1891.

17,221. E. Binney. Apparatus for the manufacture of lamp-black, carbon-black, &c. June 26.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### Application.

12,722. A. H. Baldwin and T. J. Clarke. Improvements in the machinery for the manufacture of leather pulp. July 2.

### Complete Specification Accepted.

1894.

16,611. S. H. Epstein. Treatment of fancy leather. July 3.

## XV.—AGRICULTURE AND MANURES, Etc.

### Applications.

11,905. C. H. Langdale and A. W. Langdale. Improvements in the treatment of ground slags intended for use as fertilisers. June 19.

12,470. H. Mehner. Improvements in fertilising by the aid of artificial nitrogenous manure. June 27.

12,471. H. Mehner. Improved method for producing nitrides and ammonia. June 27.

12,566. H. P. Pease. An improved hematite slag manure. Complete Specification. June 29.

12,769. D. T. Day. Process of making phosphate of lime fertilisers. Complete Specification. July 2.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

12,624. O. Beusterein. Improvements in and relating to the manufacture of starch. Complete Specification. July 1.

13,214. C. Hellfrisch. An improved process for the manufacture of starch. July 9.

### Complete Specifications Accepted.

1894.

16,235. A. Crerar.—From W. R. Boon and E. A. Hancock. An improved process of and apparatus for evaporating or concentrating saccharine and other liquids. July 3.

18,358. H. C. E. Wilmot. Improvements in the treatment of starch or starchy matter, or crystallisable sugar, for the obtainment therefrom of products more especially suitable for use in brewing. July 10.

1895.

7108. O. Imray.—From La Société Anonyme Raffinerie, Say. Purification of saccharine juices by electrolytic treatment, and means employed for that purpose. July 10.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

12,823 C. L. A. F. Buttner and C. F. Meyer. Improvements in and connected with a method of and an apparatus for drying malt. Complete Specification. July 3.

13,349. J. W. Phillips and H. C. Pullin. An improved refrigerator for cooling wort. July 11.

### Complete Specifications Accepted.

1894.

15,833. A. W. Billings. Manufacture of beer. June 26.

1895.

4741. L. Egyedi, J. Weiss, J. Popelka, and A. Mlady. Improvements in and connected with the treatment of brewers' grains and similar materials. July 17.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

### Applications.

### *A.—Chemistry of Foods.*

12,481. D. Temple and E. H. Taylor. A process for preserving new milk by fermentation. June 28.

12,743. J. Y. Johnson.—From F. von Heyden, Nachfolger. Preserving and sweetening food and liquors. Complete Specification. July 2.

12,759. P. A. Bachelerie. An improved process for preserving organic and more particularly alimentary subtances, and apparatus therefor. Complete Specification. July 2.

12,800. T. F. Edgeworth. An improved method of manufacturing a starchless food. July 3.

13,176. F. V. Friderichsen. A new or improved process of manufacturing fodder. Complete Specification. July 8.

### *B.—Sanitary Chemistry.*

11,933. R. H. Williams. Improvements in or relating to the method of applying or the manufacture of certain agents or mediums for disinfecting, deodorising, preventing putrefaction, and for other purposes. June 19.

12,067. J. H. Osbourn. Improvements in the method of and apparatus for softening and purifying water. June 21.

12,279. H. F. C. Ebeling. New or improved process and apparatus for purifying liquids. Complete Specification. June 25.

12,803. W. Ackroyd. Treatment of sewage or impure potable water. July 3.

13,106. J. Y. Johnson.—From F. von Heyden. Improvements in disinfecting and preserving. Complete Specification. July 6.

### *C.—Disinfectants.*

11,785. G. R. Morrison. An improved sheep dip and antiseptic dressing and preservative for hides and the like. June 17.

11,908. G. Dawson. Improvements in the manufacture of disinfecting preparations. Complete Specification. June 19.

13,271. E. Chedaille and F. Lasseaux. Improvements in insecticides. Complete Specification. July 9.

### Complete Specifications Accepted.

### *A.—Chemistry of Foods.*

1894.

13,003. H. H. Lake.—From F. Delangle. Improved food preparations. June 26.

15,558. D. A. Sutherland. An improved process and means used therein to effect the preservation of perishable substances. July 3.

### *B.—Sanitary Chemistry.*

1894.

16,724. E. W. Ives. Improvements in screening and mixing chambers for precipitating tanks and the like for treating sewage and other foul or waste waters. July 10.

1895.

9071. E. Fischer, E. Klein, and F. Mahlstedt. A new or improved resistance regulator for apparatus employed in the separation of amalgam and other metallic molecules from sludge. June 26.

### *C.—Disinfectants.*

1894.

15,805. P. Nusebaum. A new process of making combustible capsules for medical and disinfecting purposes. June 26.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

12,461. L. de Naeyer. Improvements in apparatus for treating paper pulp. June 27.

12,998. J. Collins, Lim., and D. Dobbie. Improvements in the manufacture of paper and in apparatus therefor. July 5.

13,355. J. S. Rigby. An improvement in the manufacture of vegetable parchment and utilising the waste product obtained. July 12.

### Complete Specifications Accepted.

1894.

20,358. H. H. Lake.—From Arndt and Frost. Manufacture of photographic printing paper. July 3.

1895.

9987. T. C. Cadwgan and The O. S. Kelly Co. An improved process for preparing paper stock. June 26.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

11,830. A. J. Boult.—From J. F. Theurer. Improved manufacture of a colouring and flavouring extract for liquids. Complete Specification. June 18.

12,295. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. Improvements in the manufacture of a pharmaceutical substance, and in the purification of the same. June 25.

13,060. F. Sykes.—From R. Hirsch. An improvement in the mode of producing saccharine. July 6.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Complete Specifications Accepted.

1894.

17,758. V. Mathieu. A process for photographing in colours. July 17.

20,358. H. H. Lake.—From Arndt and Trost. *See* Class XIX.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

12,325. E. Ungania. An improved smokeless powder and manufacture of same. Complete Specification. June 25.

12,380. J. C. Thompson. Improvements in fuzes for explosive projectiles or shells. June 26.

12,735. C. A. Allison.—From F. W. Bawden. An improved explosive. July 2.

12,768. H. H. Lake.—From The International Powder Company. Improvements in smokeless powder. Complete Specification. July 2.

13,161. J. Lux. Improvements in explosive cartridges more especially intended for use in mines. Complete Specification. July 8.

### Complete Specifications Accepted.

1894.

15,977. R. W. Anderson. Match igniters or strikers. June 26.

18,496. F. W. Bawden. An improved explosive. July 10.

1895.

11,424. S. R. Divine. Improvements in blasting compounds. July 17.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

# THE JOURNAL

OF THE

# Society of Chemical Industry:

## A MONTHLY RECORD

### FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 8.—Vol. XIV.] **AUGUST 31, 1895.** [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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## NOTICES.

The Society's Office will be closed from September 1st to September 16th next.

Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, and also those elected since the last Annual General Meeting, who do not pay subscription for 1894, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee will be 20*l*., instead of 15*l*. as heretofore, after the 1st January 1895.

### Annual General Meeting.

In consequence of the General Election, the Annual General Meeting was postponed from July 17th to July 31st, as announced on the cover of the June issue. A full account of the proceedings, the President's address, and the visits to works and excursion appears in this issue.

### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10*s.* |
| To Subscribers | 12*s.* 6*d.* |
| To others | 15*s.* |

### Bankers' Orders.

For the convenience of Members, the Treasurer has arranged with the Bankers of the Society that they shall collect subscriptions from Bankers in town and country; and Members, who have not already done so, are invited to fill up and sign the Banker's Order enclosed with the December 1893 number of the Journal, which should then be sent to the Honorary Treasurer, Mr. E. Rider Cook, East London Soap Works, Bow, E.

Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed.

## LIST OF MEMBERS ELECTED 31st JULY 1895.

Böhm, Jos. A., c/o Actien-Gesellschaft für Chemische Industrie, Mannheim, Manager.

Bowman, W. P., 7, White Horse Street, Leeds, Wholesale Druggist.

Eastick, Samuel P., 130, Fleet Street, London, E.C., Chemist.

Furness, H. B., Smith and Augusta Streets, Cincinnati, Ohio, U.S.A., Chemist.

Halliwell, Edw., Alexandra Crescent, Dewsbury, Yorks, Analyst.

Lucas, Alf., Government Laboratory, Somerset House, W.C., Assistant Analyst.

Pütz, Mrs. Helen, 16/17, Great St. Helens, London, E.C., Chemical Merchant.

Vanderpoel, Dr. Frank, 191, Roseville Avenue, Newark, N.J., U.S.A., Chemist.

Wood, W. H., 3, New Road, Halifax, Yorks, Analytical Chemist.

## CHANGES OF ADDRESS.

Allen, R. L., l/o Brookfields; Newton Farm, Middlewich.

Archbutt, L., l/o Charnwood Street; The Yews, Madeley Street, Derby.

Baly, E. C. C., l/o Tooting; University College, Gower Street, W.C.

Buchanan, Josh., l/o Johannesburg; Buffelsdoorn, viâ Potchefstroom, S.A.R.

Colquhoun, L., l/o Stevenston; c/o British and Colonial Explosives Co., Lim., Perranporth, R.S.O., Corwall.

Colquhoun, Wm., l/o Cardiff; Pontrhydyrun, near Pontypool.

Doidge, H., l/o Nottingham; retain Journals until further notice.

Duxbury, Thos., l/o Darwen; 14, Grosvenor Chambers, Deansgate, Manchester.

Henshaw, Jno.; Journals to Green Lane, Brook Street, Manchester.

Horrocks, S., l/o Parkfield Road; 12, Southwood Road, Liverpool, S.

Ingle, Dr. Harry, l/o Leeds; Technical School, Bond Street, Hull.

Ivatts, Harold E., l/o East Ham; 27, Wellington Square, Chelsea, S.W.

James, Alfred, l/o Kinning Park; 108a, Hope Street, Glasgow.

Knight, J. J., l/o Gorton Brook; 13, Grafton Street, West Gorton, Manchester.

Lascelles, J. H., l/o New Southgate; P.O., Calcutta, India.

Macfarlane, R. F., l/o Felling; Tharsis Copper Works, East Moors, Cardiff.

Maxim, Hudson, l/o New York; 55, Charing Cross Mansions, London, W.C.

Neiman, H. S., l/o Albany; 8, East 97th Street, New York City, U.S.A.

Rettie, Theodore, l/o Glasgow; P.O., Johannesburg, S.A.R.; and (Journals) 16, Great King Street, Edinburgh.

Robertshaw, C. Dawson, l/o Leeds; c/o Dr. Lewkowitsch, Lancaster Avenue, Fennel Street, Manchester.

Sexton, Prof. A. H., l/o Falkirk; 204, George Street, Glasgow.

Smith, Bernard E., l/o Newcastle; 45, Percy Park, Tynemouth.

Smith, Jas. F., l/o Brunswick Road; 5, Beach Road, Sparkbrook, Birmingham.

Stephens, H. O'Reilly, l/o Kensington; 191, Aldersgate Street, London, E.C.

Turnbull, G. W., l/o Darlington; 14, Scotland Road, Carnforth, Lancashire.

Wardman, G. B., l/o Michoacan; c/o La Gran Fundicion Central Mexicana, Aguas Calientes, Mexico.

Wilkinson, Dr. S., l/o Coleman Street; The Grove Co., Ltd., Marsh Gate Lane, Stratford, E.

## MEMBER OMITTED FROM LIST.

Stewart, Ebenezer, Oil Seed Mills, Rochester, Kent.

## Deaths.

Leathart, Jas., Lead Works, Newcastle-on-Tyne.

Riley, W. G., Hapton, near Accrington.

Roques, Adolphe, 36, Rue Ste. Croix de la Bretonnerie, Paris.

# PROCEEDINGS
OF THE
# FOURTEENTH ANNUAL MEETING.

The Annual Meeting of the Society was held in the Chemical Lecture Theatre of the Yorkshire College, Leeds, on Wednesday, the 31st July.

The Secretary having read the Minutes of the last General Meeting, held at Edinburgh, Messrs. Westmoreland and Burrell were appointed scrutators, and they proceeded to collect the ballot papers.

The President then declared the ballot closed.

### Report of the Council.

The Secretary read the Report of the Council as follows:—

We have the honour to report that the number of members on the register is now 2,895, as compared with 2,828 at the last Annual Meeting. During the year 229 new members have been elected, as compared with 251 last year; and 160 members have been removed, as compared with 207 last year. The number of new elections to some extent depends on the personal efforts of the members, who, by persuading others to join, may contribute to the permanence of the Society and the increase of its usefulness.

Among those who have died are Dr. C. R. Alder Wright, F.R.S., a chemist of the first rank, many of whose researches, of more or less technological bearing, are recorded in our Journal; Wm. Topley, F.R.S., the geologist; S. M. Burroughs, the pharmacist; and Eckley B. Coxe, one of the foremost of American mining engineers.

During the past session 85 papers have appeared in the Journal, as against 77 last year. The excess of revenue over expenditure, as will be seen from the treasurer's report already in your hands, amounted last year to 178*l.* 10*s.* 2*d.*, as against 574*l.* 17*s.* 9*d.* in 1893. For this diminution in the balance at the end of the year, the increase in the size of the Journal is entirely responsible; for the actual revenue showed an increase of nearly 100*l.* Every effort is being made to keep down unnecessary expense, but the Council considers it of first importance to bring before the members each advance in that applied science for the promotion of which the Society exists. Meanwhile this year's volume bids fair to equal if not exceed the largest of its predecessors. The compilation of the collective index from the beginning of the Journal to the close of the current year, which is now in the hands of Mr. Renaut, will entail a further outlay of about 1,000*l.* The Council would direct the attention of members to a notice appearing month by month on the second page of the Journal, which gives the terms on which the index may be obtained. Due notice will be given of the approaching completion of the work, which will probably be in the hands of members before our next Annual Meeting.

No new Section has been formed during the year, but several of those already existing, notably that in New York, show greater activity. Two local secretaries, Dr. J. T. Dunn and Mr. R. Lloyd Whiteley, who have given their services from the first, have now been transferred to other centres; and the Council takes this opportunity of tendering them its thanks for their voluntary labours, and of wishing them every success in their new quarters.

A suggestion having been made last autumn that the supply of papers to the various Sections would be stimulated by the institution of premiums or prizes similar to those of the Institution of Civil Engineers and other societies, a committee was appointed, which suggested that it might be of advantage to make an occasional presentation of a medal in recognition of exceptional merit in technological work. This suggestion being approved by the Council, a design has been prepared under the direction of the President and Sir John Evans.

The institution of an international fund to erect a statue to Lavoisier has given to the Council an opportunity of identifying the Society with a movement which recognises that services to science are rendered, not to one's own country only, but to the world.

The President invited observations upon the Report of the Council.

Mr. W. F. Reid asked how the 1,000*l.* for the expenditure on the Index was to be paid—out of the funds in hand or from the sale of the index?

Mr. E. Rider Cook, Hon. Treasurer, said the new Index was to be paid for in part by those members who chose to have it; and, moreover, they had not invested the balance of receipts over expenditure of last year, and did not propose to invest the balance that might be earned in the current year, so that in all probability the expense of the Index would be paid out of the ordinary funds of the Society without touching the reserves.

Prof. Smithells moved the adoption of the Report, and said: I see from the figures on the blackboard before us that there is every likelihood that the President will make some interesting comments. On behalf, therefore, of those not on the Council who belong to the Society, but who have the fullest confidence in those gentlemen who are giving their services on its behalf, I am sure you will have no hesitation in accepting the proposition.

Dr. Lewkowitsch, in seconding the motion, said: In the figures which have been quoted we find signs of a steady growth, except in one column. I, however, looked at the matter from the point of view of the industrial chemist and the commercial man. This leads me to ask how had this particular increase of expenses come about, and I find that it has been perfectly justified. It has been caused in the attempt to increase the usefulness and output of our plant. We have increased our expenses in order to increase the usefulness of our journal, and there is no doubt this outlay will be repaid with compound interest to the satisfaction of the members of the Society. We are all proud to know that the journal is unquestionably the leading journal, so far as chemical industry is concerned, in the world. No doubt we shall be able to make up for the decrease of profit if we take to heart the remarks made in the first paragraph of the report, and each try to win new members for the Society. I have great pleasure in seconding the adoption of the Report.

The resolution was carried unanimously.

### The Treasurer's Statement.

Mr. Rider Cook submitted a statement relating to the finances of the Society. He said: As regards the receipts and expenditure of last year, the receipts amounted to 4,962*l.*, including a balance of 245*l.* brought forward. The expenditure reached the same amount, including a balance of 339*l.* carried forward. As regards the statement of account of revenue and expenditure—not the receipts and payments—the revenue of last year consisted of 3,304*l.* from annual subscriptions, 196*l.* interest on securities, 568*l.* from advertisements in the Journal, and 292*l.* 10*s.* from the sale of the Journal. The principal item of expenditure is 3,048*l.* 11*s.* 7*d.*, the editorial and printing expenses of the Journal. The rest of the expenditure is made up of salaries, stationery, &c. As stated in the Report, the balance of revenue over expenditure last year was only 178*l.* 10*s.* 2*d.* The Society seems now to have reached practically something like its maximum of members, unless some fresh effort is made to extend it. That is a fact which the Council has recognised, and is giving a great deal of attention in the Council meetings to prevent the expenditure from growing larger.

Mr. R. Reynolds moved that the best thanks of the Society be given to the Treasurer for his statement and for his services during the past year. None would wish to measure his services by the number of pounds in the balance. Money might very well be expended, as it was going to be, on the Index, which would be a more decisive test of the health of the Society than if the money were left in its coffers.

Mr. George Ward, in seconding the proposal, said that those who knew the very admirable and efficient way in which the Society's accounts were kept could not fail to appreciate the services of the Treasurer.

The vote having been put and carried,

Mr. E. Rider Cook said in reply: Having regard to the many years which have passed since I left college, and the strides made in science since that time, I feel that I now know very little indeed about modern chemistry, and the most I can do is to leave the scientific part to those more capable, and endeavour to render service to the Society by the commercial and business knowledge which I have acquired, perhaps in the same degree as I have lost my knowledge of chemistry.

### President's Address.

The President, who was cordially received, then delivered his address. He said :—

I cannot take the Chair on this occasion, and in this room, without some expression of the gratification which I feel that it should fall to my lot to occupy my present position in a town, and in a college, with which I am connected by so many and such pleasant associations. By the kind consideration of my friends, I occupied a somewhat similar position on the occasion of the last visit of the British Association to Leeds. I have no doubt my friends of the Society of Chemical Industry are actuated by the same kind thought, that if anything could enhance in my eyes the honour which has been thrust upon me, it would be the pleasure and satisfaction of wearing that honour amongst my old colleagues and former townsmen. That satisfaction is in no small degree augmented by the thought that, being amongst friends of so many years' standing, I can, with a greater confidence, rely upon their charity to condone the many shortcomings in the exercise of my office, which I am afraid no amount of partiality on their part will render them blind to, however much they may be willing to forgive and forget them.

As you will have gleaned from the Council's Report, the year which has elapsed since our meeting in Edinburgh has seen no great changes in the fortunes of our Society. To paraphrase a saying which has become almost trite—happy is the society whose history is monotonous. Each successive report tells very much the same story of uninterrupted prosperity. The list of our members continues to lengthen, and, as you have heard, the names on the register now number 2,895. The only note of sadness is in the reference to those we have lost by death. Of one of these—Charles Romley Alder Wright—there is due from me more than the passing reference of the official record. Friends in boyhood and fellow-students, I early learned to admire his intellectual vigour, and to value the many qualities of heart which were reflected in his bright, sunny nature, in his generous impulsiveness, and in the constancy and staunchness of his friendships. One of the earliest of our members, Wright was a man we could ill afford to lose. A well-trained chemist, of varied knowledge and wide experience, he gave to his work all the powers of a mind singularly acute, and disciplined by that scientific habit of thought which is to be seen on every page of his published writings. Cut off in the maturity of his mental strength, we had every hope that for many years to come he would have been amongst us, contributing by his pen, and by his remarkable power of lucid exposition and felicitous speech, to the proceedings of our London Section. What we have lost can alone be gauged by what we still possess.

Now that our Society has arrived at the period of adolescence, it may not be uninteresting to throw a glance backwards and to spend a few moments in tracing its growth in numerical strength during the 13 years of its existence. The subjoined figures, taken from the annual official returns, serve to show how far this growth has been steady and continuous:—

| Year. | Place of Annual Meeting. | No. of Members. |
|---|---|---|
| 1881-2 | Manchester | 1,140 |
| 1882-3 | London | 1,390 |
| 1883-4 | Newcastle-on-Tyne | 1,809 |
| 1884-5 | London | 2,090 |
| 1885-6 | Liverpool | 2,271 |
| 1886-7 | Manchester | 2,302 |
| 1887-8 | Glasgow | 2,395 |
| 1888-9 | London | 2,445 |
| 1889-90 | Nottingham | 2,595 |
| 1890-1 | Dublin | 2,697 |
| 1891-2 | London | 2,782 |
| 1892-3 | Liverpool | 2,784 |
| 1893-4 | Edinburgh | 2,828 |
| 1894-5 | Leeds | 2,895 |

Although there was a slight check in its fifth year, and although, as I am credibly informed, it mewled and pewked a little in its nurse's arms, the Society has been singularly free from the ailments incidental to childhood ; and at eight years of age, when it spent its holiday at Nottingham, it was remarkably active and vigorous. And so it has gone on, growing in stature and grace, until it is the healthy robust youth you now see, actuated by the conviction that it has a useful and honourable part to play in the world, and full of hope and of confidence in a bright and successful future.

Davy once said that analogy is the fruitful parent of error, and I therefore naturally hesitate to push this analogy too far, but I may point out that the growth of our Society as regards numerical stature resembles the growth of an organised being, in that its rate is at no period a linear function of its age. We cannot expect, therefore, under our present conditions of existence, to greatly augment our rate of numerical increase. It would be unwise, of course, to generalise too far from statistics which extend only over some 13 years, but it may be interesting to note that a graphical representation of the numbers above given affords a fairly regular curve for which a mathematical expression may be found reproducing the actual numbers with a degree of accuracy which as a mean is within 2 per cent. This seems to show that the increase has been in accordance with the operation of a natural law, and that the Society is not only following the expansion of the chemical arts, but is growing in consequence of a more extended recognition of the necessity of applying sound theoretical principles to practice.

Whatever be the underlying causes which determine its course, the form of the curve seems to indicate that the conditions upon which our augmentation in numbers must depend, are fairly definite and stable; and that, therefore, so long as these conditions obtain, we can ascertain with approximate accuracy our numerical strength in the near future. The value of this observation lies in the application of it. What the application may be you will see in a moment. I may, however, be permitted to point out, as one indication, that we are collectively useful, and that our organisation meets a necessity, that few societies having relation to a special branch of science, whether pure or applied, can show a much longer roll of fellows—a fact the more significant when it is remembered that we offer none of those collateral and adventitious advantages, personal or professional, which make membership of some societies more or less eagerly sought after and less or more eagerly paid for. As evidence of the position we hold in public opinion, I should have liked, if I could be permitted to lift ever so slightly the seal which official reticence imposes, to have quoted the minute of the acute lawyer who had to advise one of the Public Departments which I have the honour to serve, as to whether this Society rightly came within the technical meaning of the word "charity," used in the Act which exempts certain bodies from the obligation to contribute to the National Purse. No stronger testimony could be adduced to show how worthily and consistently this Society has kept to the path marked out for it by its progenitors.

Although it is very far from my intention to trouble you with statistical details, it is necessary for the purpose I have in view to compare our increase in numerical strength with the financial development, if I may use such a phrase, of the Society. Obviously, it would be unreasonable to expect that a society with such aims and objects as ours, should respond precisely to the same tests as would be employed to determine the prosperity of a business concern. The primary object of our Society is, of course, not to make money, and therefore big balances are not necessarily a criterion of success. Provided, however, it can be shown that the Society is actually fulfilling its proper functions, a balance of revenue over expenditure is at least a test of good management and economy. For some years past our Treasurer has published a financial statement, in addition to the usual balance sheet, which allows the members to compare at a glance the actual revenue of the Society with its total expenditure for any particular year. Without going into details, which will be found in the statements themselves, the main facts may be thus summarised :—

| Year. | Total Revenue. | Total Expenditure. | Balance of Revenue over Expenditure. | Journal Expenses. |
|---|---|---|---|---|
| | £ | £ | £ | £ |
| 1886 | 2,774 | 2,434 | 340 | 1,734 |
| 1887 | 3,270 | 2,783 | 487 | 2,019 |
| 1888 | 3,681 | 2,763 | 918 | 1,951 |
| 1889 | 3,768 | 3,161 | 607 | 2,257 |
| 1890 | 4,015 | 3,908 | 107 | 3,031 |
| 1891 | 4,135 | 3,604 | 531 | 2,577 |
| 1892 | 4,181 | 3,690 | 591 | 2,642 |
| 1893 | 4,271 | 3,696 | 575 | 2,690 |
| 1894 | 4,361 | 4,182 | 179 | 3,049 |

It will be seen that whilst, as we should expect, the revenue of the Society increases at a rate which bears a fairly definite relation to the increase in the number of its members, the total expenditure fluctuates in a most irregular manner, and when we search for the cause of this it is found to be mainly due to variations in the annual cost of the Journal. It is not easy to explain in a few words the cause of these somewhat abrupt and irregular variations. That there must be a constant tendency towards increased expenditure on this head will be obvious. The annual increase in membership necessitates, of course, a larger issue from year to year, and each year sees a larger and larger mass of material to be dealt with by the editor and the abstractors. The fact that the published work of every organisation related to chemistry, which is not in a stagnant or moribund condition, increases in volume year by year necessarily reacts upon the size of our own publication. Moreover, the cost of production shows no tendency to diminish. All these are factors to be reckoned with. Of course I am well aware that in both pure and applied science, there are periods of activity and of comparative quiescence, and such periods must have their influence upon our own Journal, which seeks to be at once the mirror and the measure of the movement in the application of chemical principles to industry. But the fluctuations I am speaking of are not to be wholly accounted for by these periods of ebb and flow; these, after all, can only have a very partial and secondary effect. The point which I wish to make is, I think, vital in the interests of the Society. In the present phase of our development it seems to me absolutely necessary that the expenditure on our Journal should be made to bear an approximately fixed and definite ratio to our income. In fact we must in this, as in other matters, cut our coat according to our cloth. This problem of how to reconcile the ever-growing demands of the editor and printer with the necessity of setting aside the annual sum which is required to meet the various contingencies which an active and expanding society gives rise to, is exercising the treasurer of every scientific body with which I am acquainted. It is an open secret that in some societies with a turn for speed which length of years seems only to increase, the most drastic measures have had to be resorted to in order that the constable might not be outrun. I take it for granted that there is in our Society that buoyant elasticity of temperament which is one of the characteristic signs of self-reliance and resourceful energy, and that being young we have no misgivings as to our financial future. Our adolescent Society even now manages to put by every year a far larger sum than corresponds with Mr. Micawber's idea of perfect financial security. But I venture to think a considerably greater margin might be secured by a more rigorous selection and treatment of the mass of matter, and especially of foreign matter, which has to be dealt with by our Publication Committee. I trust I shall not wound even the tenderest Teutonic susceptibility if I say that a certain amount of the material which is made in Germany is hardly worth the cost of importation.

I once heard it gravely argued that it was part of the proper business of the library of a scientific society to buy, as they appeared, all those books which Charles Lamb described as no books, in the special domain of science with which that society concerned itself, in order to protect the pockets of its fellows; and I believe I have heard something to the same effect, and for the same reason, in regard to a certain style of Patent Literature which occasionally finds its way into our Journal. In turning over its pages, it has occasionally struck me that it is possible to purchase comprehensiveness too dearly, and that in the desire to make our organ a faithful reflex of all that is going on, proximately and remotely, in connection with chemical technology, we may, to use Franklin's well-known phrase, be paying too much for our whistle. I have felt it my duty to dwell upon this matter at this length in view of the fact that the cost of our Journal is now greater than ever, whilst the difference between revenue and expenditure has sunk to a point which, with one exception, is lower than in any previous balance sheet. Another consideration has also led me to draw attention to the subject on this occasion. The Report of the Council makes mention of the question of the Collective Index which is in course of preparation by Mr. Renaut. Excellent as our annual indexes are, everybody who has had occasion to use our Journal to any large extent for the purpose of verification, or for the putting together of information, must have deplored the want of a complete general index. For upwards of 13 years we have been collecting and storing all sorts of chemical treasures, but it is only within the present year that we have decided to provide ourselves with a proper key to the treasure chest. For some years past I have had to spend a considerable fraction of my working time in the compilation of a work on applied chemistry. I naturally turned to our Journal as one of the main sources of my information, and the fact was rather painfully borne in upon me that, freely as the Society has cast its bread upon the waters—at a cost, in the aggregate, of some 27,000*l.*,—it occasionally required an inordinate number of days to find it. It must be obvious that the practical value of the mass of material distributed over some 12,000 pages is enormously curtailed by the absence of a ready access to it. It required no arguments to convince the Council of the abstract desirability of a general index, but the expediency of undertaking it at the present time, in view of our financial position, was not so easily determined, and I think my fellow-members of Council will bear me out when I affirm that no single step of ours during the past Session was more carefully or more anxiously deliberated upon. I have myself no misgivings as to the wisdom of the step we eventually took. We felt we did not bring the difficulty any nearer to solution by continued postponement. If it were done, then 't were well it were done quickly. It was true economy to lay down the plan of the work in such manner that future compilations of the same kind should be consistent and in harmony with it. But, gentlemen, the preparation of such a collective index at, say, decennial periods, constitutes precisely one of those contingent charges for which provision should be made, even at the cost of sacrificing a few dubious specifications, and of excising all matter in our abstracts or reports which has obviously, and on the face of it, no permanent value. Our Journal is really incomplete in the absence of such periodical collective indexes; and I hope the day is not far distant when the Society will be in a position to follow the good example of its elder sister the Chemical Society, and supply such indexes free of charge to its members.

The past year has not seen any very striking new departures in the application of chemical principles to industry, although in any *résumé* of recent progress a number of matters may fittingly claim attention by reason of their immediate or prospective interest. The extinction of the gas-making industry, which was so confidently predicted a few years ago, seems as far off as ever. Threatened manufactures, like threatened men, sometimes live long. The very struggle for existence seems occasionally to enhance their vigour and to increase their vitality, and they gather new strength by the exercise of innate power. So many industries are now dependent upon the gas manufactory that it is like a town with many staple trades, each of which acts and reacts upon the prosperity and development of the others. This very potentiality indeed affords the strongest assurance of its continued existence, and with each fresh economy in production, with each new improvement in utilisation, with each new application as a source of power, with every new discovery in the use to which the countless products of destructive distillation of coal can be put, the industry acquires a new lease of life. If this industry has afforded to science opportunities for discoveries which are among the most brilliant of her triumphs, science has repaid the obligation an hundred-fold, and the gas manufacturer fully realises that it is only by the intelligent application of her lessons that his industry can continue to hold its own in the struggle for supremacy. The tendency of modern life is, more and more, to turn night into day, and "light, more light," is the ever constant cry. At the present time the question of enrichment is engaging the attention of every gas engineer. Six years ago cannel, which up to that time had been almost exclusively used in the enrichment of coal-gas, had risen in price to such an extent that gas engineers were driven to seek for other methods by which the illuminating value of the gas could be increased so as to satisfy statutory and other requirements. This enrichment may be effected by three methods: (1) by causing the gas to take up the vapour of volatile hydrocarbons; (2) by mixing the coal-gas with oil-gas obtained by decomposing oils by heat; or (3) by mixing the coal-gas with carburetted water-gas made by decomposing oils in heated chambers whilst subjected to a current of water-gas.

The idea of carburetting coal-gas with volatile hydrocarbon vapours is of course not new. About 40 years ago the late Dr. Letheby sought to put this idea into practice, but without success, and it is not difficult to determine the causes of his failure. The hydrocarbons he employed were far from uniform in character; they were of very different degrees of volatility, and of varying illuminating value, so that after the gas had passed through or over the enricher for some time, the more volatile portions having been evaporated, the residual hydrocarbon was more likely to decrease than to increase the illuminating value of the coal-gas. In the Maxim-Clarke process this difficulty is obviated by using a light spirit of fairly uniform composition, which is volatilised into the gas as required, and there is little doubt that if benzol continues at its present price, it would constitute the best and cheapest enricher that can be obtained.

The fall in the price of oils which took place a few years ago, naturally gave an impetus to the manufacture of oil-gas, and to its utilisation for the purpose of enrichment. Considerable difference of opinion, however, has existed as to the permanency of the gas when used on the large scale; this would seem to be wholly dependent upon the temperature at which the oil was "retorted," for a properly made oil-gas is at least as permanent in illuminating character as ordinary coal-gas, even if it is not more so. Of the various oil-gas processes, that introduced by Mr. W. Young, of Peebles, may be specially mentioned. In this process the oil to be decomposed is made to wash the oil-gas escaping from the retorts, which is thereby freed from any vapours which would be liable to condense in the mains and pipes.

Enrichment by oil-gas has been largely adopted in Scotland and in many English works, and most gas-managers who have given the process a fair trial, have abandoned the idea of returning to cannel, as oil-gas enrichment is not only far cheaper, but it is more easily worked, and the illuminating value of the gas as sent out is more under control.

The cost of oil enrichment will of course vary with the locality, which to a great extent governs the price of oil; but Professor Vivian Lewes informs me that with oil at 3*l.* a ton, it costs 0·3 of a penny to raise 1,000 cub. ft. of coal-gas one candle in illuminating value.

Enrichment by carburetted water-gas is also making headway in England; and for some time past London, north of the Thames, has been supplied with coal-gas containing a liberal admixture of carburetted water-gas, whilst large installations are at work in Belfast, Liverpool, Glasgow, and other places.

The relative merits of oil-gas and carburetted water-gas as methods of enrichment largely depend upon the conditions under which the gas-works has to produce illuminating gas. Oil-gas gives enrichment with very little increase in the bulk of gas made, whilst carburetted water-gas not only gives enrichment, but also considerably increases the volume of the product. It is indeed seen under the most favourable conditions when quantity as well as quality is required, and this in the case of sudden fog, for example, is of great advantage to the gas-manager. Moreover in large towns where the ground-area at the disposal of the gas-works is usually limited, the power of turning out very large volumes of gas from a small space is of great importance.

As regards relative cost of enrichment, I am informed by Professor Lewes that it is practically the same as that of oil-gas within a range of from 17 to 26 candles.

A serious drawback to the employment of carburetted water-gas is that it contains 30 per cent. of carbon monoxide, and although its introducers into this country have been successful in persuading gas-managers that this does not constitute any real danger, and although the Board of Trade has not yet taken any steps to limit the amount of carburetted water-gas that may be mixed with coal-gas for distribution, there can be no question that its use is attended with very great risk. Ordinary coal-gas as at present made may contain from 3 to 4 per cent. of carbon monoxide, and when enriched with water-gas to the extent employed in London, the quantity is increased to from 7 to 8 per cent., whilst in some county towns using water-gas in foggy weather, or under conditions which necessitate a rapid make of gas, the percentage has been known to rise as high as 20. To anyone acquainted with the intensely poisonous action of carbon monoxide—and I speak from some practical experience of this action, having been in jeopardy from accidentally inhaling it—the distribution of so deadly an agent into our houses will be viewed with serious apprehension. If the public mind once realises this danger, the gas industry may suffer a blow from which, with the electric light on its flank, it will not readily recover

Wöhler's discovery of calcium carbide, and of the mode of its decomposition by water (Liebig's Annalen, **124**, 220), after lying dormant for more than 30 years, seems about to bear fruit. We have in this compound, which is now being produced on a relatively large scale by means of the electric furnace, a ready means of producing large quantities of acetylene of a high degree of purity. This substance can be made to burn under proper conditions so as to produce a flame of extraordinary luminiferous value and character. It remains to be seen what practical application can be made of this fact.

Unfortunately acetylene is hardly less dangerous to breathe than carbon monoxide. Should either of these gases ever come into general use in connection with gas-lighting, some more stringent test as to the character of our gas-fittings and mode of distribution will have to be insisted upon, or the public health will suffer.

The remarkable explosions which occurred last winter in the electric mains, and which formed the subject of a Board of Trade inquiry, showed the danger which arises from leaky gas-mains. There can be no question that the escape of such gases as carbon monoxide and acetylene into the air from this cause must affect the vitality of people who are compelled to spend the greater portion of their lives in towns.

The determination, within reasonable limits of accuracy, and by a sufficiently simple and generally applicable method, of the illuminating value of coal-gas, is a problem which concerns alike the manufacturer and the consumer. Hence we have all watched with interest for the results of the somewhat protracted labours of the Photometric Standards Committee which was appointed by the Board of Trade in 1891, whose report has recently been published. Most people who have had experience of photometric work have had cause to complain of the vagaries of the sperm candle during the 35 years that it has done duty as a standard of light, and there has been a growing conviction that, like the familiar spirit in Mr. Walter Pollok's amusing story, it has outgrown its period of usefulness. The candle, indeed, cannot, in the very nature of things, fulfil the conditions of an exact standard. This has been repeatedly pointed out in successive reports to various public bodies, but the difficulty has been to find an efficient and wholly satisfactory substitute. Of the various suggestions which have, from time to time, been put forward, Mr. Vernon Harcourt's pentane standard, or some modification of it, seemed to constitute the only practicable solution, and the Photometric Committee has now found that Mr. Dibdin's 10-candle pentane Argand apparently affords the requisite conditions for a standard burner. The recommendations of the Committee have still to be legalised by Parliament, and it remains to be seen what the attitude of the gas companies will be when the matter comes up for legislative consideration.

In connection with the subject of destructive distillation, I may be allowed to make a passing reference to the great improvement in tar-distilling which has been recently effected by Mr. F. Lennard, of Messrs. Forbes, Abbott, and Lennard, Greenwich, in the construction of his continuous still. In this arrangement the tar is allowed to flow in continuously, whilst the distillates and pitch pass out without intermission. Stills capable of dealing with 20,000 to 30,000 galls. of tar in 24 hours are now in operation at the works referred to.

Although tar has many virtues, tar-works are not usually regarded with much favour by those who happen to live near them. Hence Mr. Lennard's process, which obviates the nuisance incidental to intermittent work, will no doubt be warmly welcomed by the sanitary authorities.

The application of electrical energy to the decomposition of alkaline chlorides either for the production of chlorine, or of alkali, or of both products, has been made the subject of many patents. The great majority of these processes have been stillborn, and even of those which were stimulated into vitality, the existence has been but short and feeble. With a sounder knowledge of the conditions under which success is alone possible, the problem is once more attracting the attention of technologists, and the chemical world is watching with great interest the results of two or three electrolytic processes which are now being worked out on the large scale. One of these is the invention of our member, Mr. Hamilton Castner, which has been in practically continuous operation for nearly 12 months at the Aluminium Company's works at Oldbury. In Mr. Castner's process the difficulties connected with the use of diaphragms and the liability to recombination of the products to form hypochlorite are obviated, whereby the destruction of the electrodes is prevented and a much higher electrical efficiency is obtained. I am indebted to Mr. Castner for the following account of the method:—The essential feature of the process is the employment of a moving body of mercury, which completely separates the products of electrolysis, and by its movement takes the place of a diaphragm, the sodium amalgam formed being decomposed as it is formed. The cell, which is divided into three compartments, is capable of being continuously rocked or tilted, so as to cause the mercury to flow from side to side. The two outside compartments contain the alkaline chloride solution and the carbon anodes, while the middle compartment contains an iron cathode and the caustic solution. The solution of the chloride is continuously circulating through the outside compartments, wherein it is being electrolysed, and then returns to saturators, where it is re-charged with salt. The electric current traversing the salt solution liberates chlorine and forms sodium amalgam. The chlorine escapes from each cell through an aperture into a collecting main, while the sodium amalgam, by the continuous back-and-forward tilting of the cell, passes to the centre compartment, where it acts as an anode during the passage of the current, the sodium going into solution as caustic. A regulated quantity of water is admitted hourly to the centre compartment of each cell, causing the pure solution of caustic to overflow through a discharge pipe into a large collecting pipe connecting all the cells. The cells are electrically connected in series, and are capable of being cut out or put into operation at will.

The following numerical details have been furnished by Mr. Castner:—

1. The electrical efficiency is 90 per cent. This high efficiency is due to the particular features of the process, and also to the fact that the sodium is removed from the mercury electrolytically as rapidly as it is formed, so that, actually, the mercury in circulation rarely contains more than 0·02 per cent. of sodium.

2. No hypochlorites are produced. The small loss of efficiency below the theoretical is not represented by chlorine combining with caustic, but by chlorine and sodium recombining to form salt.

3. The solution forming and carrying the electrolyte is in continuous use.

4. The wear of carbon anodes is so small as not to be of importance to the commercial result. In addition to the advantage the carbons possess in this process, owing to the absence of hypochlorites, they are previously treated by a special process which enables them to withstand the electrical action. So treated, it has been found possible to employ the ordinary pressed carbon instead of retort carbon.

5. The electromotive force required for each cell is but 4 volts for a current of 550 ampères. This low electromotive force is accounted for by the peculiar features of the process, the non-accumulation of sodium in the mercury, and particularly to the fact that the electrodes, cathode and anode, are brought almost into contact.

6. Each cell, which is 6 ft. long, 3 ft. wide, and 6 in. deep, decomposes 56½ lb. of salt daily, producing 38½ lb. of caustic and 34½ lb. of chlorine in 24 hours, for an expenditure of 3½ indicated horse-power.

7. The caustic solutions produced contain 20 per cent. of caustic soda, and yield by direct evaporation a solid caustic of 99½ per cent. purity.

8. The chlorine gas is of 95 to 97 per cent. purity, the balance being hydrogen.

9. The cells in operation are practically automatic, and require little or no attention. They are so simple in construction that a cell in full operation may be stopped, emptied, taken completely apart, put together again, and started in less than two hours by the labour of two men.

A cell in operation running at an efficiency of 88 per cent. gives the following actual results :—

| | |
|---|---|
| Per hour decomposes | 1,058 grms. of salt. |
| „ produces | 724 grms. of caustic. |
| „ „ | 642 grms. of chlorine. |
| Per day decomposes | 56½ lb. of salt. |
| „ produces | 38½ lb. of caustic. |
| „ „ | 34½ lb. of chlorine. |
| Actual electrical horse-power | Per cell 3 |
| Indicated horse-power | „ 3½ |
| Salt decomposed per ampère hour | 1·92 grms. |
| „ „ watt „ | 0·48 „ |
| „ „ kilowatt „ | 1·06 lb. |
| „ „ indicated horse-power hour | 295 grms. |
| Caustic produced per indicated horse-power hour | 209 „ |
| Chlorine produced per indicated horse-power hour | 183 „ |
| Salt decomposed per indicated horse-power day | 16·00 lb. |
| Caustic produced per indicated horse-power day | 11·00 „ |
| Chlorine produced per indicated horse-power day | 9·80 „ |

The present plant, which has been erected by the Aluminium Company, Limited, to demonstrate on a large scale the commercial success of this process, consists of 30 cells, and has a daily output of 1,200 lb. of pure caustic soda, and 1,000 lb. of chlorine, with an expenditure of 110 indicated horse-power.

I am informed that the process and patents for the United States have passed into the hands of the Mathieson Alkali Company of New York and Virginia, and large works are in course of erection in America. The erection of works will also shortly be commenced in Germany and elsewhere on the Continent. Plans, &c., relative to the erection of works on a large scale here in England have been completed, and upon the proper site being selected and other business arrangements concluded, the process will be put in operation in this country.

In the process of Mr. Vautin, whom we also have the honour to number amongst our members, which has been tried on a small manufacturing scale at Messrs. Harrison, Blair, and Co.'s works at Kearsley, fused salt is employed. It rests on a bath of molten lead, which forms the cathode, the anode being a bar of carbon immersed in the salt. The method, I believe, is at present only in the experimental stage, and it remains to be seen whether the difficulties connected with the high electrical resistance and the necessarily large wear and tear of apparatus will be successfully overcome.

The process of Messrs. Holland and Richardson is known to me only through the last report of the alkali inspector. In this method, the soda solution formed about the iron cathode flows away, and the caustic is separated by concentration from the undecomposed salt, whilst the chlorine rises and may be absorbed by lime or converted into chlorate. From the same authority I gather that the process is about to be tried on the large scale at St. Helens, where works are being erected capable of turning out a weekly yield of 40 tons of caustic soda and 80 tons of bleaching powder.

An important new departure in the manufacture of nitric acid is seen in the continuous process invented and patented by our late member of Council, Mr. Manning Prentice, of Stowmarket, in which large quantities of the acid are now produced with great economy of plant, fuel, labour, and wear and tear. Nitric acid of full strength, of a pale yellow tint, and containing not more than 1 per cent. of the peroxide, can in this way be produced directly. As nitric acid is extensively made in East Lancashire and Yorkshire we shall no doubt soon see this principle of continuous working more generally applied.

In view of the repeated warnings that in our chemical industries we are falling behind our Continental competitors, it is satisfactory to note that in at least one important manufacture we are more than able to hold our own. In the manufacture of glycerin, and we may include the manufacture of explosives in which nitroglycerin is a basis, our neighbours are left far behind in the race. As you are aware, large quantities of glycerin are now made from waste soap lyes, and since 1890 chemically pure glycerin has been prepared from this source in Leeds. We are now not only independent of the Continental supply of glycerin—a matter of some concern to us so long as such explosives as cordite have to be relied upon for national defence,—but we are able to teach our friends the enemy how to make their dynamite-glycerin, and to supply them, if necessary, with the material for the purpose.

In this connection it may be noted that there is one other by-product of the wool-scourer which has for some time attracted the attention of technologists, but which, as yet, has not been utilised to any satisfactory extent, viz., wool-fat. Considering the enormous quantities of this material which are now wasted in this district alone, it is to be hoped that the problem of extracting and utilising it more profitably will soon be solved.

The manufacture of edible fats has now assumed large proportions, and however much we may sympathise with agriculturists under the long-continued depression which has overtaken them, it is useless to shut our eyes to the fact that the trade in so-called fictitious butters has acquired a recognised position in commerce. It may, however, be satisfactory to those persons who shudder at the sound of the word margarine, to know that the amount imported into the country has been steadily decreasing for some years past. For the six months ending June 30th of this year, the quantity was 448,187 cwt., for the corresponding period last year it was 602,049 cwt., and for that of 1893 it was 629,242 cwt. On the other hand, the amount of butter imported has steadily increased; during the six months ending June 30th, 1893, it was 1,208,204 cwt., during the same period in 1894 it was 1,340,784 cwt., whilst in 1895 it was 1,456,690 cwt. In other words, whereas the amount of margarine imported in 1893 was more than half that of the butter, in 1895 it is less than one-third. It has been alleged that large quantities of margarine pass through the Customs under a false declaration at the port of entry. I am in a position to say that such is not the case. The false declaration, if any, is to the consumer, and the remedy for this rests with the local authority under the powers conferred by the Sale of Food and Drugs Act.

In connection with the chemistry of textiles, reference may be made to the resuscitation of an old process which originated with John Mercer many years ago, by means of which the calico-printer is now able to imitate the so-called "crepons" of the weaver. The process consists in the local application of a strong solution of caustic soda, which has the effect of giving the fabric the characteristic crinkled appearance.

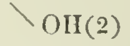
The attempts which have been made for some time past to introduce soluble gun-cotton as a silk substitute have been so far successful that this substance is now employed in association with wool or cotton fibres, the former giving the lustre and the latter the strength. Beautiful as the material is, it may be questioned whether its use is not attended with risk. Some time since, the application of nitro-cellulose for textile purposes was altogether prohibited in some Continental countries, but whether the prohibition still exists I am unable to say.

The discovery of new coal-tar colouring matters proceeds with ever increasing activity. Numerous dyestuffs have been added to the list during the past 10 years, some belonging to already existing groups, others representing new classes, *e.g.*, the oxyketines, thiazones, thiazoles, rhodamines, rosindulines, pyromines, &c. Further, numerous scientific investigations have been made which have either thrown light upon the chemical constitution of colouring matters already known (*e.g.*, the indulines), or have suggested new synthetical methods which have proved useful in practice.

Perhaps the most marked advances have been those connected with the azo colours, particularly that group to which the well-known Congo red belongs. This colouring matter, so sensitive to acids, and hence regarded askance by the colour manufacturer in 1884, the year of its discovery by Böttiger, has proved to be the precursor of a multitude of dyestuffs possessing the most varied and useful properties, *e.g.*, fastness to acids, alkalis, light, and other influences.

Although the characteristic feature of the early colours of this class, was their property of dyeing cotton *direct*, there are now those which are usefully applied to wool as *acid colours*, and others which, owing to the presence of certain atomic groups, are veritable *mordant colours*.

In connection with this latter point, the study by Kostanecki and others of the influence of constitution upon the properties of colouring matters, especially as regards the necessity of employing metallic salts as mordants, has been of considerable service to the colour manufacturer, who in the production of mordant colouring matters no longer finds himself confined to the alizarin group. The increased employment by the colour manufacturer of salicylic acid and other similarly constituted compounds is due to the recognition of Kostanecki's theory concerning the value of the atomic group—



in conferring the character of a mordant dyestuff on a colouring matter.

Another group of colouring matters, to which less numerous, though very valuable additions have been made, is that of the oxy-quinones, of which alizarin is the type. The peculiar oxidising property of fuming sulphuric acid, containing a high percentage of $SO_3$, first utilised by R. Bohn in connection with alizarin blue, has been employed with marked success for the purpose of introducing additional hydroxyl groups into alizarin and allied colouring matters, with the result that such valuable indigo substitutes as the alizarin cyanines, anthracene blue, &c., have been discovered.

The same year (1890) in which these discoveries were made, witnessed renewed attempts on the part of Heumann and others to prepare indigo itself artificially, by new and improved methods, and although such simple substances as aniline and acetic acid may be used as starting points for the purpose, we do not even now appear to have reached the goal of the successful industrial manufacture of artificial indigo. Nevertheless, the synthesis of indigo will always rank with the commercially more successful synthesis of alizarin as a brilliant chapter in the history of colouring matters.

The natural colouring matters of unknown constitution are still numerous, but considerable light has recently been thrown upon the constitution of those contained in quercitron bark, fustic, &c., which are evidently to be classified as derivatives of xanthone. Gentisin, the colouring matter of gentian root, has already been prepared artificially by Kostanecki and Tambor, and we may be on the eve ot similar discoveries respecting the better known dyestuffs above referred to. Indeed, if we can accept the statement contained in an abstract of patent appearing in the June number of our Journal, which specially refers to the production of a substance possessing the properties of catechin, by a modification of the process there described the colouring matter of quercitron bark can already be prepared artificially, as well as those of logwood, brazilwood, and annato.

The novelties and improvements recently introduced in the dyeing and printing of textile fabrics are intimately connected with the advances in colour manufacture above alluded to.

Here, too, the direct dyes of the tetrazo group have played the most prominent part. Their employment for all classes of fabrics has notably increased during the past few years, and, owing to the varied characteristics of the individual colours, they have proved of service in many different branches of the dyeing and printing industries.

Even those engaged in such an old and well-established branch as that of Turkey-red dyeing, and who, up till recently, could afford to maintain a somewhat conservative attitude, have felt compelled to recognise the existence of such dyes as those of para-nitraniline red, nitrosamine red, &c., and even pay them some attention, because, though less permanent, their brilliancy, and the facility with which they can be produced, render them rivals of Turkey-red, too formidable to be despised.

The method by which the above-mentioned dyes are produced is of general application, and constitutes one of the newer methods of cotton dyeing due to the initiative of the colour manufacturer. It consists in passing the fabric previously impregnated with an alkaline solution of a phenol and dried, into a solution of a diazo compound. Combination between the two thus takes place, and an insoluble azo colour is produced *in situ* upon the fabric.

A similar, and yet quite distinct, method of dyeing, now largely employed by the cotton-dyer, is that in which the direct-dyeing tetrazo colours containing free amido groups are employed. After dyeing the cotton with these, according to the usual method, the material is passed into a nitrous acid bath, in order to change the dye upon the fibre into a diazo compound; by a subsequent passage into the solution of an amine or a phenol, there is developed a new dye differing both in colour and properties from the original. This method of developing amido-azo dyes already fixed upon the fibre, has doubtless had its origin in the mode of applying primuline discovered by our member Mr. A. G. Green.

Not only have these developed colours found favour with the cotton-dyer, but also with the calico-printer, because they are so well adapted to the production of patterns. For this purpose it suffices to print the desired pattern with a thickened solution of the phenol, before developing. Further effects are obtained by utilising the sensibility to reducing agents which the dye obtained possesses in common with all azo colours. Calico dyed or printed with the direct on the developed colours, is printed with other colours containing stannous acetate; a subsequent steaming suffices to discharge the dye in the printed parts, and in some cases to develop a new colour. In this manner variegated discharge patterns, *e.g.*, those of the Turkey-red chintz style, &c., are imitated in the most perfect manner.

It would take too long to multiply examples, but it may be stated generally that the arts of dyeing and calico-printing are daily losing their old empirical character by the employment of methods as scientific as they are interesting.

The subject of photography as a branch of applied chemistry properly comes within the purview of this Society, and as a fascinating pursuit it has, no doubt, interest for a number of our Fellows who have no concern in it otherwise. As regards the chemical side of photography, no very striking new departures have been made during the past 12 months. The main advances have been from the optical side and in photo-mechanical processes. Considerable improvements have been made in the manufacture of the most rapid dry plates, and both in certainty of action and in keeping qualities they are but little behind the slower plates. The general adoption of Messrs. Hurter and Driffield's method of speed-testing, first indicated in a paper contributed to this Society in 1890, has afforded photographers a more rational idea of relative rapidity. A very considerable advance has been made in the preparation of so-called iso-chromatic or colour-sensitive plates. The well-known firm of Lumière Bros., of Lyons, have placed on the market plates which are far in advance of anything hitherto commercially obtainable. They exhibit a wide sensitiveness to colour, and are remarkable for their keeping qualities. The use of such plates has given a considerable impetus to the three-colour process of photography in natural colours.

Important advances have also been made in "printing-out" papers, and the English papers especially leave little to be desired both as to quality and cost. Constant additions are of course being made to our stock of developers. Among the more noteworthy of recent additions are the aromatic amido compounds and phenol derivatives, as amidol, metol, glycin, and para-amidophenol.

Attempts to connect the action of organic developing agents with chemical constitution have not been wholly successful, although certain broad generalisations are possible. It appears that for an aromatic organic substance to act as a developer, it must contain at least two hydroxyl or two amidogen groups, or one of each, in its molecule. Hydroxylamine was long ago shown to serve as a developer, and it has lately been proved that hydrazine and hydrogen peroxide are equally effective.

With regard to the so-called photography in natural colours, the most satisfactory results from a practical point of view are obtained by what is known as the three-colour process. There is doubtless great room for development, but the researches of Vogel, Eder, Valenta, Hübl, and others have done much to show the way, and it may be confidently predicted that before another year comes round a notable advance will have been witnessed.

Before leaving this part of my subject, I would impress upon those engaged in the higher branches of photography the absolute necessity of a good preliminary training in physics and chemistry. Photography is, after all, a branch of applied science, and the more science, truly so-called, is put into it, the more rapid and the more certain will be its development. There are wide and fruitful fields of research connected with the scientific side of photography waiting to be tilled by the competent worker. Many a man who is dimly conscious of the undiscovered country in front of him, lacks the courage or the means to enter and take possession. He fain would climb, but that he fears to fall. A good laboratory training, and some familiarity with the habit and methods of scientific research, would dispel many of his doubts and hasten his action. Even if he were not immediately fortunate in his search, the discipline could not fail to be serviceable in whatever branch of manipulative photography he might be engaged. And what is true of this particular branch of applied chemistry is equally true of every other. I suppose it goes without saying that the principles of a science must be known before that science can be intelligently applied, but the experience of a quarter of a century as a teacher has convinced me that we in England have yet to realise all that is thus implied. There is certain to be a rude awakening before very long from the optimism which dreams that things will go on in the future as they have gone on in the past, and that energy, capital, and all that is comprised in the phrase "business aptitude," are the sole factors of success. I am not going to still further weary you with platitudes about technical education, or to repeat the shibboleths which do duty on the platforms of night-schools and mechanics' institutions. Our manufacturing supremacy, in so far as it is dependent on science, is not going to be sustained by these things. It is rather to the setting aside of a few, selected on the principle of the survival of the fittest, and trained to think and to apply the knowledge gained in class-rooms, books, and laboratories, that we must look for our salvation. In a word, all those industries which depend upon science depend upon the existence and development of such places as that in which we are now assembled. And by development I mean the creation of a school of research in which young men, no longer haunted by the dread of impending examinations, may have time and the opportunity to give exercise to the spirit of enquiry, and to strengthen their intellectual powers in attempting to enlarge the boundaries of science. One of the greatest object-lessons in so-called technical education that I know of is to be seen on the banks of the Rhine at Ludwigshafen, and I recall, as if it happened yesterday, the vivid impression made upon me by the sight of the wonderful works of the Badische Anilin und Soda Fabrik, with their well-equipped laboratories—the like of which is not to be seen in any educational establishment in the world—and their scores of university-trained chemists at work on problems of chemical industry needing the highest skill and knowledge for their solution. And this place is only one of many such in Germany. What they mean to Germany and to German commerce you know as well as, or better than, I do. "And to whom do you think we owe all this?" asked Professor von Baeyer, of Munich, as I told him of my visit and of the profound impression it made upon me. I anticipated the answer. It was to Liebig. The little laboratory on the Lahn was as the leaven that leaveneth the whole lump. The movement which Liebig created and fostered, and which has been quickened by the labours of those who have been actuated by his spirit, has been the real factor in this wonderful development; and no ruler ever did a wiser or more beneficent act than was done by the Grand Duke of Hesse-Darmstadt when he endowed the Giessen Laboratory, the first of its kind in Europe. Liebig's influence, and the influence of his method of studying and teaching chemistry, have spread throughout the civilised world, and it is only by the practical recognition of his spirit in our chemical schools and laboratories that chemistry can progress, or that the arts which are dependent on the application of chemical principles can flourish.

In the compilation of the "abstracts and brief chronicles of the time," which constitute the bulk of what I fear is a somewhat disjointed address, I am indebted to many friends. I have especially to thank my former colleague, Professor Hummel; my former pupil, Mr. C. W. Gamble; Professor Vivian Lewes; Dr. Lewkowitsch; Mr. Forbes Carpenter, the Chief Alkali Inspector; Mr. Hamilton Castner; and Mr. Chapman Jones, for the readiness with which they have placed their knowledge at my disposal.

## The Election of Officers.

The ballot for the election of officers was announced as follows:—

President: Thos. Tyrer. Vice-Presidents: Thos. Fairley, Boverton Redwood, Sir H. E. Roscoe, F.R.S., Prof. T. E. Thorpe, F.R.S. Ordinary Members of the Council: R. Le Neve Foster, Douglas Herman, C. C. Hutchinson, Ivan Levinstein, J. S. McArthur, Sir Robert Pullar. Hon. Treasurer: E. Rider Cook. Hon. Foreign Secretary: Ludwig Mond, F.R.S.

The Council for 1895—1896 is therefore composed as follows:—

*President:*

Thos. Tyrer.

*Vice-Presidents:*

Sir F. A. Abel, Bart., F.R.S.
Horace T. Brown, F.R.S.
John Calderwood.
Chas. Dreyfus.
Dr. A. Dupré, F.R.S.
Sir John Evans, K.C.B., F.R.S.
T. Fairley.
Boverton Redwood.
Sir H. E. Roscoe, M.P., F.R.S.
E. C. C. Stanford.
Dr. T. E. Thorpe, LL.D., F.R.S.
Prof. W. A. Tilden, F.R.S.

*Ordinary Members of Council:*

J. S. MacArthur.
C. A. Fawsitt.
R. Le Neve Foster.
W. Douglas Herman.
David Howard.
Prof. A. K. Huntington.
C. C. Hutchinson.
Ivan Levinstein.
Sir Robt. Pullar.
G. N. Stoker.
Wm. Thorp, B.Sc.
Frank Wilson.

With the Chairmen and Secretaries of Sections.

*Honorary Treasurer:*

E. Rider Cook.

*Hon. Foreign Secretary:*

Ludwig Mond, F.R.S.

Mr. Tyrer: It falls upon me to propose a vote of thanks to the President for his address. We have had Presidents since 1881, beginning with one whose name will be received with pleasure and satisfaction, here certainly—Sir Henry Roscoe, who was our first President. You have had many since, and the good rule of alternating, for practical purposes, what have been called technological Presidents and scientific or professorial ones, has been exceedingly beneficial to the Society. I believe it to be, to a large extent, still true that our scientific men have not been and are not still in touch with the members of our Society—that is to say, that those who have to do with applied chemistry are not so; and if any argument were needed to support the statement, you have it in the closing part of the President's invaluable address. And yet I think it will be admitted that this Society has helped to bring the two sections of the army of workers in chemistry together, and the addresses we have had from such men as Roscoe, Abel, Weldon, Perkin, Dewar, Mond, and others, whose personalities you will be able to recall, have proved the wisdom of the alternative selection of President. I think the suggestive address we have just heard will bear fruit in the case of the younger technologists. Dr. Thorpe's reference to those splendidly equipped works on the Rhine must, I think, have good effect. We have had our attention called to the fact many times, and particularly in the eloquent lament of the Chairman of the Scottish Section not very long ago. It cannot be too often repeated; and though comparisons are said to be odious, it must be admitted that in this case comparison is not creditable to us as chemical technologists. In following the men who have occupied the chair of this Society I may be pardoned for referring to a purely personal matter. In the early days of the Society, before it had become really constituted, I was appointed a colleague of the first honorary secretary, Mr. George E. Davis, the duties being divided, I being called the Metropolitan secretary, while Mr. Carey, late Chairman of the Liverpool Section, was my Northern colleague. I see a gentleman present, Mr. Douglas Herman, whose name appears for the first time on the list of Council, and it is to Mr. Herman that I owe the position I occupy to-day. I was unknown both to Sir Henry Roscoe and to Mr. Davis, and you well appreciate my feeling when I say that I regard it as no small honour to have been assocated with such a galaxy of men as have filled the presidential chair. It occurred to Mr. Douglas Herman to suggest my name for the secretaryship; I was wired to, asking whether I would accept the office; and when I tell you that, though I had not heard there was such a society, I wired back "Yes." You will understand my audacity. I felt thus, that such a Society ought to exist, and that if it did exist the sooner I was in it the better—for myself, I mean. The desire to gratefully acknowledge the kindness of Mr. Herman in the first degree, and of my colleague, Mr. George Davis, in the second, must be my excuse for refering to this personal matter. There can be no doubt about our indebtedness to Dr. Thorpe for his very useful and suggestive address. He has followed, as you have observed, somewhat the classification in our Journal. He told us that our Publication Committee must take care to learn what to avoid. It is one thing to have a great mass of matter put before us, but quite another to have before us such matter as we, the officers of the Society and the guardians of its purse, can select in the best interests of the members; and I am sure the editor, while giving us the most valuable matter to be had in the whole world (for the Council in no way stints him), will take the delicate hint of the President. Not only may the Society be congratulated on having such a President as Dr. Thorpe, but the nation may be congratulated on having in its service one who has been for 25 years a popular and successful teacher of chemistry, and who has at the same time made it his business to know what is going on in the technical world around him in the applications of chemical science; and the nation may be considered fortunate that such a man has been placed at the head of what may be called the Government laboratory. It is an immense relief to know that we have at the head of that laboratory a man so well acquainted with scientific principles, and so sympathetic with regard to the technical difficulties of applying science. I ask you to accord your warmest thanks to Dr. Thorpe, not only for his services to the Council and Society, but also for the able address he has given us to-day.

Mr. C. F. Tetley, in seconding the motion, said: It gives me much pleasure, as Chairman of the Leeds Section of this Society of Chemical Industry, to second the vote of thanks which has been proposed so ably by Mr. Tyrer. May I say on my own behalf, and on behalf of the governing body of the building in which we now stand, it gives me very great pleasure to be able to welcome you here, and especially our old friend Dr. Thorpe as your President. Dr. Thorpe is one of the trio who first began work in the Yorkshire College in 1874, and you will see from the building in which we are now assembled the impetus that he, Prof. Rucker, and Prof. Green were able to throw into the work they had before them, and you will feel, with me, that certainly we were lucky to get a gentleman like Dr. Thorpe at the head of our infant chemical department. I congratulate him on the advancement he has recently obtained, and I do so more particularly because I am directly under the supervision of that department, and, having an old friend like Dr. Thorpe at its head, I feel I shall obtain, at any rate, full justice. As large consumers and manufacturers of gas we can congratulate ourselves that we have here our most worthy Mayor, and I hope that we may receive from the address of Dr. Thorpe some benefit in the manufacture and distribution of gas in Leeds. I listened with very much attention and with very much pleasure to his statements of various methods of enriching gas, and I hope we shall soon be in a position to benefit by these remarks, and that our Corporation will not be behind the private manufacturer of gas in the rest of the country.

The resolution having been adopted, the President acknowledged the vote of thanks.

Mr. Hehner moved that Messrs. Theobald Brothers and Miall be asked to continue the office of auditors at the remuneration of 10*l.* 10*s.* for the year.

Dr. Kohn seconded the motion, which was adopted.

Mr. W. F. Reid then moved that Mr. Rider Cook be nominated to represent the Society on the Governing Body of the Imperial Institute.

Mr. Gibson seconded the motion, which was carried.

On the motion of Mr. Newlands, who promised that no general election should interfere with their meeting next year, seconded by Mr. Chrystal, it was resolved to hold the next year's meeting in London.

Dr. Thorpe then said: There devolves upon me the pleasant duty of proposing that we offer our best thanks to the Council and Officers of the Yorkshire College for their kind hospitality in placing this room, and I may add this building, at our disposal. I think you will agree that we could not have had a better meeting-place than in this theatre, and I have a personal reason for saying this, because, having to occupy a very large proportion of your time in delivering an address, I had naturally some concern as to the character of the room in which the address should be given. Now, as I happened to know all about the acoustic properties of this room, they having occasioned me in times past a considerable amount of consideration, I felt a sense of relief in knowing that I was going to speak in a room as to whose merits in this respect I had no misgivings. I beg to propose that we do offer to the Governing Body of the Yorkshire College our most sincere and grateful thanks for the manner in which they have placed this building at the disposal of the Society of Chemical Industry.

Mr. Howard: It gives me the greatest pleasure to second the motion, and for every reason—not only that in this building we have a noble monument of that public spirit for which Leeds is so well known all over England, but a magnificent building which is the home of that very scientific training of which our President has spoken so wisely and truly. And may I say that the experience of practically applied science in chemistry enables me to echo every word he said on the subject, and enables me to appreciate the honourable work which is done in this College, and to congratulate the Council of the College on the work that they have done. I beg to second the motion.

The resolution was carried unanimously.

Prof. Smithells said: As temporary tenant of this room, I will take upon myself the duty of acknowledging your kind expressions. When we heard the Society of Chemical Industry was coming to Leeds there was no hesitation on the part of the authorities of the College in placing their building at the disposal of the Society. The Society itself, from the nature of its work, is assured of a warm welcome at a college like this, which has already signified its interest in chemistry as applied to industry. But when we heard in addition that the President was to be Dr. Thorpe—one of the small band who were the founders of this Institution in a really practical sense—the gratification of the authorities was the more sincere. With respect to the college buildings, so far as the chemical department is concerned, together with the departments of dyeing and leather industries, I think that it will arouse your interest to know that it owes its existence to the ingenuity of Dr. Thorpe.

The Mayor of Leeds then addressed the gathering. I am no authority, he said, in matters chemical. I have some little interest in chemistry, and it is the little that I have that has in a great measure brought me here to-day to give you gentlemen from various parts of the Empire a hearty welcome to Leeds. I hope that while you are in our midst, you will make the best of your opportunities. We have a great many things in Leeds that are worth your inspection. I do not know, Mr. President, that you could have taken your Society into any city in England, Ireland, or Scotland where there is a greater variety of industries to claim your attention; and I will say this, that our gas-works are worth looking at. The gas may not be as rich in illuminating power as your President and some people in Leeds might desire, because I may tell you that in Leeds we want a pennyworth for a penny, whether it is gas or anything else. But you may buy light too dear. When I tell you that a single candle in our gas got by enriching it by cannel coal involves an expenditure of 20,000*l.* a year, I can only say it is not worth it. With regard to this laboratory on the Rhine that the Professor has been talking about, we have one or two in Leeds beside that at the Yorkshire College. If I could give you a slight idea of the changes that have been brought about for the better in this matter, you would be amazed. In one of our establishments, where a laboratory has been fixed, I may tell you they are producing more in that works to-day of a certain article than was produced 40 years ago in the whole of Yorkshire. I hope that our friends will make the most of their opportunities, and they may learn a thing or two in Leeds.

The business proceedings then terminated, and the members were afterwards shown round the College, and entertained at luncheon by Mr. C. F. Tetley.

In the afternoon they were conveyed in wagonettes on visits of inspection to some of the principal foundries and manufactories in Leeds, amongst the places to be seen being the Monkbridge Iron and Steel Company's works, the generating station of the House-to-House Electric Supply Company, the central station of the Thomson-Houston Electric Tramway, the engineering works of Messrs. Greenwood and Batley, and the works of the British Screw Company, Limited.

### Visits to Works and Places of Local Interest.

After the conclusion of the morning's business, an inspection was made of the Yorkshire College, more especially of the chemical and technological departments, including the agricultural, textile, leather, and dyeing laboratories, represented respectively by Profs. Smithells, Hummel, and Beaumont, and H. R. Procter. On the invitation of C. F. Tetley, Esq., luncheon was then partaken of in the college hall.

The company numbered about 150. Mr. Tetley welcomed the members in a short speech, and subsequently his health was proposed by the President, who alluded in warm terms to the prominent place occupied by him in the public life of Leeds, and especially in relation to the Yorkshire College, of the Council of which he was a member.

After lunch, the following groups of works were visited.

### The Monkbridge Iron and Steel Company's Works.

*Leader: R. Reynolds, Esq.*

The "best Yorkshire iron" produced by this firm is made from a superior quality of ironstone and coal, in each case the same as used by the Low Moor Iron Company, and by Messrs. Taylor Bros. and Co., at the Clarence Iron and Steel Works. The iron is produced from cold-blast pig-iron, which is refined and reheated before its introduction to the puddling furnace. In this furnace, the charge of about 3 cwt. is collected into three or four balls, which are usually hammered into blooms weighing 80–90 lb. each; these small blooms are carefully examined and sorted, those of each quality being heated together and welded into larger blooms. After again heating, the blooms are rolled into plates or bars, or under the hammer are converted into cranks, straight axles, &c. At the same works steel of a high quality is made by the Siemens-Martin or open-hearth process. Pig-iron and scrap steel are heated together on the hearth of a regenerative gas furnace for about ten hours, the metal is then cast into ingots, tyre blooms, &c. The latter are then punched and flanged under the steam hammer, and finally rolled. These firms also forge steel ingots and axles by the hydraulic press, and make cranks, straight axles, and other forgings under the hammer.

The Clarence Iron and Steel Works sell every year about 5,000 tons of best Yorkshire iron and 2,600 tons of the highest class of steel. They use annually about 50,000 tons of coal, 8,000 tons of cold-blast pig-iron, 6,000 tons of Swedish pig, and 2,400 tons of coke.

Messrs. Taylor showed the visitors the chief points of interest in these works.

### The Yorkshire House-to-House Electricity Supply Co., Ltd., Whitehall Works, Leeds.

The Company was formed in April 1892, and the station was formally opened in May 1893. The system adopted was the High-tension Alternating, with transformers, the specification being prepared by Hammond and Co., and the station plant being supplied by John Fowler and Co., Ltd.

The buildings were designed to admit of easy extension, and at first 700 h.p. was installed, but the demand has increased so much that an additional 700 h.p. has already had to be added.

The station abuts on the river, so that a supply of water and coal is easily obtained. The boilers are of the Lancashire type, 30 ft. long and 8 ft. in diameter, and are fitted with Bennis's mechanical stokers. The Green economiser is used, and the filters and boiler feed pumps are in duplicate. The steam pipes are arranged on the ring system, so that repairs can be effected on any part of the plant without interfering with the working of the station. Coupled compound horizontal condensing engines running at a slow speed, drive by means of ropes the Lowrie-Parker dynamos, which supply alternating currents at a pressure of 2,000 volts. The armatures are stationary and the field magnets revolve, the exciting current being obtained from continuous-current dynamos rope driven from the alternator shafts. The switchboard is on the exchange system, so that the alternators can be run separately or in parallel on any of the circuits supplying the various districts. The current is distributed by insulated cables, laid in 8 miles of cast-iron pipes, the distance of the furthest lamp from the station being 2½ miles.

### The Burmantofts Works of the Leeds Fireclay Co., Ltd.

*Leader: Dr. J. Lewkowitsch.*

The clay used occurs in the strata underlying the Better Bed coal measures; it is fairly pure and contains no impurities to interfere either with the colour or refractory properties of the ware produced. The clay has the character of a strong blue marl, sometimes striated, and is got by mining, and has usually to be blasted on account of its tenacity and hardness. The principal "Burmantofts" specialities produced at these works are glazed bricks, architectural terra-cotta, and faïence tiles, artistic pottery, sanitary ware, firebricks, &c.

### The Roundhay Electric Tramway Company.

The line consists of 5½ miles of track, with a maximum gradient of 1 in 20; the permanent way consists of 98 lb. girder rails, and was originally constructed by the Leeds Corporation for steam traction. The electric equipment has now been in operation about four years, and was installed as a pioneer- or example-line on the Thomson-Houston system as installed in America.

Electric roads in Dublin, with 16 miles and 40 cars, and in Bristol with 6 miles and 12 cars, are now being installed on the same general plan, but with improvements in detail.

The Roundhay line has overhead wires on what is known as the cross suspension method, *i.e.*, steel poles are set 6 ft. in the ground along the kerb on each side of the road, and a steel wire stretched between the two poles. These poles are set in concrete. From the steel wire is suspended a trolley wire of hard-drawn copper 0·34 in. diameter. There are six cars, each of the standard American pattern. (Dublin and Bristol are being equipped with double-decked cars of English make.) Each car is equipped with two Thomson-Houston motors of 15 h.p. each, and the old form of rheostat control is used.

The generating station contains a boiler by Babcock and Wilcox, with mechanical stoking. The engine is of American type, built by McIntosh and Seymour, and indicates 200 h.p. at 200 revolutions, with fly-wheel governor, maintaining a speed constant within 2 per cent., no matter how widely the load fluctuates. The electric generators consist of two Thomson-Houston dynamos, each of 62 k.w. capacity. Carbon brushes are used, set radially, and are self-feeding. The switchboard is of the standard railway type. The engine is high pressure and is non-condensing, so that the cost of steam is relatively high. The number of cars is small, and yet the working expenses are exceedingly low, the total cost amounting to only 5·557*d.* per car mile. If traction expenses only are taken, leaving out office and general, the average cost for the past year is about 3*d.* per car mile.

### Messrs. Greenwood and Batley, Limited.

*Leader: C. F. Tetley, Esq.*

This business was originally established in the year 1856, at the Albion Foundry, in premises still belonging to the Company, and occupying about an acre of land in East Street, Leeds, with a frontage and wharfage on the river Aire (Aire and Calder Navigation), the buildings on which are now used as warehouses and storage for the main portion of the large and valuable collection of models, the property of the Company.

In 1859, these premises being found too small, new and more commodious workshops were built on a site containing upwards of ten acres of land, fronting on Armley Road, Leeds, and having a wharfage behind on the Leeds and Liverpool Canal, and these, the Albion Works, have since been very largely extended, so that at present the total shop area is 31,594 square yards, and the establishment gives employment in fairly brisk times to some 2,000 workpeople, and is equipped with upwards of 1,500 machine tools.

The works are connected to the Great Northern Railway system by a small branch line, and railway trucks can be taken into every workshop.

The business is worked by departments, the main being:—

1. Special and general machine tool making, including the construction of machinery used in the manufacture of war materials of all kinds, testing machines, forging machinery, minting machinery, wood working machinery, cloth cutting machinery, &c.

2. Oil and flour mill and general millwright department, including machinery for warehousing and crushing every kind of seed and refining oil.

3. Textile machinery department, embracing all machinery for the preparation and spinning of silk, silk waste, china grass, and other fibres.

4. Electrical department, for the manufacture of every kind of electrical plant.

5. Engineering department, for the construction of high-class steam engines, viz., the Armington-Sims patent high speed engine, and steam engines with Frikart's patent improved Corliss valve gear.

6. Torpedo department for the supply of the Whitehead fish torpedo.

7. Cartridge and ordnance department, for the production of small arms, cartridges, guns, projectiles, horse shoes, &c., &c.

8. Printing and sewing machine department, viz., the "Sun" patent platen and other printing machines; patent boot and shoe sewing machines, and machinery for making and sewing leather belts, &c.

### C. 2. The British Screw Co., Ltd.

Manufacturers of wood and machine screws, bolts, rivets, &c. With one exception the largest concern of the kind in England. The works have been recently erected for the purpose for which they are used. The ventilating and heating apparatus is especially worthy of notice. The following operations are performed in the manufacture of screws of all descriptions, both large and small:—

1. *Heading.*—A coil of wire is fed into the machine, which cuts off a piece of the required length and forms the head.

2. *Shaving and Nicking.*—The head of the blank is turned true, and then the slot cut by a small circular saw.

3. *Threading.*—The thread is formed on the screw by a small cutting tool, which travels along the blank until the thread is the required depth.

4. *Cleaning.*—Washing in soda solution.

5. *Assorting and Packing.*

The ingenious machines in all these processes are quite automatic in action; the principle of those performing the same operation is the same, but the details vary according to the size and material of the screw.

This series of visits was timed to be completed so as to enable the party to return to the City Square by about 5.30 p.m., to afford sufficient time to prepare for the—

### Reception and Conversazione in the Leeds Town Hall.

In this brilliant reception and entertainment the Mayor, Mr. Alderman Gilston, emphasised the welcome accorded to the members in the earlier part of the day, and between 600 and 700 ladies and gentlemen accepted his Worship and Mrs. Gilston's hospitality. The guests were received by the Mayor and Mayoress in the Victoria Hall, which was handsomely decorated for the occasion, and was largely patronised during the evening by the company as a promenade and lounge. During the evening the band of the Leeds Rifles, under the direction of Mr. J. Sidney Jones, performed a charming selection of music. The Mayor's rooms had also been specially prepared for the reception of the company, and during the evening a series of musical selections were rendered by Madame Goodall, soprano; Mr. Tom Child, principal tenor Leeds Parish Church; Mr. John Browning, principal bass Leeds Parish Church; and Mr. W. N. Hudson, pianist. The programme was varied and interesting, and each of the vocalists being in good voice, the concert was very much enjoyed, as also were the selections played by Dr. Spark on the grand organ. At nine o'clock Mr. Godfrey Bingley gave an hour's lecture in the Council Chamber, entitled "A Tour in Yorkshire," Mr. A. E. Nichols, of the City Engineer's department, officiating at the lime light lantern. The whole of the rooms and corridors in the building were utilised for the reception and accommodation of the company.

## SECOND DAY.—Thursday, August 1.

The Thursday visits to works will be best divided into two main groups:—Leeds and District, and Bradford and District; with alternatives in each group.

### Messrs. Joshua Tetley and Sons, The Brewery, Hunslet Road.

*Leaders: W. McD. Mackey and A. C. Wright, Esqs.*

The original brewery was started about 50 years ago, and the present one, commenced in 1855, now covers an area of over six acres. The site of the old brewery is occupied by the present square room, with extensive cellarage underneath and hop store-room above. A new malthouse was built in 1866, and at the same time, and again in subsequent years, the brewhouse and fermenting rooms were largely increased. There are two large steam coppers, of 14 and 15 ft. diameter, in addition to four older ones heated by fire. The fermenting vessels are all on the Yorkshire square system, most of them of slate, erected by Messrs. Alfred Carter and Co., of Liverpool. There are eight corrugated copper refrigerators, each capable of cooling 40 barrels per hour down to within 40° F. of the temperature of the cooling water used. Hydraulic machinery, supplied by Sir Wm. Armstrong and Co., is used for working piston-hoists for casks, and chain-hoists for passengers and goods, and sack-hoists. In the maltings, grain is distributed by elevators, and by an india-rubber carrying band, with discharging appliance, which were also supplied by Sir Wm. Armstrong and Co. There are 10 large boilers, supplying steam to 11 engines of various sizes, and of about 200 aggregate nominal horse-power. Steam is also largely used for heating, boiling, and washing purposes. The supply of water for brewing is obtained from a well 90 ft. deep; it greatly resembles the Burton water. The water used for cooling and washing purposes is obtained from two artesian wells, 600 ft. deep. The firm do the principal part of their own malting, and manufacture and repair on the premises, their own casks, drays, &c.; they employ altogether over 400 hands. The casks are all washed by machinery, which does away with the necessity of unheading and heading up again.

The visitors were shown over the works by C. F. Tetley, Esq., and his managers.

### Leeds Steel Works, Ltd.

These works adjoin the Midland Railway Company at Hunslet, and cover an area of 25 acres of land. The plant consists of three blast-furnaces for the smelting of basic pig iron. Each furnace is capable of making 650 tons of pig iron per week.

Raw material used per annum: 310,000 tons. Finished products, 52,500 tons.

The iron is in part cast on the pig bed, and in part taken away in a molten state in a 10-ton ladle to the steel works. The steel works' plant consists of four basic-lined Bessemer converters, capable of casting 12 tons of steel at one time. The blowing engines for the Bessemer department were made by Fowler, of Leeds Steam Plough Works. The casting and ingot cranes are all worked by hydraulic power, and are top-supported. These were made by the Bowling Company. The rolling mill consists of a 32-in. train of three pairs of rolls, the cogging being driven by a pair of Galloway engines, geared up to the mill at 2 to 1; and the roughing and finishing rolls driven by a pair of powerful engines made by Davy Bros. This mill is employed in the rolling of mild steel blooms, billets, and ten-plate bar, also various sections of steel joists, channel bars, girders, tram rails for street tramway, flats, rounds, &c. Some of the larger joists are rolled in lengths of 70 ft., and weigh 35 cwt. each.

There is also a girder-building department, in which girders are riveted together. The testing and analysing of the steel made is carried out on a very extensive scale. The output of the works is about 50,000 tons of finished steel per annum. A large quantity of basic slag is made, and is converted into slag manure by the Leeds Phosphate Works.

### Messrs. Jackson and Son's, Ltd., Tannery.

*Leaders: Messrs. T. Fairley and G. Ward, Esqs.*

The principal raw material is the "East India kip," the hide of the small cattle of Hindustan, which is cured by drying after rubbing in a salt earth containing calcium and sodium sulphates and carbonates, together with traces of salt. After soaking in water for a week or more, the hides are softened in the "stocks" or fulling mill, and are then placed in milk of lime till the hair is sufficiently loosened to be worked off by a second stocking. The adhering flesh is removed with a two-handled knife on a sloping beam, and the hides are now treated with a fermenting infusion of hen or pigeon dung, or "bate," to remove lime and bring the pelt into a suitable condition for tanning. This is again assisted by a short stocking, and sometimes by a fermented bran infusion (drench), which completes the removal of lime by its lactic and acetic acids.

The goods are tanned by immersion for about six weeks in infusions of valonia (the cup of an Oriental oak), mimosa bark from Australia, and gambier (a dried extract of the leaves and twigs of an East Indian climbing shrub). The strength of these liquors is gradually increased till the goods are tanned. These are then washed in a warm sumach liquor, and either oiled and dried for sale, or sent to the currying shop.

At Messrs. Jackson's, not only their own tannage, but immense numbers of kips tanned in India are prepared for the upper leathers of strong boots. The leather, after softening, first undergoes a scouring process to remove superfluous tan and dirt, and is then partially dried and "stuffed" by tumbling with warm grease in a drum. The remaining processes are mainly mechanical, the leather being finished in a great variety of ways, both in black and colours.

The capacity of production of this firm represents, as regards the tanning department, 1,500 to 2,000 East India hides per day, according to size and weight. In tanning material the firm uses about 40—45 tons per week. As regards the currying department, the production of which is almost entirely of waxed kip butts, the capacity of production is slightly under the equivalent of that of the tanning department.

The visitors were shown over the works by the Right Hon. W. L. Jackson, M.P.

### Messrs. J. J. Flitch and Son's Leather Works.

The principal manufactures of this firm are calf kid and imitation Russias for boots and shoes, also morocco and sheepskins for upholstery, bookbinding, and other purposes.

The skins employed for calf kid are unhaired by liming, and freed from lime by "drenching" with bran infusions; the flesh is removed by machinery. The hair is taken off by hand labour on a beam. They are then "tawed" by treatment in a drum with a mixture of flour, egg, oil, alum, and salt, reduced to a suitable thickness by mechanical and hand labour. They are finally dyed black and softened by a process known as "grounding," and finished by a suitable composition. About 50 tons of egg yolk are annually used in this manufacture by Messrs. Flitch, whose firm treats fully 10,000 dozen large calf skins or veals per annum.

Morocco and its imitations are made from sheep and goat skins, many of them tanned in the East Indies, and known in the trade as "Persians." Skins, after washing and dyeing, undergo a variety of manipulations to produce grain and gloss, much machinery being employed in the manufacture. This firm employs about 300 hands, and its various products may be roughly stated as equivalent to 10,000 skins per week.

The chief processes are:—

I.—*Preparation of the Skins, which are home or foreign: the latter partially cured by Drying and Salting:*—(*a.*) Soaking in water and washing. (*b.*) Liming and unhairing. (*c.*) Fleshing by hand or machine. (*d.*) "Pureing," by drenching in fermented bath of bran, &c. (*e.*) "Scudding" or scraping, and preparing for following processes.

II.—*Alternative Processes:*—(*a.*) Tawing, by treatment with alum, salt, egg yolk, flour, &c.; or (*b*) Tanning with infusions of bark, gambier, &c.; or (*c*) Combination of (*a*) and (*b*) to produce "ooze leather."

III.—*Dressing and Finishing of these Prepared Leathers, the Processes being varied in nature and sequence, according to the finished article required, but including generally:*—(*a.*) Shaving or splitting and trimming of the skins (before or after dyeing, where coloured leathers are required), and drying in hot chambers. (*b.*) Graining by hand or machine, embossing and finishing: by varied treatment to make different kinds of fancy leather.

The visitors were shown over the works by J. J. Flitch, Esq.

### Messrs. Breffitt and Co., Ltd., Glass Bottle Works.

*Leader: E. G. McBretney.*

This is one of the oldest works of its kind in the district, employing upwards of 800 hands, and capable of producing nearly half-a-million bottles weekly. Here may be seen the various processes of—batch mixing, pot making, founding, bottle making and annealing, sorting, fitting, and packing, mould fitting, case making, &c., beginning with the raw material and ending with the finished product ready packed for export. The materials are melted together in gas tanks, *i.e.*, large tanks, which may contain as much as 120 tons of molten glass, heated by a regenerative and reverberatory gas furnace, or in "pot shops," *i.e.*, furnaces filled with earthenware pots which contain only as much as 30 cwt. of molten glass. Some of the most improved machinery used in the trade will be seen in these works.

The average annual production of bottles by this firm is 120,000 gross, with a consumption of about 8,000 tons of raw materials and nearly 30,000 tons of fuel. The largest tank holds about 140 tons of "metal."

### Messrs. Pope and Pearson, Ltd., Colliery.

The tubs containing the coal having arrived at the top of the shaft, their contents are automatically emptied over a rocking screen, through which the small coal and dirt fall, the large coal passing on to the separating tables. There are endless belts passing before women, who pick out the lumps of stone, &c. The separating tables expose 1,300 ft. of picking surface per minute, and deal with 1,150 tons of coal in eight hours. The small coal from the screen has now in its turn to be freed from stones and earth; this is accomplished by means of Baum's patent coal-washing machinery; the small stuff is automatically sorted into its different sizes, each size being separately dealt with. By means of compressed air, water is forced at regular intervals through a fine screen, into which the coal is fed, the coal and dirt separate into layers, the coal on the top; both escape by openings provided for them.

The mines are ventilated by means of a "Schiele" fan, propelling 150,000 cub. ft. of air per minute. Power is transmitted through the workings by means of compressed air produced by engines working on both the wet and dry principles, *i.e.*, the compression cylinders are cooled either by water inside or by a water-jacket.

There is an electric lighting installation used both for surface and underground requirements.

### Messrs. Barran and Sons, Clothing Factory.

The manufacture of ready-made clothing was commenced in Leeds in 1856 by Mr. John Barran, recently created a baronet; now it is one of the chief industries of the city. Almost the whole of the work in Leeds is done in factories, and not in the homes of the workpeople in small, and often unsanitary, workrooms. Under this system the organisation and division of labour are very perfectly carried out; the operatives earn good wages, and work under the best sanitary conditions.

### Messrs. Illingworth, Ingham, and Co., Woodworking Machinery.

The machinery at this establishment is used for sawing, planing, and moulding wood. The ground floor contains two band saw mills, circular saws, and floor-board making machines. The first and second floors contain moulding machines, circular saws, lathes, and square turning machines. Automatic saw sharpeners are to be found in a special room on the first floor.

The school furniture and door and window shops contain various special machines for each manufacture, and generally for making furniture. The stove is heated by exhaust steam from the engine.

### Messrs. Goodall, Backhouse, and Co., Leeds.

This firm is known for its household specialities, and particularly for "Yorkshire Relish." The whole establishment is on an enormous scale; the parts shown comprised the powder-mixing room, where baking powder, ginger-beer powder, egg powder, blancmange powder, and custard powder are made from their various ingredients; and packing rooms, where the powders, "Yorkshire Relish," wines, and the various other products of the firm are packed ready for sending away for home or foreign use. In addition, the dried drug store and patent-medicine department were seen.

## Bradford and District.

The Bradford Technical College was thrown open to the inspection of the visitors, with its departments devoted to the five following branches of science, local industry, and technology:—Chemistry and Dyeing, Mechanical Engineering, Textiles, and Art. The total number of students in all departments is 1,300.

## Works Visited.

### Messrs. Sir Titus Salt, Bart., Sons and Co., Limited, Saltaire.

*Leader: G. W. Slatter, Esq.*

Few places are better known in the whole world than the works and town of Saltaire, the name of which is derived from the combination of the name of the river upon which it is built—the Aire—and the surname of its great founder, Titus Salt.

The visitor to the town—after noting its munificent provision for the social, religious, and educational requirements of its inhabitants—will no doubt feel that it has justly earned the name of "The Model Village," by which Saltaire is almost equally well known.

The works cover an area of about 10 acres, and their situation, as regards facilities of transport by canal and rail, are unique; the raw material being lifted by machinery directly from the boat or railway waggon into any room in the warehouse.

The manufacture of various classes of textile goods from the raw material to the finished cloth will be seen.

The material used comprises: Mohair from Turkey, Cape of Good Hope, Natal, and Persia. alpaca from Peru; cashmere from China, Russia, and India; sheep's wool from all parts of the world; and also spun silk.

*Sorting.*—The first process in wool manufacture is that of sorting the fibres of the fleece, according to length, fineness, and soundness of staple.

*Washing.*—The process of washing (which is the next after sorting) removes from the wool the greasy substance termed "yolk," with which it is naturally impregnated, and also the dirt and other matter with which it may be covered. This process requires a machine consisting of several tanks or bowls, in which the wool is immersed in prepared liquor; automatic rakes, moving constantly backwards and forwards, carry the wool forwards to the drying chambers, from which it is delivered ready for the carding or preparing. The capacity of the modern scouring machine used at Saltaire is such as to wash 1,500 lb. of wool per hour.

*Carding and Preparing.*—The next process is either carding or preparing. The object in carding is to produce a continuous band or "sliver," in which the fibres lie crossed in every direction. The machine effecting this purpose consists of a number of cylinders of various dimensions, revolving in opposite directions, and at different speeds.

Carded and uncombed wools are chiefly used in the manufacture of woollen goods, but worsted yarns are made from combed wool.

*Combing.*—The next process is combing, the object of which is twofold, first to thoroughly adjust the fibres in a parallel form, and secondly to automatically separate the short curly fibres, "noils," from the long and straight fibres, "top." The noils are used principally by makers of lower-grade woollens, not being suitable for the Bradford trade.

*Drawing and Spinning.*—The top next undergoes the process of drawing and spinning. The object in "drawing" is to reduce the sliver and produce a continuous and even thread, "roving," attenuated to such a degree that it is ready to be put into a spinning frame, and from which a yarn capable of bearing the strain of weaving may be produced.

The object of spinning is to produce different sizes or thicknesses of yarn, suitable for fabrics of all kinds, and these sizes are spoken of as "counts." 60,000 spindles were seen at work.

The yarns for warp are wound on to large bobbins, and for weft on to spools.

Great skill is required in the spinning of yarns, as they must be correct in count or size, and also even.

*Weaving.*—Weaving is the making of cloth from the yarns or threads; at Saltaire yarn is woven into all classes of material, every description of plain and fancy coatings, dress goods, linings, &c.

*Dyeing and Finishing.*—These goods are afterwards dyed with the fastest dyes, such as indigo, and then finished.

The works are driven by five sets of compound Corliss engines of the latest type and indicating 1,700 horse-power, and these are supplied with steam from a set of boilers working up to 140 lb. pressure per square inch.

### Messrs. Edward Ripley and Son, Bowling Dyeworks, Bradford.

*Leader: Thorp Whitaker, Esq.*

This is the largest dyeworks in the district, and one of the largest in the world. It was established about a century ago. The firm is occupied in the dyeing and finishing of the better class of goods produced in the neighbourhood for the Home, American, and Continental markets. The fabrics dealt with are chiefly mohair dress and coating cloths; wool dress goods, such as serges, coverts, crêpons, bouclés, &c.; worsted coatings and coat linings.

The firm passes through its hands goods to the value of upwards of 1,500,000*l.* sterling per annum, employs about 1,000 men, consumes 100 tons of coal per day, and pumps from a considerable depth over 1,000,000 gallons of water per day, on the quality of which it largely depends for the superiority of the goods dyed and finished.

### Messrs. John Smith and Sons, Limited, Field Head Mills, Bradford.

*Leaders: Walter Leach, Esq., Henry Grandage, Esq.*

This firm has for nearly 50 years carried on the business of worsted spinning, twisting, and warping, as well as the preliminary treatment of the wool fibre in washing, carding, and combing.

The greasy raw wool, containing 40 to 50 per cent. of grease, and about 4 per cent. of potash salts, is washed in two series of washing bowls, consisting of 4 bowls each, then carded by the large carding engines, which pull out and render parallel the fibres; it then goes through two bowls of soap solution to remove oil and dirt, and is then combed, whereby the long and short wool fibres are automatically separated into top and noil respectively.

After being combed, the top goes to be drawn and spun, and here two systems of spinning will be seen, viz., the continuous or English, and the intermittent, mule or French system, as well as numerous modifications of the former, as cap, flyer, and ring spinning.

The yarn when spun goes to the manufacturer to be used as weft in the making of piece goods.

In making warps the yarn is twisted, *i.e.*, two or more threads of yarn are twisted together to form one compound thread.

The firm have two sets of washing bowls, 36 carding engines, 36 combing machines, and 50,000 spindles, 10,500 of which spindles are run on the mule system. The power for working the machinery is obtained from three engines of 1,000, 500, and 250 horse-power respectively. It has been estimated that the wool from nearly 2,000,000 sheep is manipulated at these works per annum.

The various processes of dyeing and finishing of wool slubbing in the ball were also shown, the fastest dyes only being used. A large plant for water-softening was inspected. The water before use has a hardness equal to 16°, and after treatment, 2·9° to 3·6°.

### LUNCH.

Lunch was provided for all the parties visiting the Bradford centres of manufacturing interest at the Great Northern Victoria Hotel, at 2 p.m.

Mr. T. TYRER (President-elect) presided, and in thanking the Bradford sub-committee for its hospitality, proposed the health of the representatives of the various firms who had opened their works for inspection on the occasion of the meeting, viz.:—Messrs. G. W. Slatter, J. Briggs, and Naylor (Messrs. Sir Titus Salt, Bart., Sons, and Co., Ltd.); H. Sutcliffe (Messrs. E. Ripley and Sons); W. Leach (Messrs. J. Smith and Sons); H. Grandage (Messrs. W. Grandage and Co.); P. Smithson (Messrs. Pickles, Smithson, and Pickles); J. Clapham (Messrs. A. S. Henry and Co.); W. Binns (Messrs. Milligan, Forbes, and Co.); A. Dawson (Messrs. M. Dawson and Sons); J. H. McEwan and J. Foster (Messrs. Rule, Greenlees and McEwans); and coupling with them the names of Mr. Thorp Whitaker and Mr. C. Rawson, who were responsible for the general arrangements. The toast was received with enthusiasm, and Messrs. Sutcliffe, Clapham, Rawson, and Whitaker responded.

### MESSRS. WM. GRANDAGE AND CO., LOW ROYD AND BROWNROYD DYEWORKS, BRADFORD.

This well-known firm has been extensively engaged in the dyeing industry for upwards of 30 years. In addition to the Bradford works, Messrs. Grandage have large dyeworks in Brighouse, as well as offices in Bradford, Manchester, and Glasgow. The three works form one of the largest establishments of the kind in the country. There are four large wells on the premises for supplying water.

At the Low Royd Works, cotton and silk yarns are dyed, both in the warp and in the hank. Innumerable shades are constantly being dyed, and as these warps and yarns are used for making fancy goods, both union and all cotton cloths, great care and skill must be exercised in choosing the exact kind of colouring matter best fitted for each particular requirement. The Brownroyd Works is known as the piece department, where all kinds of dress goods for ladies' wear, as well as linings and shirtings, are dyed and finished.

At the Calder Dye Works, Brighouse, wool in the raw state and in the form of sliver or slubbing, and also in the form of yarn of various qualities, is dyed. Sliver or slubbing is wool in the form of a loose rope after the combing operation. It is sent to the dyer in the form of a ball or top. In some cases the top is dyed in special machines as such, but the more usual method, at the present time, is to reel the top into hanks, and dye in rectangular vessels. Slubbing, as well as yarn, is also now being dyed in machines on the Klauder system.

### MESSRS. PICKLES, SMITHSON, AND PICKLES, LTD., CHEMICAL WORKS, RAVENSTHORPE.

*Leader: Christopher Rawson, Esq.*

This firm was established in 1862. The Tanhouse Chemical Works were erected in 1869, for the manufacture of nitrate of iron, pyrolignite of iron, ammonia, and various other liquors and products used by dyers. In 1872 the firm began to cut dyewoods (logwood, fustic, camwood, &c.), and grind myrabolams. In both of these departments special machinery, which greatly economised labour, was invented by one of the members of the firm (Mr. S. Smithson). In 1885 the extraction of dyewoods and tannin materials was commenced. During the last three years Mr. Smithson has been actively engaged in the construction of three machines, all of which were on view and in work. The first machine is a combined wood extracting and dyeing machine. It was described in this Journal, 1892, 906. The colouring matter of dyewoods, &c., is extracted and utilised to the best advantage, and at the same time the spent dyewood can be easily and thoroughly removed without fear of polluting the streams. This machine may be said to consist of three divisions—one for the water used in dyeing, the second for the logwood or other dyeware, and the third a space to enable the circulation of the water through the dyewoods in one division, extracting the colouring matters, and then back again to the first division, where it is used for dyeing the material in the usual way.

By these means the dyeing of any suitable material may be carried on without direct contact with colouring matters other than those which are extracted in a soluble condition.

The circulation of the liquor in the various divisions is due to a novel steam-pipe arrangement in a confined space. On it the whole success or otherwise of the machine seems to depend.

In an ordinary dye vessel the perforated copper steam-pipe lying on the bottom simply causes the steam to blow direct into the dye liquor, the goods being mostly protected by a partition from direct action of the steam, but without any special attempt being made to utilise the issuing steam as a means of causing the circulation of the liquor in the vessel.

In this particular machine this action is taken advantage of, the steam pipe being perforated with a double row of holes, which, instead of allowing the steam to blow out horizontally, as is usually the case, cause it to issue in an upward or vertical direction. By this means the injective action of the steam, more especially when the water is nearing the boiling point, is taken full advantage of. In addition to these two more important features, the usual plant for cutting and preparing dyewoods, grinding myrabolams, extracting dyewoods, preparing tannins and other extracts used in dyeing, was open to the inspection of the visitors.

Another machine is one designed to treat town refuse. Although all evil-smelling and disagreeable-looking materials are got rid of, the apparatus is not in the ordinary sense of the word, a "destructor." The essential feature of the machine is a large revolving iron cylinder through which the refuse passes, and is dried by the waste heat of furnace gases. The dried matter is separated by mechanical means into a coarse portion and a fine portion. The former, containing a large amount of combustible matter, is used for generating steam in ordinary steam boilers, and the latter used as manure. The machinery in motion (dyewood cutting, myrabolam grinding, &c.), during the day of the visit, was run entirely by power obtained from the burning of this refuse. In close proximity to the works, growing crops of various kinds, showing the effect of the fine portion of the refuse as a fertiliser, were on view. The apparatus is described with illustrations in this Journal, December 1893, 999 and 1000. The third machine referred to, is an apparatus for economising the waste heat of furnace gases. It consists of a large iron cylinder made from the outer shells of two Lancashire boilers. Inside this shell a great number of inch and a half pipes are arranged, running through the entire length of the cylinder. The waste furnace gases are made to pass through the cylinder and play around the small pipes on their way to the chimney. Some ashes are thrown into the cylinder, which is caused to revolve slowly, and in this way the pipes are kept free from any sooty deposit. The small pipes furthest away from the furnaces are open to the air, whilst at the hottest point they are boxed in, and from this chamber the hot pure air may be drawn off for any requirement. At the Ravensthorpe Works, the hot air is caused to pass through pipes running along the boiler flues to the front of the furnaces. The furnaces are thus fed, as it were, with a hot blast, and the result is that combustion is obtained without smoke.

In addition to the Chemical Works, Messrs. Pickles, Smithson and Pickles, Ltd., have large indigo and general piece-dyeworks at Dewsbury.

### MESSRS. A. AND S. HENRY AND CO., LTD., AND MESSRS. MILLIGAN, FORBES AND CO., BRADFORD.

*Leaders: J. E. Bedford, Esq., F. W. Branson, Esq.*

These firms are of merchants who distribute all kinds of dress goods made in the district, both for the home markets and to all parts of the world.

These and other similar firms in the town receive the goods direct from the loom, passing them on to the dyer and finisher with instructions as to the shade of colour desired by them, and the particular style of finish necessary to show the cloth to the greatest advantage.

When returned by the dyer the goods are made up into the various styles to suit the particular market for which they are intended.

Stocks of immense value of all the different fabrics are kept by these firms and were on view.

### MESSRS. RULE, GREENLEES, AND McEWANS, SPRINGFIELD MILLS, BRADFORD.

*Leaders: Christopher Rawson, Esq., and A. C. Wright, Esq.*

This firm, whose headquarters are at Glasgow, only commenced business here nine or ten years ago, but such has been its progress that it may now be said to rank amongst the very foremost houses in the Bradford trade. Dress goods of infinite variety to meet the ever-changing demands of fashion are here produced, and the 350 looms working on the premises are often, and indeed at this moment, supplemented by an even larger number outside the firm's own premises.

The warehouse, which adjoins the weaving shed, and has recently been largely extended, is fitted up in the most modern fashion (including electric lighting) for the carrying out of various processes of the business, and for designing, stock and sale rooms, offices, &c., whilst adjoining there has also been lately added a two-storey building for the making up and packing of the immense quantity of goods passing through the firm's hands from year to year.

The only resident partner is Mr. J. H. McEwan, under whose management the business has reached its present large proportions.

### MESSRS. MARK DAWSON AND SON, SPRINGHEAD MILLS, BRADFORD.

At these mills the spinning of Botany, crossbred, and Genappe yarns were seen. Messrs. Dawson employ 700--800 workpeople, and have about 70,000 spindles running. They produce, on an average, about 80,000 lb. of yarns, of various classes, per week. These yarns are chiefly crossbreds, and are used principally for the manufacture of serges, braids, estamenes, crépons, &c.

### ANNUAL DINNER.

The annual dinner of the Society was held on Thursday, August 1st, at the Queen's Hotel, Leeds. Covers were laid for about 120 gentlemen. The President occupied the chair, and he was supported by the Mayor of Leeds (Alderman Gilston), the Lord Mayor of York (Alderman McKay), Mr. W. L. Jackson, M.P., Mr. Thomas Tyrer (President-elect), Mr. C. F. Tetley, Chairman of the Yorkshire Section, Mr. J. H. Wurtzburg, Chairman of the Leeds School Board, Professor Smithells, Mr. Rider Cook, Mr. J. Whitaker, President of the Society of Dyers and Colourists, and Mr. Weeks, President of the American Institute of Mining Engineers and Metallurgists.

After the repast had been served, the President submitted the toast of "The Queen." The toast was duly honoured, the company singing the National Anthem.

The RIGHT HON. W. L. JACKSON, M.P., was next called upon. He said:—"It has been allotted to me to propose for your acceptance the toast of the Society of Chemical Industry. You may think that it is very much the toast of your very good health, but I would like rather to widen it from that personal aspect. This Society has been formed within recent years, but it has already reached a position of great importance, and of great success. The Society was formed in the year 1881, and its godfather was really Sir Henry Roscoe, whose absence to-night I am sure every man present regrets. From that time to this I believe Sir Henry Roscoe has taken the deepest interest in everything that affects its interests. Like many other societies, this had a very small beginning, but to-day the number of its members approaches 3,000. That in itself is sufficient evidence that not only were those who conceived the idea of forming the Society wise in their generation, but that they met a real want. The Society is divided into sections, one of which exists in nearly every one of the large cities and towns in the country. But there is also this remarkable fact—which is unique in connection with societies formed in this country—that one of these sections is in New York, and the New York Section forms an integral part of this Society, just as much as the sections in London, Manchester, or Leeds do. Of course one might extend that and show what enormous advantages science confers on countries and people, that it unites them in a common bond which nothing can separate or destroy. But there is also another very unique feature. I am told on very good authority that the Society has more members in Japan than it has in Russia. That is rather an interesting fact at this particular moment. In a way it is not a surprising fact, because for some time past Japan has been making great strides. In fact, one of the greatest industries in this country has been threatened —I will not say in a serious sense,—but at any rate it has been stated that the Lancashire cotton manufacturers have really to take account of the competition of Japan in some of the European markets. If Japan is so progressive it is not surprising that there should be connected with this Society a considerable number of members in that country.

It seems to be the fashion nowadays for every body of men, every section of society, to be represented in the press independently and separately. But in this particular case the Society's Journal is really a valuable publication. No matter to what department of industrial commerce or manufactures a particular member may belong, if he reads carefully the Journal published monthly he will find the latest information, absolutely reliable, of what is being done in his particular department in every part of the world. If the Journal is entitled to half the praise I have given it I say it is performing a great work; because it brings to you in a compact form, valuable to every member of the Society, the latest improvements in connection with his particular industry. We live in an age which is called an age of progress, and if there is any country in the world which is to-day dependent upon its manufacturing industries for its prosperity it is the country in which we live. I am old enough to remember the time when there was in this country a very large trade (and therefore we may assume some profit) representing only the merchant's business. If you take India as an example, prior to the opening of the Suez Canal, London was the main port for India. Practically the continent of Europe was supplied from India. The opening of the Suez Canal has made a great alteration in that respect. A very large proportion of the trade of Austria and Germany now goes direct and does not come to London at all. We have therefore lost an enormous trade which even within my time came to this country, and left no doubt a considerable amount of profit and gave a considerable amount of employment to the people. I need hardly refer to the fact that agriculture in this country is at this moment not in a very prosperous condition. I have no doubt the agriculturists will be very grateful to you gentlemen who devote your minds to the solving of problems, which I suppose are the more interesting the more difficult they are, if you are able to find some means by which the distress in agriculture can be relieved. But at all events, agriculture, so far as this country is concerned, is no longer a source of great wealth or revenue. I am only pointing to this in order to prove the proposition I have put before you, that this country is more than ever dependent upon the maintenance of the supremacy of its manufacturing industries. The next question is, How are we going to retain that supremacy? We talk of our trade and commerce. In Leeds most of us are dependent for our daily bread on the success of our manufacturing industries. You see in every part of the world a disposition not to follow the lines which have been adopted in this country of what we call free trade and free imports, but an increasing tendency, I fear, to build walls of protection for local and native industries. We may regret it, but we have to face the fact. As a manufacturing country we are dependent not only on our home consumption, but on our export trade. You may take any period you like; you will find that the period which shows an increase in our exports means an increase of prosperity in this country. That is only another way of saying that we are capable of making more stuff than we can consume, and if we get outside customers we are prosperous. If we are dependent on our export trade for our prosperity. then we must be able to compete successfully with every country in the world. How are we going to carry on competition? We have a climate, say what you will about it, in which work is more easily carried on than in any climate in the world. We have a people whose physique has not degenerated. We have also the Anglo-Saxon persistency and dogged determination which is just as strong as it ever was. But we live in an age of progress, and though you may have a good physique and persistent industry, if you have not knowledge and skill you will fail in the race, and it is on this ground that I shall appeal to you for your support. This Society was founded with the object of increasing the knowledge of every member, no matter what connection he may have with manufactures. I was brought up in my trade without scientific or technical knowledge, except that which I got by working in the concern—rule of thumb you call it, and no doubt truly,—but rule of thumb is only another term for observation and experience in an industry. You have gone a step beyond that, and we are expecting you will go a step further still. We are a peculiar people in this respect: we have all the prejudices, and if you like, the narrowness of an insular people. We are afraid to admit our competitors into our works lest they should learn what we are pleased to call our secret processes. Most of our secret processes might be described truthfully as mere conceit. The fact is you cannot go about in the world—you cannot go into a concern, even though it may be less successful than your own, without learning something. You apply the lesson possibly in your own establishment with even greater success than it was applied in that you have left. It would be better if we could only realise that the raising of the standard of the knowledge of all would not in any degree lessen the effect of the law of the survival of the fittest. If you could raise the standard for all we should have better workmen to direct and more successful work; and really the question, so far as this country is concerned, is not one of individual success, but whether we are going to maintain the supremacy of our manufacturing industries. This Society is a great power in that direction. At the same time we must recognise that it has great responsibilities. Technical education has made great progress; scientific teaching has taken tremendous strides forward. We have a great illustration of it in that magnificent institution, the Yorkshire College. To such institutions doing the work silently every day this and kindred societies owe much. It makes one shudder to think what would happen if every one of the 3,000 members of this Society possessed the knowledge and capacity of your President. And yet this is the ideal at which you have a right to aim. We who are too old to take part in this forward movement look to you and put upon you the responsibility of teaching our sons how they are to maintain the supremacy of the manufacturing industries of this country. We look upon you as a great reservoir of knowledge from which they shall draw, and which shall give our industrial communities vitality in the future. I am sure this Society may be depended upon to do its part, and therefore without further word I shall give you the toast of "The Society of Chemical Industry," coupled with the name of the President, a man who is honoured in Leeds, a man who leaving here for that great hub of civilisation, London, has shed lustre on that great centre, and who in his present position has it in his power to do much, and I am sure he will do much. In coupling his name with this toast I feel I am on firm ground, and I give you Dr. Thorpe as your ideal.

The toast having been duly honoured:—

The President, in responding, said:—As I crossed the threshold of this house I recalled an observation which I heard on a recent festive occasion, when the distinguished painter, who for the time did duty as the President of the Royal Academy, reminded his audience of a saying of a very celebrated statesman, Lord Beaconsfield, namely, that many as had been the occasions on which he had attended the Academy dinner he never had enjoyed one, because beneath his plate he saw the spectre of a speech. That, I thought, would be my fate this evening,—that I should see the ghost, the nebulous shade of a speech under my plate. I am bound to tell you, however, that the distinguished guests on my right hand and on my left (the Mayor of Leeds and the Lord Mayor of York) have done their best during these two or three hours to dispel the spectre. Mr. Jackson has made some allusion to my connection with this town, and I am truly grateful to him for the very kind terms in which he has recalled to me some most pleasurable memories. For, gentlemen, I have for this city an affection as strong as ever child had for its mother. I date, indeed, from my association with Leeds what I may call a point of departure in my career, and whatever success I may have achieved I date from my association with the Yorkshire College, and attribute it to the generous encouragement which was given to me by friends whom I learnt to know during my eleven years' connection with that institution. Mr. Jackson has also made some reference to the origin of this Society. As a Lancashire man I am proud to know that this great Society had its rise in that county. It has been said, and recent events seem to show there is some truth in it, that in the political world what Lancashire thinks to-day England thinks to-morrow. I venture to think that this remark is at least as applicable in the world of science. Lancashire afforded a home to the creator of modern chemistry. John Dalton gave the strongest exemplification to the great law of the conservation of mass, out of which has arisen modern chemistry. James Prescott Joule, another Lancashire man, gave the starting-point to the development of modern physics. What one man had done for the conservation of mass the other did for the conservation of energy. These two great principles are at the foundation of all science, whether pure or applied. Therefore I think I can say that Lancashire has done its part nobly in the creation of modern science. You have been told by Mr. Jackson of the part Sir Henry Roscoe played in the creation of this Society. I am, however, bound to tell you that, much as I have reason to respect and revere the fame of my distinguished teacher and predecessor in this chair, Sir Henry Roscoe, and grateful as we are and ever shall be to him for the service he then did for us, he was not the only Lancashire man who put his shoulder to the wheel, and did his best to create and mould this Society. There are gentlemen in this room who have played their part in making this Society what it is—Lancashire men, all of them. We are honoured at this meeting by the presence of Mr. Hargreaves, Mr. Herman, and Mr. Davis, while we have had at our recent meetings Mr. Eustace Carey. All did their share contemporaneously with Sir Henry Roscoe in giving this Society its start in life. I recal, as if it were yesterday, how I was summoned from this town by Sir Henry Roscoe to do my little part in helping him to give form and shape to the Society. The Society had its origin in South Lancashire, having immediate and direct connection with the great industries of that district, but it was by the efforts of these gentlemen that it was placed on the larger and more catholic basis on which it now stands. The day of small beginnings was even smaller than Mr. Jackson is aware of. It is to the credit of these gentlemen that it was developed from a mere provincial association into the large and all-embracing society which you now behold—a society which is clearly destined to include all English-speaking people. The day is not far distant when we shall have sections of this Society in Canada, Australia, and, in fact, in every country where the inhabitants speak the English tongue. Of the value of the Society we have the most cogent evidence. I was personally very much pleased to hear it publicly stated to-day by a gentleman who is eminently fitted to form and to express a judicial opinion, that of all organisations which publish a technical journal, this Society with its journal takes the most prominent and paramount position. The Journal of the Society of Chemical Industry is as much respected and as much looked up to in Germany and France as it is in this country. On behalf of the Society I thank you, Mr. Jackson, and you, gentlemen, most cordially for the very kind manner in which you have drunk to-night the health and prosperity of our vigorous Association. We are still young; we have all the vigour, the hopefulness, and the energy of youth, and we all wish that we may carry forward to the future the same vitality, the same energy, and the same power of usefulness which have distinguished us in the past. To you, Mr. Mayor, I would tender, on behalf of the Association, our most cordial acknowledgments of the splendid hospitality you have extended to us. I have not heard that on any occasion has a visit to any of our towns been so enjoyable and resulted in such pleasure as that to Leeds. We have fortunately been favoured with admirable weather. If it has not been sunny, it has at least not been too hot to prevent us from freely moving about from place to place to see all those works which have been, in the most liberal and open-handed way, opened for our inspection. I wish to convey to all who have in this manner thrown open their establishments for our edification and instruction our most cordial and grateful thanks.

Mr. Howard then submitted the toast, "Local Industries." This is, he said, a very wide subject, for although the golden fleece figures prominently in the city arms it is by no means to that alone the energies of the great precursors of the industries of Leeds have been confined. It is difficult to say what branch of industry is not prominent here and practically successful, for Leeds has ever been in the van of industrial progress. In passing from the past to the present, and from the present onwards, we may well consider what is the future prospect of these great industries. We all know, only too well most of us, how tremendous is the competition that has to be met, how increasingly difficult it is to keep up with the times. But surely, if there be any great centre of industry to which one may look with great expectations of progress and prosperity it is this great city, which is in itself a monument of industry, zeal, and skill of the Yorkshiremen who have made it. I think we may go further. You, Mr. Mayor, reminded us yesterday most aptly, that chemistry extends a great deal further than that which is narrowly called chemistry. Legally, none are chemists but those who are pharmacists. Taking chemistry in its wider sense, however, it is difficult to say which of the great industries of Leeds does not in actual practice, it may be without quite knowing it, make use of the great principles of chemical science. It is to the science of chemistry that I look for future progress. The time has passed for rule of thumb, though I confess I have the profoundest respect for the summed-up wisdom of our ancestors. It would be unwise to throw it aside recklessly; it is a foundation on which to build future progress. And may I again recal the somewhat quaint supporters of the city arms—the birds of Minerva, the goddess of wisdom. Nowhere is there more opportunity of learning the true principles of scientific thought than at the Yorkshire College of Science. I do not know anywhere where that linking together of pure scientific knowledge, which has been and ever must be the only basis for industrial science, and which never can be dissociated from successful industry and the applied branches of science, is so worthily conceived and so happily carried out. I regard that great and magnificent institution as an omen of the highest kind for the future prosperity of the industries of Leeds. Just as in the past, you found here the traditional methods of the art and mystery of business so well marked, you will now find the art and science of business is equally well carried out. I cannot more happily couple the toast than with the name of the Mayor of Leeds, who has shown himself so appreciative of the work of this Society, and so magnificently hospitable to its members.

The toast was then honoured.

The Mayor of Leeds, in responding, said:—I hardly know what I am to say; Lancashire seems to hold the field. I was rather sorry to hear the President say he belonged to Lancashire; I thought he was almost good enough for Yorkshire. But from wherever he came we made him what he is. I am not going to make any comparisons between the industries of Leeds and other places, because it would be to their disadvantage. There are some places that are noted for one thing and they live and sometimes thrive by it. Leeds, I am glad to say, is dependent on no one industry. I daresay it would take Mr. Jackson and myself all our time to tell you to-night which is the staple trade of Leeds. We not only make cloth, but we have one firm that can supply 10,000 suits of clothes in a single week. That does something to clothe humanity, whether it betters it or not. The variety of our industries to my mind is but an evidence of the versatility of the genius of our people. I sometimes say that London is what we have made it and that it could not exist without us; for whenever we have a man who seems to rise above the common herd he is taken to London. Even when we had made Professor Thorpe what he is they would not let him remain; they took him to London that he might raise the standard of intelligence of the people there. That is no uncommon practice with Leeds people. In the leather industry I believe we are second to none. We not only make the leather, but we supply all creation with shoes. People go so far as to say that by means of recent discoveries the hides of cattle bought in our markets on Wednesdays and taken to Mr. Jackson's, on Friday night reappear as ladies' shoes. You have seen through the steam-plough works. We have supplied creation with the means of husbandry. You have seen Greenwood and Batleys, where we can destroy creation with almost equal ease. I have no fear as to the future of this country, if genius, skill, perseverance, and intelligence are allowed fair play in the development of our industries. We have not only iron, machinery, flax, cloth, linen, glass, and porcelain works, but we have an industry in this town unknown almost to you. I daresay not many know that Leeds is a wine-producing centre; but you might have had your suspicions raised if you had gone round and seen the fields of rhubarb we cultivate. By the railway over which Mr. Jackson so ably presides it is no uncommon thing to send out 250 to 300 tons of rhubarb in a single month to be made into wine. It was worth coming to Leeds to get to know that. But to my mind the great aim and object of the Society is not to lessen the means of production, nor the amount of employment for our artizan population, but it is to economise and recover what has been hitherto waste material. This will not only have to be taught in our colleges but put into practice in our workshops. I was through a large chemical works a short time ago and I saw a great pile of refuse from the making of alkali. When I was a boy I saw that heap being piled up, waggon after waggon, as a nuisance because it occupied useful ground. What did I find the other day? After it had lain there for 60 years they were working that heap over again and converting it into sulphuric acid. This is one of the provinces of chemistry. We have been making useful what has been useless. We are making profitable that which was unprofitable in the past, and Leeds, from its great variety of industries and the skill and intelligence and frugality of its people, is in the van of progress. When you, gentlemen, have taught us how to utilise the carbon we send out of our chimneys, the produce of our labour will be less costly and the atmosphere more pure. I am satisfied that England has not yet arrived at her greatest development, and if English skill is left "free" from fetters of an artificial kind, I will back England against creation in her manufactures. We shall be able to hold our own if we are wise, but I fear that our recent lines have not always indicated wisdom. I hope in the future these things will be put on one side, that the workman will be free to give to his industry the highest skill that is in him, and that the employers will see that such skill and such determination meet with their just reward. Employers and employed ought to work together in harmony. Their interests are mutual. Let us be careful lest pounds, shillings, and pence take the place of patriotism. We are to be held up, not by the genius of any one mind, but by the combined genius of the English people. This has been the cause of our past stability, and we shall have to rely upon it in the future. You may talk about municipalisation and nationalisation, but the thing which nationalises is the genius of your sons and the thrift of mothers and daughters, and not the airing of newfangled schemes. The scientist belongs to no county or country. He is the common property of humanity. We all admire his genius, and we live by the results of his labour.

Mr. Tyrer, in submitting the toast of "The Guests," said :—I think we should all be glad if each of our guests were able to reply to the toast I am proposing. I have only to mention their names to satisfy you on that point. I regret that the Lord Mayor of York has to leave. He was down to reply to the toast. The President told you that we had with us Mr. George E. Davis, but during the evening I received the following telegram :—"Prevented from supporting the President to-night. Wish you every success; the Society prosperity; the Journal long life. Davis." Our first honorary general secretary, Mr. Davis, whose acquaintance with journalism enables him to form a correct estimate of the Journal, has always maintained that it would be the backbone of the Society. It is a justifiable pride to see that the Journal he and Mr. Mond so strongly advocated has succeeded. We have with us Mr. Scattergood of the Medical Department of the Yorkshire College, also the Town Clerk of Leeds (Mr. John Harrison), and Mr. Wurtzburg, who, it may not be known to all, is Chairman of the Leeds School Board; and if the youth of Leeds have their education supervised with anything like the skill displayed in the local industry with which he is connected, the outlook is indeed as hopeful as the Mayor has predicted. There is another gentleman whom I associate with this toast, Mr. Weeks, who is connected with the United States Geological Survey. We have had a graceful reference to the New York Section of the Society, and the predictions concerning it I hope will be justified. Last year's Journal shows how active, mentally and otherwise, our New York Section has been, but the postponement of our meeting has deprived us of at least two other American visitors, Prof. Ira Remsen and Dr. Hart, of Lafayette College, Editor of the Journal of the American Chemical Society. It was also likely that we should have had with them Dr. Otto N. Witt, but that was not to be. I am quite sure that the mention of these names does not lessen your acceptance of the toast. I may take, perhaps, a wider view of the term "guests and visitors," by expressing for myself and all not of this district, our profound gratitude and thanks for the way in which you have treated us. We have indeed been welcome and happy guests at Leeds and Bradford, and I am sure we shall carry all through the next year and far beyond it a grateful recollection of your many kindnesses. I beg to propose the toast of "Our Guests," coupling with it the name of Mr. Weeks, of the Geological Survey of the United States.

Mr. Weeks, in responding to the toast, said :—I do not know whether to call myself a guest or not to-night. I feel when I am on English soil that I am at my old home, although my ancestors went out from this old home to found a new one across the sea. We speak the same language, we have the same thoughts, we have in many respects the same history, we have the same hopes, we have the same aspirations, and I think that in the future, as humanity marches onward and seeks higher aims and cherishes loftier aspirations, the Americans and the English will be found side by side through all the centuries. I have listened with a great deal of attention to what has been said to-night. This is my first experience, though I have been in England many times, of an English public dinner. I confess freely that I hardly expected to hear such speeches as we have all heard to-night. I think I never heard better after-dinner speeches than some I have heard here. I had the impression from what I had been told on the other side that there was not always quite so much wit at an English public dinner as there turns out to be. I shall carry back an altogether different story. Moreover, I have heard to-night what struck me as being words of the greatest wisdom. We have started out to fight with nature. We are trying to learn her secrets. We are endeavouring to perform all over this world what in America we call "production." We stand beside dull inert matter and command that out of it shall come living form, things of beauty, things for the use of man; and there was never a truer word said than by one of the gentlemen who spoke this evening, that we take things and make out of them men. We have been troubled in our country to describe what raw material was and what the finished was. There is but one thing that can be called raw material, and that is what God has given us. There is but one finished product, and that is man. I see before me some of the grandest finished products the world has ever seen. I am reminded to-night of a picture I saw in one of our comic papers a while ago. The scene represented was a garden, on a seat there was a beautiful lady, suppose we call her England. Behind her, looking over in a very languishing way, was a gentleman. Suppose we call him Uncle Sam. She looked up to him and said, "Who do you love the best in the world?" and he replied, "My dear, can you ask me that question? You know whom I love best!" Her answer was, "Yes, yes, I know; but who comes next to him?" If you will allow me to say so, that is just the way I feel to-night, and you may say, "Who comes next to him?" and I will say look on the seat. Another thing I heard to-night which impressed me greatly was the statement that the thing we have to do in the future, not only here, Mr. Mayor, but elsewhere, if any nation is to take its proper place in this struggle for industrial supremacy, is to look after the waste. If there is any nation in the world that has got to look after the waste it is my own country. If I were to express the difference in the methods of working of the two nations, I should say we were economical of labour and wasteful of material, whilst other nations are wasteful of labour but economical of material. That is a thing we have to do—to be economical of material. A hundred years hence the captains of industry will be surprised at the way we wasted things. I have been in the North of England and seen that wonderful industry in Durham, the making of coke. There they are throwing into the air every year millions and millions of pounds of materials which you, gentlemen of this Society of Chemical Industry, have told us how to save. Another thing we have to do in the United States and also here, is in some way to make more effective the supplies of coal we have underneath our feet. We are using these with the greatest lavishness, as though the supply were going to last for ever. Yet we know what the result of this must be. The end is not far off. Your Mayor has said that the supremacy of England depends on your manufacturing supremacy, but no people can retain their supremacy in manufactures unless they have fuel in abundance; and by wasting our supplies of fuel you here and we in our country are throwing away the greatest blessing, in a material sense, with which the Creator has endowed us. Why should we be spendthrift when we know better? So, gentlemen, work out this question. Do the thing that is put before you. There has been a good deal said about "rule of thumb" men. To-day the people who used to call them "rule of thumb men" speak of them as practical men, as if there were something higher and holier in the theoretical man than in the practical man. What we want is more practical men, who know what they are doing. I sometimes define engineering to be an intelligent choice of evils. In practical life you have always before you something to do. Whatever you choose to do, you will wish you had done the other thing. As engineers, as practical men, we have to decide what is the wisest thing to do in view of all the circumstances. The theoretical man can possibly tell you all the things you can do, but he cannot tell you which is the right thing to do, for he is not a practical man. We want in business a man who knows what he wants to do and how to do it. And now allow me to thank you for the honour you have conferred on me to-night. I cannot, however, believe that this honour is bestowed on me as an individual, because you do not know me. I have the honour of being the President of the American Institute of Mining Engineers and Metallurgists, and I feel you are honouring the societies I represent On their behalf I return to you sincere thanks. If ever you come to the United States and attend any of our meetings we shall be glad in some way to reciprocate the friendly feelings you have displayed towards us to-night.

Mr. Stanford next proposed the toast of "The Yorkshire Section." He said :—The President and the Mayor have struck on the good old British principle that there is no country like ours, and "if you want to see a county, come to mine." Were I a native of Cumberland, I should have claimed Dr. Dalton as belonging to that county, and had I been Mayor of Leeds I should have claimed Dr. Priestley for this city. We are meeting the Yorkshire Section on their own invitation for the first time. This year our meeting has been postponed by the elections, and it must be a comfort to the President-elect to hear that the Chairman of the London Section has arranged that no general election shall interfere with the next annual meeting. It is a great thing to be behind the scenes, as Mr. Newlands apparently is. I hope he is right in his prognostication. We have seen a great number of the industries of this district. We have been glad to find that those in Bradford are all in most active work. In fact, as a clever friend remarked to-day, there was only one part of the plant not going, and that was the sunshine recorder. That, of course, was in Bradford. In Leeds such a thing is entirely unknown. Sunshine is invariably to be found here by those delicate modern instruments which modern scientists produce. I confess that there is no other place in the world where there are so many manufactures and where they are carried on with so much atmospheric effect. But I have admired, as I have admired no building of the same sort—the Town Hall. One thing I admire more than all, and that is the Yorkshire Technical College. I represent perhaps the oldest technical college in the kingdom, possessing the greatest number of students, and which provided you with your President. At present it inhabits a number of different houses, but we hope some day to emulate the Yorkshire College, which has been already selected as the model of our future building when we can afford to have it. I feel that this young section, supported as it is by these splendid industries all around, and with the Yorkshire College to back it, must be very successful. In speaking of the section, I would mention particularly the name of Sir James Kitson, who would, I hear, have been with us to-night had it been possible. To him this section was indebted for its first start, and a very excellent one it was. After him they had the services of Prof. Smithells, and now they have Mr. Tetley. I am going to ask you to allow me to associate his name and that of Mr. Rawson with this toast, and to express our sense of debt to the hospitality of Mr. Tetley.

Mr. C. F. Tetley, in responding, said :—It gives me much pleasure, on behalf of the Yorkshire Section, to respond to this toast, and to thank you all for the exceedingly handsome way in which you have referred to my name. It has been a great pleasure to the section to be able to offer sufficient inducement to you gentlemen to come here. I hope, with the Mayor, that the opportunities we have afforded have been accepted by those who have been among us, and that the insight they have obtained into our methods may be of use to them. I would particularly thank Mr. Stanford for the magnificent phrase he applies to the unhappy smoke producer. The phrase, adulterated argon, should certainly count as one masking a most delicate sarcasm. We are glad to hear there is a goal before us towards which we must all strive. We hope that the more scientific members of this section will arrive at some degree of perfection before very long. I ought, as chairman of this section, to point out that you owe thanks to a gentleman who has taken very largely on his shoulders the work of organising our meeting. During the illness of Mr. Procter, Mr. Wright has nobly stood in the gap, and anything that has been well done has been due to him. I hope, therefore, before we separate there will be an opportunity of offering Mr. Wright our thanks for the way in which he has done the work.

Mr. Rawson (Bradford), who also responded, said :—This Yorkshire Section occupies a rather unique position among the sections of this Society, inasmuch as it includes a great number of large manufacturing towns, of which Leeds and Bradford are the principal. Most of the other sections are sections of one large town only. We decided to divide the excursion into two groups, and I venture to think that has been a satisfactory arrangement.

In this great manufacturing centre we have not so much of a purely chemical industry to show you, but in the great manufacturing concerns you saw yesterday and to-day there are a great number of chemicals used. There is scarcely an operation but involves some great principle of chemistry. The meetings we have had in Leeds have been very successful. We have had excellent papers, and in a great measure we are indebted to the staff of the Yorkshire College. Then on many of the papers we had interesting discussions. I should, however, like to see more of our members taking part in these discussions, because I believe that in these debates the greatest amount of good is to be derived. On behalf of the Bradford side of the Yorkshire Section, I beg to thank you for the way in which you have received this toast.

Mr. Newlands was next called upon. He said :—I have been very much struck on my visit to the works to-day with the excellent management apparent in all departments, and also with the good feeling which seems to exist between the managers and their men. The management of a meeting is somewhat like that of a works. There must, of course, be some who are humble workmen and others managers. To-day we have in this Section two men who have specially distinguished themselves as leaders. I do not wish for one moment to detract from the merits of others who have also done their best to render this meeting a great success ; but I think you will agree with me that the success would have been nothing like so complete if it had not been for the work of one or two men. I need hardly say that one of these is Prof. Smithells. Another gentleman who was certainly the right man in the right place is our friend Mr. Wright. I know from communications which have passed between this Section and London during the troublesome times we have had recently, that Mr. Wright and Prof. Smithells have worked in the most admirable way, and I ask you to drink their health.

Prof. Smithells : This is quite an unexpected honour and I must not detain you more than a moment. I am, it is true, a Lancashire man, but one of no particular distinction. What I may eventually turn out to be under the tuition of the Mayor it is not for me to say. I can only entertain hopes. With regard to the meeting of the Society in Leeds, it has been an honour to us to receive you. We have done our best to make your visit an agreeable one, and it is gratifying to hear your warm words of thanks. I have had but a small share in it. When the work came upon us, it was hoped that Mr. Procter, who has served this section so admirably in many ways, would be able to undertake it, but unfortunately he has not been able to do so, owing to circumstances we all regret. I was pressed to do the work but felt unable to undertake it, and so I told Mr. Wright I thought it was an opportunity for him to distinguish himself. I think he has availed himself of it to the full. The closing hour in Leeds is 11 o'clock, and I believe we have already rendered ourselves liable to a prosecution. If any particular official were held responsible it would be the treasurer; you will therefore excuse me from saying more.

## THIRD DAY.—Friday, August 2.

### Visit and Excursion to Wharfedale.

About 150 members and friends had a most enjoyable excursion to Wharfedale. The day opened dull and threatening, but in the afternoon it was beautifully bright and warm. The party arrived by special train about 10.30 at Skipton Station, and were met there by char-a-bancs and waggonettes, and conveyed by way of Rylstone, Cracoe, and Linton to Burnsall, where at one o'clock luncheon was partaken of in a marquee on the village green, near the May-pole. After spending a short time looking round this ancient village, the journey was continued to Barden Tower. Here the party left the carriages, and, after inspecting the tower, walked down the river-side, through the fields, to the Strid, and thence through the woods to the wooden bridge, where tea was served in Mrs. Hibbert's marquee. The party then rejoined the carriages and drove to the abbey, where they inspected the beauties of the old abbey and the neighbourhood. Eventually the visitors drove to Bolton Abbey Station, where at seven o'clock a special train was in readiness to convey them back to Leeds.

A very interesting description of the route through Wharfedale was specially contributed, for the guidance and pleasure of the visitors and members of the Society, by Prof. Miall, of the Yorkshire College, abstracts from which are here given:—

Shipley to Skipton.—Airedale, between Shipley and Skipton, exhibits a pretty regular succession of sandstones and shales, belonging to the Millstone Grit formation, which underlies the coal measures. The coarse sandstones often form vertical cliffs along their outcrop, while the shales form gentle grassy slopes. The table land between the valleys is covered by moors, which extend with little interruption into Scotland.

The strata in this part of Airedale dip down the valley towards Leeds, and lower and lower rocks reach the surface as we approach Skipton. Here the mountain limestone appears, having been squeezed up in a much contorted mass, which is exposed in the great quarries of Skipton Rock.

Skipton.—Skipton, until within the memory of persons still living, was a clean and quiet market town, the centre of a large grazing district. It contained hardly more than one wide street, which was overlooked, as it still is, by the Castle and the Church. During the last 40 years, factories, and the dwellings of factory workers, have greatly multiplied, and the appearance of the town has undergone a great change.

The older parts of the Castle date from the fourteenth century. Additions of great extent were made in the time of Henry VIII. The estate was for more than 300 years in the hands of the Cliffords, a family which served many kings in succession, both in peace and war, and was sometimes enriched by grants of land, at other times impoverished by forfeiture. The Cliffords were conspicuous in the long wars in France and in the wars of the Roses. The "black-faced Clifford," or "the butcher," was a leader on the Lancastrian side at Wakefield, and was slain just before Towton. For 24 years afterwards the heir of the Cliffords, the "Shepherd lord," lived in close retirement, but he regained his estates when Henry VII. came to the throne. He built Barden Tower, above Bolton, and commonly lived there. Skipton Castle was held against the revolt known as the Pilgrimage of Grace, and in a later age was besieged for three years by the Parliamentary forces, in the Civil War. In 1648 it stood a second siege for the king, and when taken was condemned to be "slighted" or demolished. The work was not effectually done, and the owner, Anne Clifford, Countess of Dorset, Pembroke, and Montgomery, ventured to rebuild it in 1656, when she also rebuilt the tower of the adjoining church.

Skipton to Bolton.—Between Skipton and Rylstone the country is occupied by sandstones and shales. To the left is the moorland hill called Flasby Fell, or Sharpa; to the right, Embsay Moor. As we approach Rylstone, the square tower of the Nortons appears on the edge of the moor. The Nortons figure in the old ballad of the "Rising of the North," as well as in Wordsworth's "White Doe of Rylstone. Neither the ballad nor the modern poem tell the tale truly. After the rebellion came to an end, old Richard Norton escaped to Flanders, and only one of his eight sons suffered. The Nortons and Cliffords were long neighbours, rivals, and enemies. Under Henry VIII. the Cliffords were courtiers, changed their faith when the king changed his, and married into the royal family. The Nortons were often in opposition, and at length broke into rebellion. After the "Rising of the North," the estates of the Nortons were forfeited to the crown, and came before long into the hands of the Cliffords.

At Cracoe, a range of conical limestone hills appears. These are believed by Mr. Tiddeman to be reefs of the mountain limestone sea, which stand up out of contemporaneous evenly-bedded black limestones. "It is highly probable," he says, "that the black limestones are successive floors of the ocean bed of carboniferous times, and that the white limestones (composing the conical hills) are the islands which dotted its surface."

The road curves round between Threshfield and Embsay Moors to Linton, where is a hospital for aged women. This part of the limestone district of Craven abounds in veins of lead, which have long been worked.

Burnsall, on the Wharfe, is prettily situated, but not otherwise notable.

From this point we descend the Wharfe. The most interesting features of the route are Bolton Priory and Bolton Woods.

Barden Tower.—This grange was built by the shepherd lord, Henry Clifford, and was restored upwards of a hundred and fifty years later, by Anne Clifford. It was in tolerable repair at the end of the last century, but is now unroofed and neglected. The building, though finely situated and rich in interesting associations, has no architectural importance. Here Bolton Woods begin, extending some four miles along the Wharfe to Bolton Bridge.

Bolton Priory.—The priory (for Augustinian monks) was transferred from Embsay, near Skipton, in 1151. The building was erected at various times between 1151 and the Dissolution in 1540; at the latter date the tower was still incomplete. It is probable that there was at one time a central tower. The conventual buildings were situated on the S. and W. of the church.

The original west front is partly concealed by the tower. It exhibits a deeply recessed doorway, surrounded by three lancet lights, and enriched with a series of arcades.

The north side of the nave is more recent than the south, and is extended into an aisle. At the east end of this aisle is a chantry chapel occupying the space of a single arch. Beneath it is the vault of the Claphams of Beamsley.

The north transept is nearly perfect, but only the west wall of the south transept remains. The choir is an excellent example of the decorated style. Two tries of round-headed, intersecting arches occupy the inner surface of both walls.

The wooden screen and the painted roof are the work of Prior Moon, who erected the unfinished western tower, as the inscription over the west door shows.

Bolton Hall, a residence of the Duke of Devonshire, includes the gateway of the Priory. The more ancient part was erected shortly before the Dissolution, but considerable additions have been made in modern times.

### The Smoking Concert.

In the large room of the Queen's Hotel, Leeds, a large number of members of the Society were entertained at a smoking concert given by the members of the Priestley Club. Dr. J. Lewkowitsch, President of the Club, occupied the Chair, and an attractive programme of recitations, humourous speeches, and narratives, with some excellent vocal and instrumental music, was gone through.

At its close, Mr. Thomas Tyrer, President-elect, thanked the members of the Priestley Club in the name of the members, for its hospitality. He congratulated the Society upon one of its most interesting and ably organised meetings, and referred particularly to the excellence of the Bradford arrangements which had been committed to a sub-committee.

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* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

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# I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

*Use of Chromates for the more Complete Prevention of Boiler Incrustation.* A. Nieske. Wochenschr. f. Brauerei, 1895, 215—216.

This process is based on the observation that under the conditions of pressure in a boiler, calcium carbonate and sulphate are decomposed by a soluble chromate with the formation of calcium chromate, which is said to be deposited in the shape of a light, non-adherent sludge. The chromate (usually sodium bichromate) is dissolved in the feed-water, or put into the boiler. It is claimed that the salt exerts no corrosive action whatever on the boiler-plates, that the formation of scale is prevented, the plates remain quite clean, even after protracted working; and that the sludge is readily expelled by blowing-off.—H. T. P.

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*Carborundum: History, Physical Properties, and Chemistry,* J. A. Mathews, School of Mines Quart., Columbia College. U.S.A. 16, [1], 73.

*See under* XI., *page* 755.

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## PATENTS.

*Improvements in and relating to Drying and Evaporating Apparatus.* C. F. J. Möller, Berlin, and P. Pfeifer, Brunswick. Eng. Pat. 8545, April 30, 1894.

In this invention the latent and sensible heat of steam escaping from material being dried, is made available for drying by means of condensation. Various forms of apparatus are described. In one form the material to be dried is placed upon trucks and moved through a drying chamber. At one end of the latter there is a furnace, the hot gases from which pass through an arrangement of pipes, and this heats the drying chamber sufficiently to drive off the water capable of being expelled from the material under treatment. At the hottest part of the drying chamber there is a pipe through which the vapour driven off is exhausted, passing along a set of pipes, situated in the cooler part of the chamber, in which it is condensed, and yielding up its latent and sensible heat, thus assisting the drying process.

—R. B. P.

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*Improvements in Apparatus for Heating, Evaporating, or Condensing.* D. B. Morison, Hartlepool. Eng. Pat. 11,226, June 9, 1894.

This invention relates to the construction of evaporators which can be used for heating or evaporating liquids—boiler-feed water, for instance; or for condensing steam exhaust.

The apparatus consists of nests of tubes placed in suitable chambers. The steam space of the evaporating vessel contains a set of tubes which constitute an additional cooling surface supplementary to that of the tubes in the lower, or water, space of the vessel.—R. B. P.

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*Improvements in Furnaces applicable to Metallurgical, Chemical, and other Purposes.* J. Wilkinson, Pudsey, York. Eng. Pat. 11,351, June 12, 1894.

The furnace described, is designed for heating a number of ovens or muffles with as much economy as possible. The ovens are built in a shell over the furnace, the products of combustion from which are caused, by means of appropriate baffle arches, to pass along flues formed by spaces left between the ovens themselves, and between the ovens and the walls of the shell. In this way, the ovens are equably heated on all sides. The shell may be lined with incombustible non-conducting material, such as slag-wool, to hinder radiation.—A. G. B.

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*Improvements in Vacuum Pumps.* E. D. Chaplin, Nantick, Mass., U.S.A. Eng. Pat. 11,377, June 12, 1894.

This invention especially refers to pumps for exhausting incandescent lamp bulbs. It is usual to exhaust such bulbs in two stages.

According to the present invention, the disadvantages of the older types of pumps are said to be obviated. The improved vacuum pump has two pump pistons each independently actuated by its own power piston, and working one within the other. The outer piston thus serves to cover and uncover an air-inlet formed in the side of the pump cylinder, the action of the pistons being such that they commence their suction-stroke in unison and thereupon the inlet is immediately uncovered by the outer piston. They then contact with one another upon the completion of the stroke by the inner piston, and then, on the commencement of the return stroke of the inner piston, the air-inlet is immediately covered by the outer piston, thus causing the air previously drawn into the cylinder to be forced into the space between the two pistons. The air-inlet is thus opened and closed quickly at the proper times, so that none of the air drawn into the pump cylinder can expand back into the bulbs.—R. B. P.

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*An Improved Steam Pan for Boiling Sugar or other Liquids.* G. Fletcher, Litchurch, Derby. Eng. Pat. 11,525, June 13, 1894.

The specification describes a steam pan for boiling sugar and syrups, the heating drum of which can be raised from the pan for cleaning purposes, and again lowered therein, without breaking and re-making joints.—R. B. P.

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*Improvements in Filters.* A. Turnbull, Bishopbriggs, Lanark. Eng. Pat. 13,612, July 14, 1894.

The filter is arranged to carry a continuous web or roll of filter-cloth, having means for replacing the clogged filter-cloth by a fresh portion from the roll, without removing the cover of the casing.—R. B. P.

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*Improvements in Multiple-Effect and other Vessels for Evaporating Liquids.* G. Fletcher, Litchurch, Derby. Eng. Pat. 13,857, July 18, 1894.

The improvements mainly consist in curving the bottoms of the chambers or vessels inwards, from the sides towards the centre, either concentrically or eccentrically with the said vessels. A continuous and uniform flow of liquid is thus said to be induced. The liquid is also distributed equally to the under-side of the heating tubes, and so ensures a continuous circulation until the required density is attained. A claim is also made for the combination with vessels of a similar kind, with a condensed water-trap. This water-trap has a discharge valve of the equilibrium type, and it is controlled by a suitable float.—R. B. P.

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*Improvements in Stoves for Vulcanising and Deodorising Waterproof Garments.* I. Frankenburg, Selford. Eng. Pat. 14,375, July 26, 1894.

*See under* XIII., *page* 759.

*An Improved Process of and Apparatus for Evaporating or Concentrating Saccharine and other Liquids.* A. Crerar, London. Eng. Pat. 16,235, August 25, 1894.

*See under* XVI., *page* 762.

*Improvements in or relating to Means for Protecting Metal Surfaces, or Surfaces containing Metals, against Corrosion by Water or other Fluids.* J. A. Paskin and W. Ackroyd, Halifax. Eng. Pat. 16,886, September 5, 1894.

The surfaces are coated with gutta-percha, either melted or in solution.—F. H. L.

*Improvements in Apparatus for Extracting Juice from Canes, Roots, and the like.* A. G. Berry, Glasgow. Eng. Pat. 5897, March 21, 1895.

*See under* XVI., *page* 762.

*Improvements in or relating to Boiling Pans, Heaters, Coolers, and the like.* C. Postranecky, Löbtan Dresden, Saxony. Eng. Pat. 7345, April 10, 1895.

This specification describes a method of constructing jacketed heating pans and such like apparatus. The rivets usually employed for securing the jacket to the pan are dispensed with, and as an improved joint, an annular cup is fitted to the boiler, into which the outer edge of the jacket is inserted and molten metal poured therein. The edges of the jacket are perforated, corrugated, or otherwise formed so as to ensure a good joint.—R. B. P.

*Improvements in Centrifugal Machines for separating Fluids of Different Densities.* J. Laidlaw, Glasgow. Eng. Pat. 7390, April 11, 1895.

The improvements relate chiefly to cream separators. In place of a single drum, two or more are grouped symmetrically round a central driving shaft. Each drum is rotated upon its own axis by suitable gearing from the central shaft, and fed from a common regulating chamber, discharges into an annular channel common to all the drums.—R. B. P.

*A New or Improved Process for Preparing, by the Aid of Gaseous Mixtures, Liquefied Gas by Compression.* F. Kuhn, Uetikon, Zürich. Eng. Pat. 8374, April 27, 1895.

According to this invention, only dry gases are operated on, and corrosion of the apparatus is consequently avoided. The cold produced by the expansion of dry compressed gaseous mixtures, is used to effect the separation of the liquefiable constituents.

A suitable gaseous mixture is taken, *e.g.*, that produced from heating minerals, containing from 1 to 10 per cent. of sulphur dioxide, or products of combustion containing carbon dioxide, and suitably compressed. The compressed mixture is cooled, if necessary passed through a purifier, and then conducted into the compressing apparatus, in the upper part of which there are several coils, through which the non-liquefied elements of the gaseous mixture escape, after expansion in a motor, with the object of utilising the pressure of the compressed gaseous mixture for re-cooling the gaseous mixture.—R. B. P.

## II.—FUEL, GAS, AND LIGHT.

*The Action of Heat upon Ethylene. II.* V. B. Lewes. Proc. Roy. Soc. **57**, 394—401.

In Part I. of this communication (Proc. Roy. Soc. **55**, 90; this Journal, 1894, 505, 873) the author showed that ethylene, when subjected to heat, was converted into acetylene and methane ($3C_2H_4 = 2C_2H_2 + 2CH_4$); this acetylene either at once polymerising into secondary products or decomposing, to carbon and hydrogen, according to the temperature at which the reaction was being conducted.

In many cases of destructive distillation ethylene is one of the principal products; it is therefore of great importance to ascertain the precise causes of its formation. The present experiments were instituted to ascertain the effect (1) of rate of flow, (2) of area of heated surface, and (3) of dilution, upon the reaction.

The apparatus and analytical methods were the same as those previously employed (this Journal, 1894, 505), except that the platinum tube was 736 mm. long, with a diameter of 14 mm. Temperatures were, as before, measured by the Le Chatelier thermo-couple.

The results of the numerous experiments may be summarised as follows:—

1. The initial decomposition of ethylene, by heat, is very rapid, and requires but a short flow through a heated containing vessel; such primary decomposition, however, being but slowly completed, owing to secondary reactions, which tend to re-form ethylene. Thus, with a gas containing 97 per cent. of ethylene, the decomposition, which nearly all occurred in the first inch of the tube, was as under:—

Percentage of Ethylene decomposed.

| Length of Tube heated. | 1 Inch. | 6 Inches. | 18 Inches. |
|---|---|---|---|
| Rate of flow 5 c.c. per minute.. | 80·10 | 85·48 | 93·76 |
| „ 15 „ „ .. | 70·83 | 79·42 | 90·31 |
| „ 40 „ „ .. | 50·58 | 63·17 | 87·15 |

2. Dilution has but little effect in retarding the decomposition of ethylene, unless it be very large (over 75 per cent.).

3. Increase in rate of flow diminishes the amount of decomposition when the heated area is small, but rapidly diminishes in effect as the length of flow through a heated area increases.

4. Radiant heat, and not contact with heated surfaces, is the chief cause of the decomposition of ethylene. That this is so is proved especially by the experiments, in which diluted ethylene is passed through the heated tube; for, if contact had been the active factor, dilution, by reducing the number of impacts of hydrocarbon molecules with the heated surface, would have led to a considerable decrease in the decomposition effected. (See *supra*, 2.)—E. R. B.

*Dimensions of Gasworks Apparatus.* Reissner. J. für Gasbeleuchtung, 1895, 17.

Various rules are in use for determining the dimensions of the apparatus on a gasworks; these are sometimes based upon the experience at a particular works and may then only be applicable to special conditions; but the averages of the experience from a number of works are of more general use. Reissner, the manager of the Berlin Municipal Gasworks, has drawn up the following rules, which, after many years' experience, have been adopted in the various works under his charge.

For estimating the necessary dimensions of the various apparatus the maximum gas production of a December day is taken, and from this the so-called normal dimensions are calculated.

*Retorts.*—With Silesian coal, 15 per cent. of retorts in reserve, but if in any one of the four or five works some benches are unavailable for one whole winter in consequence of rebuilding, &c., then a reserve of 10 per cent. may, as an exception, be regarded as sufficient.

*Condensers.*—A minimum of 3·65 sq. ft. of cooling surface per 1,000 cub. ft. of gas per 24 hours, or, for completely furnished works, 4·56 sq. ft. of cooling surface per 1,000 cub. ft. of gas. The Berlin form of condenser is a cylinder 4·26 ft. diameter and 28·86 ft. high, with 11 internal cooling tubes 4 ins. in diameter; the outer surface, together with the connecting pipe to the adjoining cylinder, having nearly the same air-cooling surface as the water-cooling surface of the inner pipes.

*Scrubbers*, filled with boards. A minimum of 5 cub. ft. capacity per 1,000 cub. ft. of gas per 24 hours, and for completely furnished works, 6 cub. ft.

*Exhausters.*—One exhauster in reserve at each works.

*Purifiers.*—Five trays with oxide of iron in each, 1·17 sq. ft. of area per 1,000 cub. ft. of gas per 24 hours; where there are four purifers, all are included in the calculation. In cases of necessity, for one winter, and with tolerably fresh purifying material, 1 sq. ft. area per 1,000 cub. ft. of gas will suffice.

*Catch-Purifier.*—With four to six trays of sawdust, one catch purifier to each four oxide purifiers and of the same dimensions.

*Station-Meters.*—A maximum of 80 revolutions of the drum per hour. On account of unavoidable irregularities in the production, the maximum quantity of gas passing per hour should be estimated at 10 per cent. above the average hourly production.

*Gasholders.*—A minimum of 80 per cent. of the greatest daily production. In Berlin it is at times difficult, with this minimum, to keep all the retorts regularly charged, especially on Mondays.

*Works Connections.*—Outlet main from five beds of nine retorts in each, 12·5 ins. diameter. From the point where the mains from the retorts unite into large mains, the latter in Berlin are 37·4 ins., 39 ins., and 39·37 ins. diameter, giving an estimated velocity of 9·84 ft. to the gas. With smaller mains the velocity should be between 6·56 and 9·84 ft.

*Cross Connections* between two mains on the same works may have a velocity for the gas not exceeding 12 ft. For the outlet main from the works to the town it is estimated that in Berlin there is a loss of pressure in the large mains of one inch in 2,734 to 3,280 yards length of main, with the greatest hourly output on a maximum December day, and this maximum output is about one-eighth of that of 24 hours.

### *Cause of Luminosity in the Flames of Hydrocarbon Gases.*

V. B. Lewes, Proc. Royal Soc. **57**, 450–468.

In previous communications (this Journal, 1892, 231) the author has shown that the hydrocarbons (ethylene, butylene, benzene, methane, and ethane) of the inner non-luminous zone of illuminating-gas flame, are converted, by the baking action of the flame-walls, into acetylene; so that, at the moment when luminosity commences, over 80 per cent. of the unsaturated hydrocarbon present is acetylene. Again, (See Proc. Royal Soc., 1893 and 1895; this Journal, page 737; and 1894, 505 and 893) he has also shown that, above 1,200° C., all acetylene (whether that already in the non-luminous zone, or that which, at this temperature, is produced from methane) is decomposed, to C and H. It is clear, therefore, that the luminous bodies cannot be the "dense vapours" of Frankland, the author having shown that luminosity commences at 1,340° C. and continues to 1,875° C.

Admitting then the "solid particle" theory, and allowing as has hitherto invariably been done, that the incandescence of the carbon particles is maintained by their combustion and by that of the surrounding hydrogen and carbon monoxide, it would appear, that with flames of given size, burning from like jets, the luminosity ought to vary with—

A. The temperature of the flame, and

B. The number of carbon particles in a given area,

so that the higher temperature of the flame, the whiter would be the light; also that a flame with many solid particles, but with low temperature, would be more lurid than one with the same number or fewer particles, but having a higher temperature.

The observations of the author, which form the subject of the present communication, disprove the above explanation of the cause of the incandescence. He shows, taking more accurate readings of the temperatures of flame, by means of the thinner-wired platinum and platinum-rhodium thermo couple, which he now describes, that acetylene, ethylene, and coal-gas have their ratios of temperature and illuminating value directly opposed to each other, thus:—

| Portion of Flame. | Acetylene. | Ethylene. | Coal-gas. |
|---|---|---|---|
| | ° C. | ° C. | ° C. |
| Non-luminous zone .......... | 459 | 952 | 1023 |
| Commencement of luminosity | 1411 | 1340 | 1658 |
| Near top of luminous zone ... | 1517 | 1865 | 2116 |

*Illuminating Value Calculated to 5 cub. ft. per Hour.*

Acetylene 240·0, ethylene 68·5, coal-gas 16·8.

From these and other considerations, the author states that there is no apparent relation existing between the temperature of the flame, the number of its carbon particles, and its luminosity.

On the other hand, acetylene is a highly endothermic body, and at the moment of its decomposition there must, therefore, be a very sudden liberation of a large quantity of heat; indeed, Berthelot has calculated that the temperature developed by the detonation of acetylene, at constant volume, is no less than 6,220° C. If this heat be suddenly imparted to the carbon particles resulting from the decomposition of acetylene, at the moment of their liberation, they would be raised to incandescence.

To prove this point, the author describes several experiments, the most striking of which are perhaps those in which he passes acetylene through heated tubes, obtaining, as the temperature rises, a sudden jump from 800° to 1,000° C. in one case, and in another, incandescence of the liberated carbon.

If, however, the incandescence be thus due to the endothermicity of acetylene, it is, at first sight, not easy to account for the non-luminosity of the cyanogen flame, seeing that the endothermicity of the latter is greater than that of the former. (Heat of formation of acetylene, $C_2H_2 = -47{,}770$; of cyanogen, $C_2N_2 = -65{,}700$.) Cyanogen, however, is much more stable at high temperatures than is acetylene, and is not decomposed in the flame before it burns, in spite of this flame being hotter than either that of acetylene or that of ethylene, and about as hot as is that of coal gas. When, however, a hydrogen flame was burnt from the open end of a 9-mm. platinum tube, and a 2·5-mm. tube was passed up through the broad tube to the apex of the inner zone, and cyanogen was admitted, the flame at once became luminous; and upon surrounding the hydrogen flame with an oxygen atmosphere, that luminosity increased. The luminosity of the cyanogen flame depends, therefore, on the temperature; and if it were burnt in a flame sufficiently hot to rapidly decompose it, it would probably give nearly as high an illuminating value as does that of acetylene.

The author summarises his results as follows: "(1.) That the luminosity of hydrocarbon flames is principally due to the localisation of the heat of formation of acetylene in the carbon and hydrogen produced by its decomposition. (2.) That such localisation is produced by the rapidity of its decomposition, which varies with the temperature of the flame and the degree of dilution of the acetylene. (3.) That the average temperature of the flame due to combustion would not be sufficient to produce the incandescence of the carbon particles within the flame."

The author states that it is now possible to give "a fairly complete description of the actions which endow hydrocarbon flames with the power of emitting light." When the hydrocarbon gas leaves the jet at which it is being burnt, the portions in contact with the air are consumed, and form a wall of flame around the issuing gas. The radiant heat emitted by the flame-walls converts the hydrocarbons present into acetylene, methane, and hydrogen. "The temperature of the flame quickly rises as the distance from the jet increases, and a portion of the flame is soon reached at which the heat is sufficiently intense to decompose the acetylene with a rapidity almost akin to detonation, and the heat of its formation localised by the rapidity of its decomposition raises the liberated carbon particles to incandescence, thus giving the principal part of the luminosity to the flame. The particles heated by the combustion of the flame gases still continue to glow, until finally themselves consumed, this external heating and final combustion adding but slightly to the light emitted." Any unsaturated hydrocarbon which has escaped conversion into acetylene, and any methane, become converted into acetylene in the hotter regions of the flame, then suffer decomposition to C and H, and thus increase the light-giving area of the flame.—E. R. B.

### *Technical Synthesis of Acetylene.* O. N. Witt. Chem. Ind. 18, 72—75.

Universal interest has been excited with regard to the process of T. L. Wilson for the preparation on a manufacturing scale of nearly pure actylene. The method is an extension of Wöhler's observation in 1862, that calcium carbide $CaC_2$ is decomposed by water into calcium hydroxide and acetylene. An intimate mixture of the two substances, lime and anthracite, is subjected to the action of the electric arc in a Cowle's furnace. At the high temperature the carbide fuses, sinks to the bottom of the furnace and can be drawn off into moulds. It is generally cast into rods which have a blackish-grey colour and are crystalline. They are not easily affected by the atmosphere, but are very rapidly decomposed by water giving off acetylene of 98 per cent. purity. For laboratory purposes this is most conveniently done in a Kipp's apparatus. A similar method is employed on a manufacturing scale, a suitable cast iron vessel, provided with manholes for charging and draw-off cocks for the lime sludge, being used. The gas which is colourless has a specific gravity compared with air of 0·91, and smells of garlic. It can be condensed at 0° C. and 21·5 atmospheres to a colourless mobile liquid, which like liquid carbonic acid, when allowed to expand quickly, solidifies owing to absorption of heat. The acetylene snow so formed is inflammable and burns without melting or leaving any residue. The gas is easily soluble in various liquids; water at the ordinary temperature and pressure dissolves 1·1 times its volume, alcohol dissolves large quantities of the gas and petroleum dissolves 2·6 times its volume, whilst brine only dissolves 0·05 volume. Mixtures of air and acetylene are explosive when in the proportion of 1·25:1, the most explosive mixture being one expressed by the ratio of 12:1 (this Journal, 1894, 1182), whilst the mixture is no longer explosive when the volume of the air is more than 20 times that of the acetylene. As regards other properties of the dry calcium carbide it can be heated in the air without change, but burns in oxygen to calcium carbonate. Chlorine at 250° C. attacks it, yielding carbon and calcium chloride, whilst sulphur reacts with the formation of calcium sulphide and carbon bisulphide. It also forms compounds with arsenic and antimony. Up to the present, the principal use proposed for acetylene has been for illuminating purposes, and when burnt from a large aperture it gives a strongly luminous but smoky flame. By the use of suitable burners, however, it is possible to obtain thin flames which without smoking emit a light of very high luminosity, in addition to which the flame does not flicker, and possesses scarcely any non-luminous zone.

To obtain the best results it requires, however, to be burnt at a pressure of about 60 mm. of water. Smoking can also be prevented by mixing the gas with $\frac{2}{3}$ its volume of air, and burning it from an ordinary fish-tail burner. With regard to the consumption of the gas compared with ordinary coal gas, about 0·6 litre of acetylene are required per candle-hour as against 11·5 litres in an ordinary burner, 10 litres in an Argand, 3·7 litres in a new Siemens lamp, No. 00, and 2·7 litres per candle-hour in a Welsbach burner for ordinary gas. The heat given out by an acetylene flame is also considerably less, and for equal illuminating effects only about half as much carbonic acid and water are given off as in the case of coal gas. The importance of acetylene as an enricher is alluded to by the author who is also of opinion that it renders possible the construction of an absolute photometric standard. The disadvantages attending the use of acetylene as an illuminating agent are its poisonous qualities and its property of forming explosive compounds with cupric oxide. Owing to its powerful smell, however, it is unlikely that any large quantities of the gas could escape without detection and experiments have shown that only copper and silver acetylide are explosive, whilst iron, lead, and tin, the metals most commonly used for the necessary apparatus, do not form explosive compounds.

The author quotes figures given by Dr. Frank in a lecture in Berlin giving the relative cost of illuminating by coal-gas and acetylene, from which it would appear that in Berlin, roughly, 10 tons of coal, giving 2,800 cub. m. of 16 candle-power gas, cost M. 135, whilst considerably more than this amount of illuminating effect can be obtained by decomposing 1 ton of calcium carbide, which, allowing for the lime produced, would cost about M. 68 (cf. this Journal, 1895, 561). The technical production of acetylene is, however, not only of importance in the gas industry, but a much larger field is open in other branches of chemistry, reference being made to Berthelot's benzene synthesis and also to syntheses in the fatty series by reducing acetylene to ethylene, from which, by the addition of water, there results ethyl alcohol. Figures are also given comparing the cost of producing alcohol synthetically as against the potato starch method. A good potato harvest produces 16,000 kilos. of potatoes per hectare, containing 18 per cent. of starch, or 2,880 kilos. One kilo. of starch gives, theoretically, 0·5679 kilos. of alcohol, but the best distilleries only obtain an 85 per cent. yield, which is equal to 1391·6 kilos. of spirit. Assuming theoretical yields, 1 ton (1,000 kilos.) of calcium carbide converted into ethylene, ethyl sulphuric acid and alcohol would give 718·1 kilos. of absolute alcohol, or more than 8 tons of very good potatoes. With a bad harvest only producing three-fourths of the above amount of potatoes containing 12 per cent. of starch, the yield of alcohol would be only 695·8 kilos., or less than the theoretical amount from 1 ton of calcium carbide. The possibility of other syntheses such as those of oxalic and acetic acid and aromatic compounds is also mentioned, as well as the preparation of hydrocyanic acid according to the equation—

$$C_2H_2 + N_2 = 2HCN.$$

It is also possible that calcium carbide itself, without previous conversion into acetylene, may be employed in various chemical reactions, of which the author suggests the carburation of cast iron and other metallurgical operations. (See also this Journal, 1895, 135, 353, and 470.)—T. A. L.

## PATENTS.

### *Improvements in the Manufacture of Patent Fuel.* J. B. Taylor, Bath. Eng. Pat. 13,299, July 10, 1894.

The claim is for the shape and construction of the blocks, which are made of the usual materials. The improvements comprise perforating the blocks, making indentations on their surfaces, and bevelling or rounding their corners or edges.—A. G. B.

### *Improvements in Methods of and Apparatus for Heating Crucibles by Means of Electricity.* A. C. Girard and E. A. G. Street, Paris, France. Eng. Pat. 15,632, August 16, 1894.

The heating is effected by a voltaic arc, which is made to rotate round the axis of the crucible by the action of magnetic fields. The crucible, which is preferably made of carbon, is suspended in the centre of the furnace by its upper flange, which rests upon a shoulder provided in a carbon block, contained in the hollow of a block of refractory material, such as magnesia or silica. The crucible is shut in above and below by two blocks of similar material, and two inner pieces of carbon complete the whole interior of the furnace. The whole is surrounded by a cylinder of iron closed at its ends by covers of bronze, which are insulated from the iron tube while making a joint therewith. The blocks at the lower part of the furnace are pierced to permit of the passage of a carbon electrode, shaped so as to surround the lower part of the crucible, without however touching it. This electrode is pierced with a small hole along its axis, to provide means for striking the arc, either by a fine carbon rod or by a pneumatic device. There is electrical connection between the upper and lower plates closing the iron tube, and the crucible and electrode respectively, and these plates are also in connection with the poles of a suitable source of electricity. Outside the iron envelope are wound two solenoids, which when traversed by an electric current, cause opposite poles to be formed at its two ends, thus producing a rotation of the arc around the axis of the crucible. When the material in the crucible is at the melting point, it is discharged by causing the whole apparatus to turn about a horizontal axis perpendicular to a tap hole and suitable channel provided in the crucible and side of the furnace. The axis of oscillation is in two parts, which are insulated from one another and the material of the furnace, but are in connection with the opposite electrode, so that the crucible can be emptied without extinguishing the arc. When the arc is required to turn on the upper surface of the crucible, the envelope is preferably made of some non-magnetic material. The magnetic field is excited by an iron ring concentric with the furnace, and round the ring are wound four coils, two coils which are at opposite ends of a diameter forming one circuit, and the other two coils forming the second circuit. The circuits are so joined that consequent poles are formed in the iron rings, and the alternating currents passing through these two circuits differ in phase by a quarter period.—G. H. R.

### *Improvements in the Manufacture of Artificial Fuel.*

W. H. Biggs, Cardiff, Glamorgan, and R. R. Greenhow, Llanishen, Glamorgan. Eng. Pat. 22,036, November 14, 1894.

Anthracite briquettes have heretofore failed as fuel because the material has never been used in a sufficiently finely-divided state. According to this invention, anthracite small coal ("duff") is passed through a disintegrator which will deliver it in such a condition that it will all pass through a sieve of at least 20 wires per linear inch, a finer condition being preferable. It is then mixed with (say) 6 per cent. of equally finely-powdered pitch, and the mixture is passed on to a pug-mill, wherein (say) 6 per cent. of coal-tar or other liquid hydrocarbon is incorporated with the mass. The mixture prepared in this way, is heated by superheated steam and compressed into briquette moulds at a pressure of about 2 tons per square inch. If it be desired to render the briquettes smokeless, they may be gradually heated to about 800° or 900° C. It is claimed for these briquettes that each cakes separately in the furnace, that they are not deteriorated by rain, and that they are hard enough to bear tipping from a waggon or from sacks. —A. G. B.

### *Improvements in Coke Ovens, and in the Method of Removing and Utilizing the Products of Combustion from such Coke Ovens.*

H. A. Allport, Barnsley, York, and A. Crossley, Pontypool, Monmouth. Eng. Pat. 22,152, November 20, 1894.

The claim is for the combination of the process of withdrawing the products of combustion through openings in the bottom of the oven by means of exhausting apparatus, with the process of expelling them by means of air forced into the oven above the coal.—A. G. B.

### *Improvements in Incandescent Lamps for Liquid Fuel.*

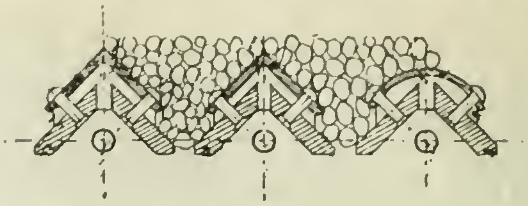
L. Friedländer and T. Müller, Berlin, Germany. Eng. Pat. 7673, April 16, 1895.

The construction of the actual burner of this improved lamp, is similar in principle to that of those already in use, but differs from these in some details, for which claim is made. The chief novelty consists in the arrangement for vapourising the oil before it issues from the injector orifice. The valve regulating the flow of vapour, is situated in a chamber immediately below this orifice, and the oil supply-pipe is provided with a side tube at a point just below its opening into the said chamber. This branch tube terminates in a narrow jet, which is curved over so that the flame of the oil which flows from it, may play upon the junction of the main tube with the branch tube and upon the chamber. In this way both tube and chamber are kept sufficiently hot to vaporise the oil. The auxiliary jet is furnished with a regulating valve.—A. G. B.

### *Improvements in Furnaces for Coal Dust and Small Fuels.*

F. Pelzer, Dortmund, Germany. Eng. Pat. 8447, April 29, 1895.

The figure shows a section of the grate-bars of the furnace. Each bar consists of two rails inclined towards each other, but separated by a central slot, and connected at suitable intervals by cross ridges or supports. The slots are overlapped by curved rails secured to the ridges. Below the bars, and immediately opposite the openings, are perforated pipes for supplying jets of water, which, by impinging on the hot bars, cool these and at the same time furnish steam to aid the combustion of the fuel. Secondary air must be admitted above the fuel, to burn carbon monoxide and hydrogen.—A. G. B.



### *Improvements in Burners for Heavy Hydrocarbons.*

W. P. Thompson, Liverpool, Lancaster. From A. and O. Huff, Berlin, Germany. Eng. Pat. 9231, May 9, 1895.

In this burner the heavy hydrocarbon flows through an annular pipe situated immediately above the luminous portion of the illuminating flames, so that it becomes very hot; the vapourised oil then passes into a second annular pipe concentric with the first and situated over the non-luminous portion of the flames. From this second pipe there springs a tube which passes over the end of a vertical cylinder, rising from the burner head and passing through the common centre of the two pipes first referred to. A hole in this tube, situated immediately over the end of the cylinder, permits the vapourised oil, which has a considerable pressure owing to the confined space in which it is generated, to issue into the cylinder; in doing so it draws in air, so that the cylinder becomes a mixing chamber and, at the same time, a superheater. A shade, provided with holes at the top for admission of air, covers the mixing chamber and protects it from being chilled by a draught. —A. G. B.

### *Improvements in or relating to Furnaces.*

T. and G. Wilton, Beckton, Essex. Eng. Pat. 9309, May 10, 1895.

This invention relates to furnaces wherein no grate bars are used, but the fuel is placed in a mass upon or around a perforated blast pipe or pipes disposed centrally at the base of the furnace. With the blast pipe or pipes is also an arrangement of side injection pipes having steam and air nozzles at the furnace front, in combination with the blast pipe or pipes. There is also claimed in such a furnace, the use in combination with the blast pipe, pipes, or chambers, of a screw-conveyor and casing therefor, this central conveyor acting in combination with the blast pipes, &c., and having for its object the facilitating of the removal of clinker. The conveyor consists of a bar carrying arms and set in suitable bearings; it rotates in a circular casing which is open at the top so that the clinker may fall into it and be carried to the front of the furnace, whence it is ejected. The conveyor case may be cast in the same sections as those which constitute the blast pipes, in which event, orifices should be provided between the pipes and the conveyor case, to permit of the latter being kept cool by the blast.—A. G. B.

### *An Improved Process of and Apparatus for the Utilisation of the Smoke and Products of Combustion from Furnaces.*

E. Edwards, London. From M. Richter, Midlenau, Raspenau, Bohemia. Eng. Pat. 9620, May 15, 1895.

The smoke is conducted through a smoke consumer inserted in the exit flue, completely occupying its cross section. This consumer consists of a system of tubes conducting the feed-water for the boiler and the air for the combustion of the fuel in the grate; it is heated with smokeless fuel like coke, or with a mixture of this and smoking fuel, or smokeless fuel mingled with heat-retaining materials. The tubes are best arranged concentrically, the inner one conveying the water and the outer one the air.

—A. G. B.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Ozokerite.* E. B. Gosling. School of Mines Quarterly (Columbia College, U.S.A.), **16**, [1], 41—68.

Ozokerite, the principal solid hydrocarbon mineral, was discovered in 1833 by Dr. Mayer, at Slanic, in Roumania, and was examined in the same year by Glocker, who named it ozokerite, from *οζω* and *κηρος*.

The chemical composition of ozokerite varies, as is shown in the following table :—

| Locality. | Carbon. | Hydrogen. | Authority. |
|---|---|---|---|
| Slanic ............ | 84·43 | 14·39 | Schroetter. |
| Truscawitz ....... | 84·62 | 14·29 | Walter. |
| Boryslaw, A. ..... | 84·94 | 14·87 | Hofstadter. |
| „ B. ..... | 85·78 | 14·29 | „ |
| Turpeth .......... | 86·80 | 14·00 | Johnston. |
| Utah, A. ......... | 85·44 | 14·45 | Smith. |
| „ B. ......... | 85·75 | 15·15 | „ |

Similarly, all the physical characteristics also vary : thus, the melting-point varies from 56°—100°, the boiling point from 210° to 300° and over, and the specific gravity from 0·85 to 0·97.

These variations no doubt largely depend upon the amount of liquid hydrocarbon (petroleum) admixed with the ozokerite, but the chemistry of this substance is still very obscure. Probably both olefines and paraffins are present in it, but even this is uncertain.

Geologically, ozokerite is always accompanied by petroleum, and, like it, occurs principally in tertiary and cretaceous strata; where both occur, the petroleum is found at the lower level.

By fractionation, the same substances are obtained from either body, though in different proportions, thus :—

| Component Bodies. | American Petroleum. | Ozokerite. |
|---|---|---|
| Naphtha and benzene................ | 41 | 17—28 |
| Lubricating oils ..................... | 39 | 15—20 |
| Paraffin-like body..................... | 2 | 30—50 |
| Residue and loss...................... | 18 | 10—20 |
| | 100 | 100 |

As to the origin of the heavy hydrocarbons, which constitute the bulk of ozokerite, the author leans towards the view that they were formed from petroleum hydrocarbons by oxidation, with elimination of water.

The elimination of the water is in nature assisted by the salt clays and similar deposits found near ozokerite deposits; in the American petroleum fields, where no such material is present, vaseline-like substances take the place of ozokerite.

By far the largest known deposit of ozokerite is that which has been worked since 1859, at Boryslaw, in Galicia. Here the mineral is found, at a depth of 10—80 m., in an irregular series of "true veins," varying in width from a few millimetres to many metres. The containing rocks are miocene sand stones. The mineral is won by aid of timbered shafts (12,000—13,000 in 1887) and galleries. The ozokerite obtained from the lowest levels is softer than that obtained nearer the surface, owing to its containing a large percentage of liquid and gaseous hydrocarbons. The yield of wax is about 4—8 per cent. of the mineral mined.

Besides the Carpathian deposits of Austria and of Roumania, ozokerite is yielded along the north side of the Caucasian Mountains and on the islands and along the shores of the Caspian Sea. It occurs also in the transcaspian region of Russia, in Central Asia (shores of Lake Bal-Kash), Italy, England (Urpeth), Scotland, New Zealand, Egypt, Algeria, and the United States. The most important deposits in the latter country are in paraffin-oil shales, on the eastern flank of the Wahsatch Mountains of Utah. These shales, which are probably of miocene age, extend into Colorado, Arizona, and New Mexico.

The mineral, as brought to the surface, consists partly of fairly pure lumps, which are clarified by treatment with hot water or steam, the melted ozokerite being subsequently run off and cast into cakes ready for shipment; and partly of earthy matter, rich in ozokerite. The earthy mineral is first stirred up with cold water, much of the ozokerite floating to the surface and being removed, and then treated with hot water, as are the lumps before mentioned. The final residues, which contain about 1—1·5 per cent. of ozokerite, are extracted by benzine.

In England, at Messrs. Field and Co.'s works, the refining of ozokerite in conducted as follows :—About 5,000 lb. of the imported crude cakes are melted in tanks by the aid of steam coils. The melted mass is run into retorts, whence it is distilled at a high temperature by steam, assisted by direct heat under the retorts. The distillate cools to an oily mass, and this is then subjected to hydraulic pressure, The press cake is melted and treated with sulphuric acid in steam-jacketed vessels provided with agitators. After settling and clarifying, it is drawn off into forms, and left to solidify. In this way, a white, hard wax, of melting point 60°—65° C., in amount about equal to 60—70 per cent. of the crude cake is obtained. It is suitable for candle-making. Sometimes the mass, after treatment with acid, is washed with hot water and filtered through animal charcoal.

The method of refining adopted in Russia is very similar to the above. Several other processes (mostly patented) have been proposed, and are described by the author at length.

Ozokerite vaseline is obtained by allowing melted ozokerite to pass through 12—15 filters of animal charcoal, or through double that number, if a perfectly colourless product be required. The mass is then treated, for 3—4 hours, with superheated steam (250° C.). About 25—30 per cent. of product is obtained.

To estimate the quality of ozokerite, before refining on the manufacturing scale, Lach heats 100 grms. of ozokerite with 20 of fuming sulphuric acid to 170°—180° C. until no more fumes are evolved, determines the loss due to evaporation, adds 10 grms. of the residues of potassium ferrocyanide manufacture, heats to 140°, stirs, and allows to cool. Of the product, 1/10th part is extracted with boiling benzene and the wax obtained by evaporation of this solution. The method is accurate within 1 per cent. Sauerlandt's process is by distillation with superheated steam.

*Average Result of Distillation of Ozokerite from Different Localities.*

| —— | Boryslaw A. | Galician B. | Persian. | Urpeth. | Colorado and Utah. | Baker. |
|---|---|---|---|---|---|---|
| Oils............... | 37·61 | 38·28 | 22·18 | 18·30 | 90·00 | 81·8 |
| Paraffin mass ..... | 56·58 | 52·27 | 53·55 | 64·95 | | |
| Coke............... | 2·85 | 4·63 | 16·03 | 11·15 | 5·28 | 4·4 |
| Loss by water gas. | 3·00 | 4·82 | 7·24 | 5·60 | 4·72 | 13·8 |
| Specific gravity ... | 0·93 | 0·93 | 0·925 | 0·89 | 0·928 | 0·903 |
| Melting point..... | 60°—66° | 60°—66° | .. | 60°—70 | 76·00 | 79·0 |
| Colour, &c. ....... | Dark yellow | Dark brown | Dark green, rather hard. | Soft and sticky | Dark brown | Dark brown to pitch black. |

The principal refineries of ozokerite are:—(in Austria) at Aussig, Florisdorf, Drohobicz, Lemberg, Newpest, Hermanstadt, Stockerau, Vienna; (in Germany) Halle, Frankfort, Homburg; (in Russian Poland) Strzemiszya, Sosnowice; (in England) Battersea; (in France) near Paris; (in the United States) Greenpoint, Long Island.

The Austrian production was 16,000 tons in 1892, and from 1877—1890, varied between 6,170 and 13,925 tons, averaging about 11,000 tons. The Russian production is about 2,000 tons. The United States produced, at Soldier's Summit, Utah, in 1890, about 150 tons; and, in 1892, about 60 tons. In 1890, the United States imported 1,069,241 lb. of mineral wax.

In the original paper is a complete bibliography of the literature of Ozokerite, in which the following references are indicated by the author as of special interest:—

*Literature of Ozokerite.* E. B. Gosling. Sch. of Mines Quarterly, **16**, [1], 62—68.

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| 1837 | Ann. der Chem. und Pharm. | 23 | 286 | Analy. of Oz. from Slanic, &c. | Malgretti. |
| | Annalen der Chemie and Phys. | 55 | 217 | " " | Magnus. |
| | Wagner's Jahresbericht | 12 | 663-7 | Galician Oz. | |
| 1869 | " " | 15 | 702 | Occ. work and factories. | |
| 1871 | Annales des Mines | .. | .. | Petrol. and Oz. de la Galicie | Heurteau. |
| 1872 | Wagner's Jahresber. | 17 | 871 | Treatment at Battersea. | |
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| 1878 | Dingl. poly. Journal | 231 | 383 | Sp. gr., melting-point, &c., of Gal. Ozok. | Sauerlandt. |
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| | Jahrbuch der K.K., Geol. Reich. Anstalt. | .. | 131-38 | Where found, etc., in Galicia | Paul. |
| | Verh. der K.K. Geol. Reich. Anstalt (Vienna). | .. | March & May. | Occ. at Boryslaw | Paul. |
| 1885 | Chemiker Zeitung | 9 | 77 | Criterion of quality | Sauerlandt. |
| | Eng. and Mining Journ. | .. | 168 | Utah and deposits | Clayton. |
| | This Journal | 4 | 488 | Caucasian oz. | Lach. |
| | Wagner's Jahresber. | .. | 1242 | Treatment. | |
| 1886 | Handwörterbuch der Chem. (Fehling and Hell). | .. | .. | General discussion condensed. | |
| | This Journal | 5 | 35 | Waterproof, &c., patent | Buyton. |
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| | This Journal | .. | 652 | Action of $H_2SO_4$ on Oz. | Redl. |
| | " | .. | 505 | Purification. | |
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| 1889 | This Journal | 8 | 315 | Prices, &c. | |
| | " " | .. | 535 | Occurrences. | |
| | " " | .. | 590 | Prod. in U.S. | |
| | " " | .. | 696 | Occurrences. | |
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| | This Journal | 9 | 957 | Galic., Oz, &c. | Shotsky. |
| 1891 | Dingl. pol. Journal | 280 | 69 | Probable formation | Zawzrecki. |
| | " " | .. | 85 | " " | |
| | " " | .. | 133 | " " | |
| 1892 | Chem. Centralblatt | .. | 686 | Industry | Redwood. |
| | Dingl. poly. Journal | 284 | 252 | Prob. formation | Zaloziecki. |
| | " " | 284 | 143 | " " | Kast and Seidner. |
| | This Journal | 11 | 93 | General article | Redwood. |
| | " | 11 | 424 | Patent bleaching | Baxter. |
| | " | 11 | 598 | Prob. formation | Kast and Seidner. |
| | " | 11 | 599 | Patent bleaching | Henderson. |
| | Wagner's Jahresber. | 38 | 38-39 | Prod. and statistics. | |
| 1893 | Gites Minéraux Métallifères par Fuchs et De Launay. | .. | 154 | General article. | |

—E. R. B.

*Discrimination between α- and β-naphthol, &c.* Aymonier. Zeits. Anal. Chem. **34**, [2], 228.

*See under* XXIII., *page* 771.

## PATENTS.

*A Process for obtaining Cyanogen or its Compounds from the Gases resulting from the Dry Distillation of Substances of Organic Origin.* H. Drehschmidt, Berlin. Eng. Pat. 16,149, August 24, 1894.

The gases described in the title are brought into contact with solid and porous mixtures containing approximately one or two molecules of an alkaline earth metal (as magnesium or calcium) oxide or carbonate, with one molecule of the oxide or carbonate of a heavy metal (as iron, manganese, or zinc) such as may form, in combination with cyanogen, double compounds not decomposable by hydrogen sulphide or carbonic acid; and such mixtures are to be obtained by chemical precipitation. One method by which the required porous mass is obtained, consists in suspending in water, powdered oxides, hydrates, or carbonates of the alkaline earth metals, and adding a solution of the iron or other heavy metal in the proportion required to give the product specified. The alkaline earth may be replaced by an alkali or alkaline carbonate. The precipitate is separated, washed, dried, and powdered. Modifications of this process are also described. The manner of utilising the porous mass in absorbing cyanogen from gases, is similar to that in which ordinary gas-purifying materials are applied. When the porous mass is saturated with cyanogen, it is removed and treated in any way to obtain the cyanogen compounds.—E. S.

*Manufacture of Alkaline Cyanides and Ferrocyanides.* G. Kraemer, Berlin. Eng. Pat. 16,529, August 30, 1894.

*See under* VII., *page* 750.

# IV.—COLOURING MATTERS AND DYES.

*Artificial Mordant Colouring Matters.* R. Nietzki. Chem. Ind. **18**, 76—80.

The paper, after a short introduction in which colouring matters are arranged in four classes, gives an account of the growth of the mordant-dyeing colour industry. According to the author, dyestuffs are divisible into: (1) basic colouring matters; (2) acid colouring matters; (3) direct cotton colours; and (4) mordant dyestuffs. Those in the first class are generally neutral salts of organic bases, dye animal fibres and certain woody fibres, such as jute, from a neutral bath, produce insoluble compounds with tannin, and dye-tannined cotton. Acid dyestuffs are almost always sulphonic acids. They dye animal fibres from an acid bath, but have no affinity for cotton. The colouring matters of the third class are mostly disazo compounds, together with certain natural products, such as turmeric and safflower. Unlike the acid colouring matters, they dye both animal and vegetable fibres from a faintly alkaline bath. The term mordant colouring matter is applied to those dyestuffs which form lakes with certain metallic oxides, a reaction which takes place on the fibre, and give varying shades, often differing considerably from the original colouring matter, according to the particular mordant employed. This property was known, in the case of madder, to the ancient Egyptians and Indians, but, until about 10 years ago, the employment of mordant colouring matters was only very limited. The principal reasons for the increased use of these dyestuffs is ascribed to the fact that on the one hand certain relations have been found to exist between their properties and constitution, which have led to the synthetic preparation of several compounds of this class; whilst a second cause is the use of chrome mordants, which in some cases has alone rendered possible the use of certain dyestuffs possessing the necessary fastness. Such a substance is naphthazarin, which, although discovered 30 years ago, has only been in general use about 10 years, since the introduction of chrome mordants, with which it gives a very fast black. The metals, of which the oxides are true mordants, are aluminium, iron, chromium, copper, cobalt, and nickel. It might be assumed that all substances which give insoluble compounds with a colouring matter, would act as mordants, but such is not the case. Alizarin, for example, forms an insoluble barium salt, but it cannot be dyed upon a fabric impregnated with barium carbonate, as the lake formed washes out. It would therefore appear as if the oxides form a compound with the fibre, and that this combination continues to exist after the lake formation has taken place. Microscopically examined, a cotton fibre mordanted with alumina, and dyed with alizarin, even under a high power, appears uniformly dyed, and no solid dyed particles can be discerned. The presence of acids or alkalis generally retards the formation of a lake, but when the latter is once formed on the fibre, it is not easily decomposed. It appears, however, that other oxides are present in the lake, calcium always accompanying alumina, in fact satisfactory alizarin dyeings cannot be obtained if calcium be entirely excluded, a fact which, in earlier times, appeared to confine the Turkey-red industry to certain districts. In the case of chromium oxide lakes, magnesium always appears to be present, the dyeing being performed in presence of chromic acid together with the chromium oxide. This, which probably had its origin in the logwood black industry, is carried out practically by boiling the wool with bichromates, with or without sulphuric acid, chromic acid and chromium oxide being precipitated on the fibre. The first artificial mordant colouring matters were derivatives of anthraquinone, purpurin, iso- and flavopurpurin, nitro-alizarin, and alizarin-blue. Anthragallol, discovered by Säuberlick in 1877 by condensing gallic and benzoic acids, was not used technically until 10 years later, after the introduction of chromium mordants. In 1881 gallocyanine was introduced, the first representative of the oxazine colouring matters. This substance, obtained by the action of nitrosodimethylaniline on gallic acid, possesses both feeble basic and acid properties, but dyes a somewhat reddish-blue on a chromium mordant. Subsequent to this discovery it was found that certain nitrosophenols or quinone-oximes give dark green lakes with iron salts. To this class of colouring matters belong dinitrosoresorcinol, the *o*-nitrosonaphthols and their sulphonic acids, and certain nitrosodihydroxynaphthalenes.

According to Kostanecki, only the *o*-nitrosophenols possess the properties of a mordant colouring matter, and in continuation of this investigation in conjunction with Liebermann, in which it was found that in the case of mordant-dyeing anthraquinone derivatives, two hydroxyls in the ortho position were necessary, Kostanecki has suggested that all mordant colouring matters contain two acid groups in the ortho position. Although this has not proved to be an absolute rule, it is certain that in those cases in which it is fulfilled the mordant-dyeing properties are more strongly pronounced. The first azo colours which dyed on mordants were those obtained by combining the diazo compound of amido-benzoic acid with β-naphthol or diphenylamine, but owing to the instability of their lakes it was not until Nietzki discovered Alizarin Yellow GG by combining *m*-nitrodiazobenzene with salicylic acid, that this class of colouring matters had any technical importance. It appears that this property is common to almost all azo-salicylic acid compounds, of which another example is Diamond Yellow. Other similar colouring matters are obtained by combining diazosalicylic acid derivatives (the derivatives of the diazo compound of amido-salicylic acid) with various compounds. One such colouring matter is Diamond Black, obtained by combining the diazo compounds of amido-salicylic acid ("diazo-salicylic acid") with α-naphthylamine, diazotising the resulting amido-azo compound, and combining it with 1·4-naphthol sulphonic acid. The dyestuff gives a black on chromed wool. A further step in the production of mordant azo colouring matters was the discovery of the dihydroxynaphthalene dyestuffs. The first representative of this class was derived from 1·2-dihydroxynaphthalene (β-naphthhydroquinone) and its sulphonic acid, but it proved too costly for technical purposes. Of practical value are those colouring matters derived from dihydroxynaphthalene, in which the hydroxyl groups are in the 1·1′, or peri position. The disulphonic acid of this compound, in which the sulphonic acid groups have the positions 3·3′, is of especial interest, and is known as the chromotrope acid. By combination with diazo compounds, disazo derivatives are obtained which dye unmordanted wool the same shade as the colouring matter, but are altered subsequently by treatment with a mordant. Certain of these dyestuffs, for instance, which dye a bright red, are converted, when the fibre is boiled with bichromate, into a deep blue-black.

Another class of colouring matters is that of the trihydroxyketones, of which gallacetophone—

$$CH_3.CO.C_6H_2(OH)_3$$

obtained by the action of acetic acid on pyrogallic acid (pyrogallol) in presence of a condensing agent, is a representative. It dyes on alumina with a yellow and on chrome mordants with an olive-green colour. Another colouring matter probably belonging to the oxyketone class is galloflavin, obtained by oxidising an alkaline gallic acid solution. Further investigation in the alizarin series has led to the discovery of the introduction of hydroxyl groups by the action of fuming sulphuric acid, and the production of tetra- and pentahydroxyanthraquinones, which are known as Alizarin Bordeaux and Alizarin cyanin. Alizarin blue treated in this way gives Alizarin green and Alizarin indigo-blue. By acting with sulphuric acid on dinitroanthraquinone, Anthracene blue is produced, which is a hexahydroxyanthraquinone. The chrome lakes of all these colouring matters are the most valuable. Another anthracene blue is obtained from 1.3.3′.1′ - tetrahydroxyanthraquinone (anthrachrysone), which is obtained by condensing symmetrical dihydroxy benzoic acid by means of sulphuric acid. This substance is nitrated and reduced, yielding a di-amido compound which dyes wool yellow from an acid bath. By subsequent boiling with chromium fluoride the yellow colour turns blue. As already mentioned, Naphthazarin only came into general use after the introduction of chromium as a mordant, and the same applies to Galleïn and Cœruleïn, two colouring matters discovered about 20 years ago by Baeyer. The latter gives a dark green on a chrome mordant. The colouring matter, Anthracene yellow, is a hydroxycoumarin, and obtained by condensing pyrogallol with aceto-acetic ether and subsequent bromination of the dihydroxycoumarin obtained. Mention is also made of a mordant triphenylmethane colouring matter, Aurin-tricarboxylic acid, obtained by condensing salicylic acid with formaldehyde. It gives violet shades on chromium mordants, and is used to a small extent in printing.

In conclusion, the author points out that the fastness of the modern artificial dyestuffs, and more especially the mordant-dyeing colouring matters, towards light, alkalis, and acids, is considerably greater than that of natural colouring matters, such at logwood, fustic, and camwood;

and although at present the artificial mordant colouring matters cannot compete with these natural products in the matter of price, still the latter are being gradually superseded by the former in those cases where more stable products are required.—T. A. L.

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### *Note on the Artificial Mordant Colouring Matters.* F. V. Kallab. Chem. Ind. 18, 215.

The author points out that he was the discoverer of Oehler's Cloth Red G and B, which were on the market two years before Alizarin Yellow G G, and were the first representatives of mordant-dyeing azo colouring matters. Cloth Red G is the sodium salt of amido-azo-toluene-azo-β-naphthol sulphonic acid (Schaeffer acid), whilst Cloth Red B is the corresponding R-salt derivative.—T. A. L.

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### *Are the Magentas Ethers or Salts?* A. Rosenstiehl. Bull. Soc. Ind. de Mulhouse, April 1895, 98—105.

The production of a salt from rosaniline and hydrochloric acid is accompanied by the formation of 1 mol. of water. The question is therefore one of the position occupied by the atom of chlorine in the molecule of the magenta. If it be fixed to the nitrogen, the constitution of magenta is that of a salt; if it be attached to the carbon, then magenta possesses the constitution of an ether. The fact that the rosanilines are capable of fixing one atom of halogen only, although they contain three amido groups, seems to indicate that the magentas possess the constitution of the ethers, or rather of amido-ethers.—C. O. W.

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### *Analogy between the Functions of Rosaniline and its Sulphonated Derivatives.* A. Rosenstiehl. Bull. Soc. Ind. de Mulhouse, April 1895, 105—106.

The introduction of the sulphonic group into the phenyl residue of the rosanilines does not interfere with the basic functions of the amido groups which are in the para position to the methane carbon. If rosaniline be a strong base, the same remark must hold good in the case of the sulphonated rosanilines. The sulphonated rosaniline will exhibit the functions of a base so soon as the sulphonic group has been saturated. The acid functions having then disappeared, the alkaline functions of aromatic amido-alcohol become apparent. Both rosaniline and sulphonated rosaniline are basic bodies, the only difference between them being that the former is insoluble whilst the latter is soluble in water.—C. O. W.

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### *The Sulphonated Triphenylmethane Dyes.* M. Prud'homme. Bull. Soc. Ind. de Mulhouse, April 1895, 93—98.

A solution of commercial magenta exactly decolorised by a hot solution of caustic soda, on the addition of a cold solution of ammonium chloride at once re-assumes a magenta tint, the intensity of which very rapidly increases. If the decolorised solution contain the body—

$$NaO - C \equiv [C_6H_3.SO_3Na.NH_2]_3,$$

this reaction would be expressed by the equation—

$$NH_4Cl + (NaO - C \equiv ]C_6H_3.SO_3Na.NH_2]_3) =$$
$$NaCl + (NH_4O - C \equiv [C_6H_3.SO_3Na.NH_2]_3)$$

This ammonium salt should be of a highly dissociable nature, and its $NH_4O$ group should therefore readily conduce to the formation of the coloured compound—

$$HO - C \equiv [C_6H_3.SO_3Na.NH_2]_3$$

Indeed on treating a cold solution of magenta with ammonia, decolorisation takes place, but on warming, the red tint reappears. If instead of ammonium chloride, the carbonate be employed, the colourless solution recovers its colour, but on boiling, the coloration definitely disappears. The result would have to be expressed by the equation—

$$CO_3(NH_4)_2 + 2(NaO - C \equiv [C_6H_3.SO_3Na.NH_2]_3) =$$
$$Na_2CO_3 + 2(NH_4O - C \equiv [C_6H_3.SO_3Na.NH_2]_3)$$

The dissociation of the last compound of this equation on boiling, would then lead to the reaction expressed by the equation—

$$Na_2CO_3 + 2(HO - C \equiv [C_6H_3.SO_3Na.NH_2]_3) =$$
$$CO_2 + H_2O + 2(NaO - C \equiv [C_6H_3.SO_3Na.NH_2]_3)$$

A solution of magenta decolorised with caustic soda regains its colour on treatment with a current of carbonic acid. On boiling, the solution returns to the colourless state by a reaction analogous to that expressed by the above formula. If, however, acid magenta be decolorised by means of barium hydrate, treatment of the colourless solution with carbonic acid restores the colour, but without any barium carbonate being precipitated. On boiling, decolorisation again takes place, also without precipitation of barium. This solution therefore appears to contain the body—

$$HO - C \equiv [C_6H_3.SO_3Na.NH_2]_3$$

in the colourless state. This body combines directly with carbonic acid, forming a coloured product, which, on boiling, again undergoes dissociation and decolorisation. Indeed rosaniline itself on treatment with carbonic acid dissolves, forming a coloured solution, which, on boiling, again becomes colourless. These experiments lead to the following conclusions:—

1. The alkaline salts of the sulphonated diamido- and triamidotriphenyl carbinols are colourless. These bodies possess the functions of hydroxylated bases.
2. The salts of these bases are coloured.
3. Commercial acid magenta, according to the proportion of acids employed in its manufacture, is or can be a mixture of the colourless—

$$HO - C \equiv [C_6H_3.SO_3Na.NH_2]_3$$

and of the coloured—

$$Cl - C \equiv [C_6H_3.SO_3Na.NH_2]_3$$

or even of the latter and of the coloured compound—

$$Cl - C \equiv [C_6H_3.SO_3H.NH_2]_3$$

—C. O. W.

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### *Diphenylmethane Derivatives. New Process for their Preparation and Transformation into Colouring Matters.* J. Walter. Bull. Soc. Ind. Mulhouse, 1895, 82—87.

For each molecule of pure formaldehyde in the crude product, add 2 mols. of dimethylaniline together with an excess of 5—10 per cent. of the latter, and a weight of HCl equal to that of the dimethylaniline. Heat to just below 100° C. for 24 hours, and the second day boil with upright condenser. Add excess of NaOH and distil off excess of dimethylaniline. On cooling, the oily product changes to white crystalline leaflets, which, on crystallisation from alcohol, yield pure tetramethyldiamidodiphenylmethane melting at 88°—91° C.

This can be used for the production of colouring matters by oxidation together with aromatic amines, *e.g.*, dimethylaniline, dibenzylaniline, &c. The oxidation is effected with $CuSO_4$ and NaCl, as in the production of methyl violet. The colouring matters resulting are violets and blues. With phenylnaphthylamine two distinct colouring matters are obtained, one soluble in water, the other in spirit. The former is extracted from the melt with HCl and precipitated with salt. It dyes tannin-mordanted cotton a reddish-blue. The spirit-soluble colour is extracted from the residue with alcohol. On precipitation with water a useful blue for printing results, or, on evaporation of the alcoholic solution to dryness, a spirit blue with a coppery lustre, similar to the older spirit blues. With care this can be converted into the corresponding water-soluble sulphonic acid analogous to "soluble blue."

By heating tetramethyl diamidodiphenylmethane with sulphur in the presence of zinc chloride and ammonia, there is produced a basic yellow colouring matter similar in properties and shade to auramine.

The dimethylaniline of the original reaction can be replaced by aniline or other aromatic amines; *e.g.*, with aniline there is formed diamidophenylmethane. On diazotising this, both amido groups are attacked, and the diazo derivative produced can be combined with phenols and amines. Thus, with α-naphthylamine sulphonic acid a reddish-orange results. This is very sensitive to acids, but if again diazotised and combined with phenols, &c., useful acid colouring matters from reddish-yellow to deep brown are obtained. Or the di-diazophenylmethane can be further transformed into an amido-azo body by heating with aniline. This derivative may be employed in the manufacture of colouring matters, by re-diazotisation and combination with amines or phenols. The colouring matters are yellow, orange, scarlet, and even violet-black acid dyes.

When equal molecules of diamidophenylmethane and aniline hydrochloride are heated with nitrobenzene and a trace of ammonium vanadate to 180° C., a red colouring matter can be extracted from the melt, which appears to be para-magenta.

Tetramethyldiamidodiphenylmethane and its analogues can also be prepared by mixing methyl alcohol with sodium bichromate and $H_2SO_4$ in the cold, and using this mixture in place of the crude formaldehyde, but the yield is much smaller.

By oxidising tetramethyldiamidodiphenylmethane by means of $CuSO_4$ and common salt, or in slightly acid solution with $PbO_2$ or $MnO_2$, a violet-blue colouring matter is formed, which yields useful shades on tannin-mordanted cotton.—R. B. B.

*New Syntheses of Triphenylmethane Derivatives.* J. Walter. Bull. Soc. Ind. Mulhouse, Feb.—March 1895, 80—81.

When perchlorinated methyl formic ether is mixed with dimethylaniline, especially in the presence of aluminium or zinc chloride, a bluish-violet colour is obtained on heating. According to the proportions, conditions of temperature, &c., the products of the reaction may be true colouring matters, leuco-bases of the same, or perhaps tetramethyldiamidobenzophenone. If this last, it may be transformed by reduction to benzhydrol (diphenylcarbinol), or by other reactions, to hydrochlorides of substituted benzophenones. These compounds yield colouring matters on condensation with amines.

Dimethylaniline may be replaced by other aromatic amines, and less chlorinated products may be substituted for the perchlorinated methyl formic ether. These ethers act in a similar way to phosgene gas, and being liquids, are more convenient to use, besides being more readily prepared in the pure state.

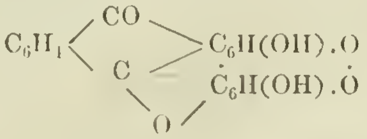
The colouring matter prepared from dimethylaniline as above is a readily crystallisable violet-blue.

On heating formic acid or a formate with dimethylaniline and zinc chloride there results the leuco base of a violet, which is probably hexamethyltriamidotriphenylmethane.
—R. B. B.

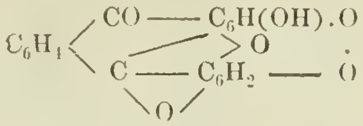
*Constitution of Coeruleïn.* M. Prud'homme. Bull Soc. Ind. Mulhouse, 1895, 72—75.

When coeruleïn is melted with aniline hydrochloride a colouring matter results, which yields bluish-greens with iron and chromium, and blue with aluminium mordants. But if the base, aniline, be substituted for its hydrochloride, 1 part of coeruleïn being heated with 3—4 parts of aniline and the excess of aniline distilled off, a violet powder with brownish-red reflex remains. The increase of weight corresponds to the fixation of two molecules of aniline and the loss of one molecule of water. If the product is dissolved in concentrated $H_2SO_4$ and diluted with water a blue solution is obtained, from which alkalis precipitate a green base soluble in dilute acids to a fine blue solution; the acetate of this base dyes wool, silk, and tannin-mordanted cotton in greenish-blue shades not fast to soaping.

Since this colouring matter cannot be fixed by mordants it is probable that the hydroxyl groups of the coeruleïn have disappeared, and as these are removed by the fixation of aniline, two hydroxyls have left the coeruleïn molecule. Buschka's formula, when modified to account for the loss of water in the transformation of galleïn into coeruleïn, only shows one hydroxyl group in the latter. But if the two OH groups of galleïn be preserved intact, coeruleïn must be—



and not—



(Buschka's formula.)

The existence of two hydroxyls in the coeruleïn molecule corresponds with its known properties. According to Liebermann and Kostanecki only these oxy-ketonic colouring matters are fixed by mordants, which contain two OH groups in the *ortho* position in the same benzene nucleus. But it would appear from the constitution of coeruleïn, as here indicated, that this rule might be extended thus:—Only those oxy-ketonic colouring matters which contain two hydroxyl groups in the *nearest relative position* are capable of application with mordants.—R. B. B.

*Difficulty in Detecting Chlorine in Methylene Blue; also Notes concerning Methylene Blue.* W. Lenz. Zeits. Anal. Chem. 1895, **34**, 39.

*See under* XXIII., *page* 772.

*Acid Compounds of some Natural Yellow Colouring-matters. Part I.* A. G. Perkin and L. Pate. Proc. Chem. Soc. 1895, [153], 126—127.

In a previous communication by one of the authors, in conjunction with J. J. Hummel (Ber., **15**, 2337), an account was given of some peculiar acid compounds formed by the action of mineral acids upon hæmatein and brazilein, the colouring-matters of logwood and brazilwood. In continuation of this work, the behaviour of acids towards various natural yellow colouring-matters has been studied, the results of which are embodied in the following table:—

| —— | $H_2SO_4$. | HBr. | HCl. | HI. |
|---|---|---|---|---|
| Quercetin | $C_{15}H_{10}O_7 \cdot H_2SO_4$ | $C_{15}H_{10}O_7HBr$ | $C_{15}H_{10}O_7HCl$ | $C_{15}H_{10}O_7 \cdot HI$ |
| Rhamnazin | $C_{17}H_{14}O_7 \cdot H_2SO_4$ | No action | No action | No action |
| Rhamnetin | $C_{16}H_{12}O_7H_2SO_4$ | " | " | " |
| Luteolin | $X \cdot H_2SO_4$ | " | " | " |
| Fisetin | $C_{15}H_{10}O_6H_2SO_4$ | $C_{15}H_{10}O_6HBr$ | $C_{15}H_{10}O_6HCl$ | .. .. |
| Morin | $C_{15}H_8O_6H_2SO_4$ | $C_{15}H_{10}O_7HBr$ | $C_{15}H_{10}O_7HCl$ | $C_{15}H_{10}O_7 \cdot HI$ |
| Catechin | No action | No action | No action | No action |
| Maclurin | " | " | " | " |

These compounds are produced in the form of lustrous orange or scarlet needles, which cannot be recrystallised without decomposition. On treatment with water, they are decomposed into the original colouring matter and free acid; and a similar result occurs when the hydrochloric acid compounds are heated for some time to 100°.

As is well known, the colouring-matters here studied belong to two different classes, only one of which therefore appears to combine with acids. Of these, fisetin and maclurin may be taken as types. A third class also exists, in which are included gentisein, the colouring-matter of gentian root (Tambor, *Inaug. Dissert., Leipzig,* 1894), and datiscetin, which is obtained from *Datisca cannabina* (Schunck and Marchlewski, *Annalen*, **277**, 261).

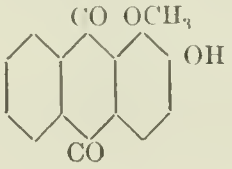
### *The Colouring and other Constituents contained in Chay Root. Part II.* A. G. Perkin and J. J. Hummel. Proc. Chem. Soc. 1895, [154], 150—151.

A previous examination of chay-root (this Journal, 1894, 244), showed that it contained rubichloric acid, two waxes, cane-sugar, ruberythric acid, alizarin, two dimethyl ethers of anthragallol (A) and (B), melting-point 209°, and 225°—227°; an alizarin monomethyl ether, and *m*-hydroxyanthraquinone. By the investigation of very large quantities of the root, 2 cwt. obtained through the Imperial Institute, two new substances have been isolated.

One substance, $C_{15}H_{10}O_4$, was obtained as orange-coloured needles melting at 232°. When heated with hydrochloric acid to 180° it yielded hystazarin, and was found to contain one methoxy group. It is therefore an *hystazarinmonomethyl ether.*

A second constituent, $C_{16}H_{12}O_5$, formed minute orange-red needles melting at 212°—213°, and its acetyl compound at 160°. It contained two methoxy groups, and by the action of hydrochloric acid at 180° was converted into anthragallol. It was consequently an anthragallol dimethyl ether, and it is interesting to note that chay root therefore contains the three possible dimethyl ethers of anthragallol.

Since the publication of the previous communication (*loc. cit.*), Schunck and Marchlewski (Trans. Chem. Soc., 1894, 182) have prepared the alizarin β-monomethyl ether from alizarin. This is not identical with that found in chay root, which must consequently be the α-compound—



The readiness with which this is decomposed into alizarin by boiling with dilute alkalis, readily accounts for its non-production by the usual methods.

## PATENTS.

### *Manufacture of Azo-Colouring Matters, Derivatives of the* 1:4 *α-Naphtholsulphonic Acid from corresponding Azo-Colouring Matters of Naphthionic Acid.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 14,056, July 21, 1894.

According to the method described, azo-colouring matters, which are obtained by combining a diazo- or tetrazo-compound with naphthionic acid, may be converted into the corresponding derivative of 1·4-naphthol sulphonic acid by heating with an aqueous solution of caustic potash in an open vessel from 120° to 150° C. In some cases, especially with the tetrazo colouring matters, it is necessary to use caustic alkali by itself without the addition of water, and also to employ a higher temperature, but in no case does this exceed 200° C. The method presents distinct advantages over those now in use, since the azo colours from 1·4-naphthol sulphonic acid are much more easily produced from the naphthionic acid colours than is 1·4-naphthol sulphonic acid from naphthionic acid itself. The two following examples illustrate the method:—1 kilo. of the colouring matter, obtained by combining diazotised naphthionic acid with naphthionic acid, is mixed with 3 kilos. of 40 per cent. caustic potash solution, and heated with constant agitation in an open vessel to 130°—140° C. Ammonia is given off and the heating is continued for about half an hour. The melt is then dissolved in water, neutralised with hydrochloric acid, and the colouring matter, "fast red," is precipitated with salt. In a similar manner, azo-orseilline can be obtained by fusing 1 kilo. of Congo red with 2—3 kilos. of caustic potash at 160°—170° C., with constant agitation for about one hour, until ammonia is no longer evolved, the melt being worked up in the usual manner.—T. A. L.

### *Manufacture of α, β, Naphthylamine Sulphonic Acid.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 15,067, August 7, 1894.

By heating the salts of β-naphthylamine *o*-sulphonic acid to 200°—230° C., they are converted into the salts of β-naphthylsulphamic acid, whilst those of α-naphthylsulphamic acid behave differently, being converted at a much lower temperature into the salts of α-naphthylamine *o*-sulphonic acid. Thionaphthamic acid or α-naphthylsulphamic acid was obtained by Piria, together with naphthionic acid by heating α-nitronaphthalene with aqueous alcoholic ammonium sulphite. A better method is that of Traube (Ber. **23**, 1653 and **24**, 360), which consists in reacting on an excess of α-naphthylamine in presence of a solvent with chlorosulphonic acid, sulphuric anhydride, or with fuming sulphuric acid. The α-naphthylsulphamic acid is separated as ammonium salt, and this by the action of caustic soda or sodium carbonate is converted into the sodium salt which is sparingly soluble in cold water, or it can be separated in anhydrous laminæ by the addition of salt. In order to convert it into 1·2-naphthylamine sulphonic acid, the well-dried sodium salt of the α-naphthylsulphamic acid is heated in a current of dry carbonic acid gas to 185°—190° C. until a sample dissolved in water, boiled with hydrochloric acid and supersaturated with caustic soda, no longer contains α-naphthylamine. A higher temperature can also be employed as the 1·2-naphthylamine sulphonic acid salt can be heated to 240° C. without decomposition, and on the other hand the transformation can take place, although more slowly, at 170° C.—T. A. L.

### *The Manufacture of New Dyes of the Rhodamine Series and Intermediate Products and Leuco-compounds related thereto.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 15,859, August 20, 1894.

Under suitable conditions, chloral hydrate and a dialkylated *m*-amidophenol can be condensed in such a manner that the ultimate product of the reaction is a colouring matter of the rhodamine series. The reaction takes place in four stages as follows:—1. The dialkylated *m*-amidophenol and chloral hydrate combine in equimolecular proportion with elimination of one molecule of water. The resulting product is colourless and insoluble in water, but may be crystallised from alcohol, acetone, chloroform, or benzene. 2. One molecular proportion of the condensation product so obtained, when heated under suitable conditions, combines with another molecular proportion of a dialkylated *m*-amidophenol. 3. The product so obtained is a leuco base, which on oxidation gives a blue colouring matter. The oxidation may be carried out by exposing the leuco base to the action of the air in presence of ammonia, but it is preferable to carry out the oxidation in solution by the use of ferric chloride, chromic acid, peroxides, or the like. 4. These blue colouring matters when heated in solution are rapidly converted into rhodamines, and since different dialkylated *m*-amidophenols can be used in the second stage, from those employed for the first condensation, the process is applicable for the production of asymmetrical rhodamines of a new series which hitherto have not been practically obtainable. The following example describes the method employed for obtaining such a rhodamine. Molecular proportions of chloral hydrate and dimethyl-*m*-amido phenol are ground together for about half-an-hour. The mixture first liquefies and then becomes solid. One molecular proportion of diethyl-*m*-amidophenol is then ground in and the product after spreading in thin layers on trays, is heated for 12 hours at a temperature which is gradually raised from 40° to 70° C. After powdering, the leuco base so formed is suspended in 50 times its weight of water and dissolved by carefully adding dilute acid. A 5 per cent. solution of ferric chloride is then run in with constant agitation until no further formation of colouring matter takes place, which is determined by salting out the colouring matter and adding ferric chloride to the filtered solution. When this is the case, salt or sodium nitrate is added and a blue colouring matter is obtained as a hydrochloride or nitrate. It dyes tannined cotton, blue shades which turn reddish. In order to convert it into the unsymmetrical rhodamine, the blue colouring matter, preferably as hydrochloride, is dissolved in water and allowed to stand for 12 hours or until the desired change has taken place. This is determined by adding sodium acetate to a sample and extracting with ether, when, if no blue colouring matter is extracted, the change is complete. On adding dilute nitric acid until the colour of the solution has changed from red to bluish-violet, shining green crystals of the new rhodamine separate out. The new colouring matter dissolves in water and alcohol giving bluish-red solutions with a yellow fluorescence. It dyes wool bluish-red and tannined cotton violet-red shades.

—T. A. L.

*Improved Manufacture of Colouring Matters Dyeing Blue with Mordants.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 16,530, August 30, 1894.

This is an extension of Eng. Pats. 23,311 of 1893, and 9856 of 1894 (this Journal, 1894, 1189, and 1895, 478). In connection with the colouring matters referred to, it has been found that the *o*-naphthoquinone compounds employed in the second of the above specifications, may be replaced by hydroxy-*o*-naphthoquinones and their sulphonic acids. These products may be obtained by treating nitroso-dihydroxynaphthalenes with sodium bisulphite and oxidising the resulting dihydroxynaphthalene disulphonic acids to the corresponding quinone compounds. The nitroso derivative from 29 kilos. of ethyl-benzylaniline sulphonic acid is reduced to ethyl-benzyl-*p*-phenylene diamine sulphonic acid, and an alkaline solution of this compound has added to it, with constant agitation, 43·5 kilos. of 2′.1.2.4-hydroxynaphthoquinone sulphonic acid. The condensation product is salted out, filter-pressed, and dried. In order to convert it into a blue dyestuff, 20 kilos. of it and 4 kilos. of flowers of sulphur are dissolved in 160 kilos. of fuming sulphuric acid containing 23 per cent. of $SO_3$. The mixture is well stirred, heated to 40°—60° C. for 4—6 hours, and poured into ice-water. The solution is then gently warmed, when a precipitate separates out. This is filtered off, re-dissolved in dilute soda solution, again filtered, and the dyestuff precipitated from the filtrate by salt. It gives blue shades on chrome mordanted wool, fast to light, acids, and alkalis.—T. A. L.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*The "Mercerisation" of Cotton.* A. Scheurer. Bull. Soc. Ind. de Mulhouse, May 1895, 125.

Mercer, in his patent of 1851, recommends that the caustic used shall be cold and concentrated. The author in 1883 studied the action of caustic soda on the cotton fibre under varying conditions of concentration, time, and temperature, with results as tabulated below:—

| —— | | | Contraction Produced by Mercerisation. | Length at Moment of Rupture. | Resistance. |
|---|---|---|---|---|---|
| *Caustic Soda 38° B.* | | | | | |
| 0. | Untreated tissue ..... | | 100·0 | 120 | 100 |
| 1. | At 20° C. | 1 minute.. | 83·5 | 106 | 120 |
| 2. | | 5 minutes. | 83·5 | 106 | 120 |
| 3. | | 20 minutes. | 83·5 | 106 | 120 |
| 4. | At 50° C. | 1 minute.. | 85·0 | 108 | 120 |
| 5. | | 5 minutes. | 86·0 | 110 | 116 |
| 6. | | 20 minutes. | 85·0 | 108 | 120 |
| 1,000 *grms. Caustic Soda at* 38° B. + 150 *grms. of Dry Caustic Soda.* | | | | | |
| 7. | At 20° C. | 1 minute.. | 86·0 | 110 | 116 |
| 8. | | 5 minutes. | 84·5 | 107 | 120 |
| 9. | | 20 minutes. | 84·0 | 107 | 120 |
| 10. | At 50° C. | 1 minute.. | 82·0 | 102 | 122 |
| 11. | | 5 minutes. | 82·5 | 103 | 122 |
| 12. | | 20 minutes. | 86·0 | 110 | 116 |
| 750 *grms. Caustic Soda at* 38° B. + 250 *grms. of Water.* | | | | | |
| 13. | At 20° C. | 1 minute.. | 84·5 | 107 | 11 |
| 14. | | 5 minutes. | 84·0 | 107 | 120 |
| 15. | | 20 minutes. | 86·0 | 110 | 116 |
| 16. | At 50° C. | 1 minute.. | 84·5 | 107 | 11 |
| 17. | | 5 minutes. | 86·5 | 110 | 115 |
| 18. | | 20 minutes. | 82·5 | 103 | 122 |
| 500 *grms of Caustic Soda at* 38° B. + 500 *grms. of Water.* | | | | | |
| 19. | At 20° C. | 1 minute.. | 86·5 | 110 | 115 |
| 20. | | 5 minutes. | 87·0 | 112 | 113 |
| 21. | | 20 minutes. | 86·0 | 110 | 116 |
| 22. | At 50° C. | 1 minute.. | 93·0 | 118 | 106 |
| 23. | | 5 minutes. | 92·0 | 117 | 108 |
| 24. | | 20 minutes. | 92·0 | 117 | 108 |
| 25. | At 90° C. | 1 minute.. | 95·0 | 121 | 105 |
| 26. | | 5 minutes. | 95·0 | 121 | 104 |
| 27. | | 20 minutes. | 93·0 | 118 | 106 |

The length of the untreated tissue is taken at 100 and the other measurements are compared with this standard. Similarly, the resistance to rupture is also compared with that of the untreated cotton taken at 100, the experiments being made on the weft of the tissue with bands containing an equal number of threads.

The above numbers show that a lye of a concentration beyond that of 750 grms. soda 38° B. + 250 grms. of water, does not sensibly increase the contraction of the fibre, that an immersion of one minute is sufficient to complete the action, and they confirm Mercer's observation that the action, proceeds most effectively in the cold. The numbers given must not be taken as absolute, being true only for the particular tissue (68 *portées alsacien*), and will vary with the nature of the cotton and the twist of the thread.

—W. E. K.

*Silk Coating for Cotton Fabrics.* Trade Journals Review. July 1895, 20.

The proposal has frequently been made to "ennoble" cotton fabrics, by chemically coating them with a layer of silk.

The process comprises several distinct and, in part, preparatory operations. The first is that of "mercerising" with acid or alkali, the second impregnating with silk solution, the third the precipitation of the silk, and the fourth the polishing. Previous to mercerising the cloth is boiled, calendered, and beetled. It then passes on a stretch, and, guided by a system of drawing and squeezing rollers, goes through sulphuric acid of about 1·53 sp. gr., contained in a shallow-jacketed iron vessel, and kept at 5°—8° C. The rollers, submerged in the acid, are glass, porcelain, bronze, or lead-lined. Those fixed above the bath, and arranged for the purpose of squeezing out the superfluous acid, are rubber. Pressure and speed are regulated according to the weight of the fabric, one yard of cloth passing in from five to 30 seconds. Leaving the squeezing rollers the cloth at once plunges into a lead-lined wooden tank, divided into several compartments, all of which are traversed, whilst a constant stream of water flows in the direction opposite to the travelling fabric. When every trace of the acid is thus washed away, the cloth is fixed upon a tenter frame where it is dried on the stretch, whilst alternate jerking movements of the bands or chains of the frame replace each thread in its proper place. Calendering and beetling follow.

Instead of sulphuric acid, caustic soda or potash free from carbonate, of about 1·35—1·4 sp. gr., and at 4°—8° C. may be employed. Manipulation remains the same, but the material for the rollers and tanks has to be selected. The essential feature of the process is of course the preparation of the silk solution. Concentrated solution of silk is obtained economically with hydrochloric or sulphuric acid, with caustic potash or soda; or ammoniacal copper solution may be used in preference. Mr. Kayser observes that "after all it is simply a question of the dissolving power of hydrated oxide of copper, obtained by careful precipitation of a cold and dilute copper salt with one equivalent of caustic alkali, filtering and washing in strong ammonia at a low temperature, and to the point of saturation." The solution is finally strained through asbestos cloth into a jacketed vessel, fitted with an agitator. Then at 8° C. silk of any kind is added gradually until a point is reached when the last handful ceases to swell up. The agitation is continued and the thick pasty mass gradually becomes fluid, when it is in the proper condition for use. It is then transferred to a box furnished with guiding rollers, and with a cover having slits for the admission and egress of the fabric. Cloth prepared as indicated runs through the silk fluid, and immediately on leaving the bath enters a hot flue, where both the ammonia and the water evaporate, leaving a deposit of oxide of copper and of silk. From the former the fibre is freed by running the cloth through dilute acid and thence through the washing machine. Drying on the frame finishes this part of the process, unless the manipulation is repeated to provide a particularly heavy silk covering. The cloth may now be bleached either by stoving or with peroxide of hydrogen, as is customary, or the silk may be dyed or printed. It has, however, whatever course be adopted, to undergo mechanical treatment, such as calendering, beetling, and polishing before the full lustre can be developed. In order to be able to do the work with due regard to economy, it is necessary to take steps for the recovery of the copper and ammonia used in the process. Of course other solvents beside ammoniacal copper hydrate can be used. Solutions of silk in caustic alkali and sulphuric acid, respectively, would be found to co-operate successfully. They are placed in separate vessels, and the fabric is passed through each in turn. The alkali which adheres from the first bath becomes neutralised in the acid, with the result that the silk substance is precipitated upon the fibre.

### PATENT.

*Improvements in the Method of Producing Ornamental and other Designs upon the Surface of Textile and other Fabrics.* L. Mistovski, Heywood, Lancashire. Eng. Pat. 1297, January 19, 1895.

This patent refers to the ornamentation of ordinary single-texture waterproof fabrics. To the fabric is given a coat of shellac in ammoniacal or other suitable solution, and on this, before or after vulcanisation, any design may be printed in the usual way, a coating of transparent rubber solution being afterwards applied as a protection.—F. H. L.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*New Methods for the Production of Azo Colours on Cotton, Woollen, and Silk Fabrics.* J. Pokorný. Bull. Soc. Ind. de Mulhouse, May 1895, 137—139.

The author has previously shown that cotton prepared with tannin and tartar emetic has the property of absorbing and fixing certain diazo- and tetrazo-compounds. Such a prepared tissue is, for example, coloured brown by the diazo compound of α-naphthylamine, orange by the corresponding β-compound, and brown by the tetrazo-compound of dianisidine. These colours resist a strong washing with cold water. The dianisidine compound combines on the fibre with the naphthols, amines, &c., giving a deep violet with β-naphtholate of soda and a dark puce with the hydrochloride of toluylene diamine. These new colours resist soap well. The author has found that wool and silk exhibit a similar property of absorbing diazo- and tetrazo-compounds and combining on the fibre with naphthols and amines, and that cotton prepared with tartar emetic, also wool and silk, will in like manner absorb diamines from their aqueous solutions; for instance, the hydrochlorides of dianisidine and toluylene diamine, which may then be diazotised and combined with naphthols, &c., on the fibre. The author finds further that cotton prepared with an alkaline sulpho-ricinate behaves exactly in these respects as if prepared with tannin and tartar emetic.

—W. E. K.

*Method of Printing Alkaline Cœruleïn and Alizarin-Blue Colours on Turkey Red.* F. Binder. Bull. Soc. Ind. Mulhouse, May 1895, 136. (Sealed note of April 29, 1886.)

The process is based on the reduction of the colours by zinc in presence of caustic soda. The colours are dissolved in caustic soda at 38° B., the zinc is then added, and the mixture, after lying 12 to 24 hours, is thickened by means of British gum and gum dragon. After printing, the pieces are steamed 4 or 5 minutes, washed off, and soaped at the boil. In the case of the Cœruleïn colour it is advantageous to chrome after steaming. A similar result may be obtained by reducing the ordinary bisulphite compounds of the colours by means of zinc and then adding the caustic soda.

—W. E. K.

*Discharge Effects produced by means of Chlorates and Prussiates.* P. Jeanmaire. Bull. Soc. Ind. Mulhouse, May 1895, 134. (Sealed note of April 2, 1885.)

The method is based on the action of the chlorates upon the prussiates at 80° to 100° C., observed by the author six or seven years previously, and is applied to the discharging of colours in general, but in particular of vat indigo blue. The white discharge is effected by means of the chlorates of soda, baryta, &c., applied at a suitable strength with an admixture of 4 to 20 grms. ferricyanide of potassium per litre of printing-colour. For red discharge, chlorate of aluminium is used with the ferricyanide, and by preference a persalt of tin is also added. After printing, the tissue is steamed in a Mather-Platt steamer, and then washed, dyed, &c., as usual. The discharge may also be used with pigment colours. It may be applied to the discharge of alizarin blue and most colours fixed by means of oxide of chrome. The action is said to be due to the alternate reduction of the ferri- to ferrocyanide, and its re-oxidation by means of the chloric acid.—W. E. K.

### PATENTS.

*Improvements in or appertaining to Dyeing Machines.* M. Cockroft and S. J. Pegg, Leicester. Eng. Pat. 14,334, July 26, 1894.

This machine is designed for the dyeing of yarn or of tacked lengths of hose or socks. By means of an arrangement of rod-carrying blocks and rod-grips or jaws, in conjunction with an endless chain, the rods bearing the yarn, &c. are carried through the dye-bath. The yarn is partially immersed when in the upper line of traverse, and wholly below the surface of the liquid when in the lower line. When the extremity of each circle of motion is reached, the rod-grips automatically open to allow of the removal of the rods or their transference to a washing-off machine. Economy of steam and dyestuff is claimed.

—R. B. B.

*Improvements in Kiers or Vessels for Bleaching Textile Fabrics.* B. Walsh, Manchester. Eng. Pat. 14,374, July 26, 1894.

The improved kier is intended for the use of caustic soda instead of lime and sodium carbonate. In combination with an ordinary kier, is an auxiliary chamber for use as a reservoir. In this vessel the liquor is heated by means of steam coils to the desired temperature, and circulated thence through the kier. The vessel is connected with the kier by two pipes, to one of which is attached a circulating pump.

The necessity for pipes or coils in the kier is obviated, and other advantages claimed are greater economy of working, a saving in chemicals, steam, labour, and water, and a greater production, with a thorough bleach and no tender cloth.—R. B. B.

*Improvements in Dyeing certain Colours on Cotton Yarns and Fabrics.* H. Wylie and J. Morton, Renton. Eng. Pat. 15,433, August 14, 1894.

A MIXTURE of the oxides of iron and chromium is fixed on cotton by passing through a bath containing the bisulphites of those metals. Fixation is completed by drying and steaming, or by means of phosphate or carbonate of soda. The shades vary from olive-green to olive-brown, according to the proportions of the two ingredients.
—R. B. B.

*Improvements in and relating to the Printing of Cotton Fabrics.* W. E. Kay and The Thornliebank Co., Lim., Glasgow. Eng. Pat. 19,388, October 12, 1894.

THIS invention has for its object, the production of printed fabrics, of which certain parts have a crinkled appearance, due to "mercerisation" of the remaining portions. The fabric is first printed, in the parts which are to appear crinkled, with a gum resist, or resist and colour. This is followed by an all-over application of caustic soda, with or without colour, whereby those portions not covered by the resist are mercerised and shrunk. The printing of strongly caustic colours is thus avoided, and the necessity for registering the background print against the pattern, as in the direct printing method, is removed.—R. B. B.

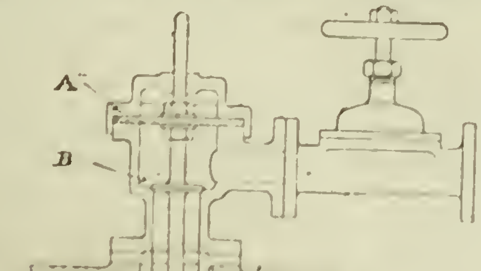
*Improvements in or relating to Printing in several Colours by one Impression.* F. Barnwell, Manchester. Eng. Pat. 20,423, October 25, 1894.

ORDINARY printing inks are treated with three mixtures successively. The first contains castor oil, turpentine, glycerin, oil of tar, and copaiba balsam. The second consists of sulphuric ether and chloroform, the third of liquid ammonia, spirits of ammonia (arom.), and ipecacuanha. After pouring off any liquid, the ink is ready for use. Inks of various colours so prepared, may be used side by side on the same inking roller without in the least flowing sideways and mixing with one another, and thus several colours may be printed in one impression.—R. B. B.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Automatic Acid Egg Air-Valve.* Chem. Trade J. **429**, 82.

BY the use of this valve the air is instantly and automatically shut off, thus preventing waste. The acid entering the egg tends to lift the wooden float C (which barely touches the bottom when the egg is empty), and this lifts valve B. When the egg is full, and the necessary connections opened to direct the liquid where required, the air-tap attached to the automatic valve is opened, the compressed air rushes in, acting both on rubber diaphragm A and valve B, which, being open, allows the air to pass down and force the acid out of the egg. As the last few inches of liquor descend, the float does the same, and the valve B, being in perfect equilibrium, is shut, cutting off the air-supply. The air-tap must, of course, be shut by the attendant before refilling. By lifting or depressing the projecting spindle end, it will be ascertained at once if the valve is working rightly.



*New Method for the Gas Volumetric Determination of Nitrogen in Nitrates.* F. Gantter. Zeits. Anal. Chem. 1895, **34**, 25.

*See under* XXIII., *page* 770.

*New Volumetric Method for the Determination of Phosphoric Acid in its Pure Solutions.* R. Segalle. Zeits. Anal. Chem. 1895, **34**, 33.

*See under* XXIII., *page* 770.

*Use of Chromates for the Absolute Prevention of Boiler Incrustation.* A. Niesko. Wochenschr. f. Brauerei, 1895, 215.

*See under* I., *page* 736.

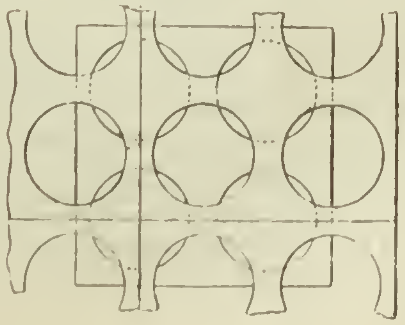
### PATENTS.

*Improvements in or relating to Condensing Towers.* E. J. Barbier, Paris. Eng. Pat. 14,014, July 20, 1894.

EACH tower, whether one or a series is used, may be provided with a central vertical cooling shaft, admitting through-passage of cold air. At a convenient height from the bottom, immediately above the inlet opening, a perforated plate is placed to support a series of bells or inverted cells formed with perforated ends, arranged to fill the space between the shaft and the walls of the tower up to near the top. The cells are preferably of cylindrical or truncated conical shape, formed with a number of walls, the perforated ends being made concave and of basin shape, the better to retain any solid particles that may be carried over. These cells facilitate condensation by cooling and by producing multiplied eddying currents of the vapours or gases about moist surfaces. Towers used in series are connected by pipes, each pipe leading from the top of one tower to near the bottom of that next it. When gases are to be dissolved or washed, a suitable liquid is caused to flow upon the superposed cells. If metallurgical fumes are being treated, the cells are removed from time to time to remove the condensed products. Each tower is provided with an outlet pipe at the bottom, for flow of liquid into a suitable vessel.
—E. S.

*Improvements in the Filling of Towers used in the Purification of Acid, and for such like Purposes.* H. L. Doulton and L. E. Saneeau, Lambeth, Surrey. Eng. Pat. 14,767, August 1, 1894.

EARTHENWARE tiles or bricks having holes formed vertically through them, are used to replace coke for charging the towers described in the title. A convenient size for the blocks is about 9 ins. square by 4 or 5 ins. deep, each



having four holes of 3 ins. or more across. When such blocks are piled up so as to break joint in successive layers, small openings will be left, though not in a vertical line with those above and below. The holes may be round or square. The illustration given, shows the manner of piling the blocks.—E. S.

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*Improvements in or relating to the Manufacture or Treatment of Bicarbonate of Soda.* W. L. Wise, London. From Solvay and Co., Brussels, Belgium. Eng. Pat. 14,985, August 4, 1894.

The sodium bicarbonate produced by the ammonia-soda process is, in its wet state, placed in a cylinder having a pervious false bottom to drain. When no more mother-liquor passes off, a quantity of water, or preferably of solution of pure bicarbonate, equal in volume to the ammoniacal mother-liquor retained by the drained salt, is added, without agitation. The supernatant liquid then displaces the mother-liquor, "molecularly, so to speak, and in the order of the densities of the liquids present." The bicarbonate thus washed, is allowed to flow into a trough, within which a hollow cylinder is mounted so as to revolve horizontally. The cylinder has solid ends and a periphery of perforated sheet metal coated externally with a filtering medium, such as metallic cloth covered with flannel. A partial vacuum, of about 25 to 30 centimetres of mercury, is produced within the revolving cylinder, and the bicarbonate in the trough is kept in agitation. The crust of nearly dry bicarbonate that forms upon the cylinder, is removed from time to time by a scraper, for transference to a suitable receptacle.—E. S.

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*Improvements in or relating to the Manufacture of Bleaching Powder and other Hypochlorites.* W. L. Wise, London. From E. Solvay, Brussels, Belgium. Eng. Pat. 14,986, August 4, 1894.

When sodium chloride is electrolysed for the manufacture of caustic soda, the evolved hydrogen and chlorine are mixed, as produced in many forms of apparatus, and such a mixture is liable to have the gases present in such pro-proportion as to be explosive, either by contact with a flame, or under the influence of light. It is found that the presence of hydrogen does not interfere with the absorption of chlorine by lime; but with the mixture of gases described, it is preferred to employ small continuous-action chlorinators, such as a revolving cylinder arranged with its axis at a slight inclination to the horizon, and having internal helical ribs.

Another process, by which all risk of explosion of the gaseous mixture is obviated, and which permits of using ordinary chlorinating chambers, consists in collecting the practically pure hydrogen issuing from the outlet to the chambers, and mingling it with the entering gaseous mixture. The excess of hydrogen thus added, renders the mixture non-explosive. In the manufacture of other hypochlorites, in which the gases are passed through a liquid, the mixture of electrolytic chlorine and hydrogen may be used without inconvenience.—E. S.

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*Improvements in or relating to the Separation of Caustic Alkalis from the Liquors obtained by the Electrolysis of Alkaline Salts.* W. L. Wise, London. From Solway and Co., Brussels, Belgium. Eng. Pat. 14,987, August 4, 1894.

Only about 10 per cent. of caustic alkali is stated to be usually obtained in the electrolysis of alkaline chlorides, and the object of the invention is to effect the separation of such unconverted chlorides. The solution may be concentrated until the chloride separates, and the mixture of salt and caustic solution then treated as described below. But preferably, a strong solution of caustic soda, of about 40° B., is added to the original solution, to cause precipitation of the chloride. The soft mud thus produced, is placed in a cylinder jacketed for steam-heating, and provided with a permeable false bottom, with a device for admitting the washing liquid at its upper part, and with a discharging device at its lower part. Saturated brine, equal in volume to the caustic solution to be displaced, is admitted in such manner as not to agitate the contents, and the discharge-cock at the bottom of the vessel is opened, when the "caustic solution is expelled practically in successive horizontal layers, and is replaced by the salt water without any mixture taking place." The discharge-cock is closed in time to prevent flow of the brine. The process is carried out at a temperature of about 100° C., obtained by passing steam through the jacket to the cylinder. The slight causticity of the mother-liquor (the washing brine) does not interfere with its fitness for a succeeding operation.—E. S.

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*A Process for obtaining Cyanogen or its Compounds from the Gases resulting from the Dry Distillation of Substances of Organic Origin.* H. Drehschmidt, Berlin. Eng. Pat. 16,149, August 24, 1894.

*See under* III., *page* 742.

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*Manufacture of Alkaline Cyanides and Ferrocyanides.* G. Kraemer, Berlin. Eng. Pat. 16,529, August 30, 1894.

Anthracene residues, rich in carbazol, are heated with a proportional quantity of caustic potash or soda, in a cast-iron vessel, the temperature necessary to obtain potassium carbazol being 260° to 280° C., and about 60° higher for the sodium salt. The melt is run into suitable moulds, and, after cooling, the cake of potassium (or sodium) carbazol is readily separated from the upper layer of solid anthracene hydrocarbons. The proportions used to obtain the potassium carbazol are, 200 parts of anthracene residue containing 40 per cent. of carbazol, and 30 parts of potassium hydroxide.

The crude potassium carbazol is converted into potassium cyanide, with separation of carbon, by heating to bright redness in a suitable vessel, the addition of a little potash assisting the reaction. It is stated that 50 per cent. of the nitrogen of the carbazol is thus converted into cyanide. If a ferrocyanide be required, iron powder is added to the carbazol compound which is to be converted. Similar results are obtained with sodium carbazol, but the temperature of reaction is higher.—E. S.

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*Improvements in or connected with the Transport of Sulphuric, Hydrochloric, Nitric, and other Corrosive Acids.* R. England, London. Eng. Pat. 16,536, August 30, 1894.

Suitable neutral absorbent substances, such as kieselguhr, peat, &c. are to be used, instead of the whiting, sawdust, ashes, &c., stated to be ordinarily used for packing bottles or vessels containing such acids—E. S.

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*Improvements in the Treatment of Alkaline Salts, or the Salts of Alkaline Earths.* J. Y. Johnson, London. From N. Basset and W. de Baranoff, Paris. Eng. Pat. 21,447, November 7, 1894.

Sodium chloride, mixed in a moist state with sand or the like, is moulded into balls, which, when dried, are acted upon in heated apparatus (which is described) with dry air and sulphurous acid gas if chlorine is to be obtained as a by-product, or with steam and sulphurous acid gas when hydrochloric acid is to be produced. Solution of the sodium sulphate thus obtained, is decomposed by calcium di-hydrogen phosphate by aid of heat and agitation, to produce the corresponding sodium phosphate and calcium sulphate. The sodium phosphate solution is precipitated by milk of lime to throw down tri-calcium phosphate, to be again utilised in the process, solution of caustic soda being thus obtained, which may be saturated with carbonic acid, produced in another stage of the process, hereafter described, to obtain sodium bicarbonate, from which other sodium salts are producible by usual means.

Calcium sulphate, either natural or a by-product in the above-described processes, is heated with carbon in a retort. The carbonic acid gas evolved is stored for use, and the calcium sulphide is moistened and treated in a close chamber with carbonic acid gas. The hydrogen sulphide given off is burned into sulphurous acid, for application in the first-mentioned process. Part of the sulphurous acid is also applied to obtain the soluble calcium phosphate used in decomposing sodium sulphate, the process consisting in agitating powdered tri-calcium phosphate with heated water whilst the sulphurous acid gas is injected. The solid product, calcium sulphite, is used with or in place of calcium sulphate, in obtaining carbonic acid gas, calcium sulphite, and sulphurous acid in succession.

The described processes are equally applicable in treating potassium chloride, which, however, is obtained as carbonate instead of as bicarbonate.—E. S.

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*Improvements in the Manufacture of Sulphuric, Nitric, and Nitrous Acid, and of Sulphate of Soda, Oxide of Iron, and Alumina.* W. Garroway, Glasgow, N.B. Eng. Pat. 2466, February 5, 1895.

A MIXTURE of ferrous sulphate and sodium nitrate in equivalent proportions, is heated to dull redness in an iron pot or retort such as is commonly used in the manufacture of nitric acid. Sodium sulphate and ferric oxide are formed, whilst nitric acid, accompanied by nitrous acid, is volatilised. The acid vapour may be led into sulphuric acid chambers, for use there, or may be recovered by condensation. Sodium sulphate is lixiviated out of the fixed residue, and the solution concentrated to obtain Glauber's salt. The ferric oxide remaining is stated to be of superior quality for application as a pigment.

Aluminium sulphate or alum may be substituted for ferrous sulphate in the process, in which case the residue contains alumina, which is separated from sodium sulphate by dissolving out the latter.—E. S.

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*Improvements in and connected with the Manufacture of Alkaline Carbonates.* W. von Baranoff, Paris. Eng. Pat. 9555, May 14. 1895.

THE difficulty experienced in obtaining an approximately complete decomposition of barium sulphate into sulphide when the former is heated, as is usual, with carbon in excess, is stated to be due to the use of the excess of carbon. The inventor, therefore, heats an intimate mixture of finely-ground barium or strontium sulphate with only the theoretically necessary quantity of carbon, or thereabouts, as required by the equation $BaSO_4 + 2C = BaS + 2CO_2$.

The barium or strontium sulphide thus obtained is finely ground, and treated, as far as possible, out of contact of air, with solution of an alkaline sulphate, and without filtering, carbonic acid gas is directly passed in, hydrogen sulphide being evolved. The solution of alkaline carbonate obtained may then be separated, and the barium or strontium sulphate reproduced be used for regenerating the sulphide formed in the first reaction. This procedure is adopted to prevent the formation of hyposulphite, thiosulphate, or the like.—E. S.

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*Process of Manufacturing Alkaline Bichromates.* M. W. Beylikgy, Tenafly, New Jersey, U.S.A. Eng. Pat. 9558, May 14, 1895.

FINELY ground chrome ore is mixed with lime, and "an oxygenated compound of the radical metal of the alkali," of which it is desired to obtain the bichromate; the mass is formed into bricks, and roasted at about the temperature of melting silver, until the neutral chromate of the alkali is fully formed; the mass is then kept at a higher temperature until the reaction is completed, as indicated by the colour or by chemical tests. On lixiviating the cooled roasted mass, the double chromate of lime and the alkali under treatment passes into solution. The solution of double chromate is fed into a coarse filter, preferably of asbestos, impregnated with an insoluble fatty acid, such as oleic acid. The lime constituent is withdrawn by the fatty acid, forming a calcareous soap, and solution of the alkaline bichromate filters through, and may be concentrated to obtain solid bichromate. The filter after washing, is treated with dilute hydrochloric acid and the calcium chloride formed washed through; the regenerated fatty acid remaining on the filter, can then be used again.—E. S.

## VIII.—GLASS, POTTERY, ENAMELS.

*The Expansion of Ceramic Pastes and Glazes.* H. Le Chatelier, Bull. de la Soc. d'Encouragement pour l'Ind. Nat. February 1895, 181—184.

ONE of the most difficult problems in the manufacture of porcelain and pottery, is to obtain glazes perfectly adapted to the pastes used. When this is not the case, they expand unequally on heating, and cracks are produced in the glaze. With the object of discovering the relation between the chemical composition and the expansion, the author has examined different varieties of silica, clay, and baked porcelain.

The expansion of quartz and quartz sand on heating is shown graphically, being measured on a millimetre scale.

It is also shown for different varieties of silica, but there is a little uncertainty in the relative expansion of the amorphous silica and tridymite, on account of the presence of the lime used to agglomerate them. The general law appears to be that all varieties of silica, with the exception of amorphous silica, at certain temperatures show abrupt changes in dimension, and these are also likely to occur, though to a less extent in ceramic pastes, all of which contain free silica.

The expansion of a number of ceramic pastes and glazes, is also represented graphically. Porcelain alone shows expansion, increasing regularly with the temperature, which seems to indicate that the partial vitrification has led to the transformation of the quartz into amorphous silica. A specimen of Saxony porcelain also showed a very feeble expansion—about 7 per cent. The stoneware from Vosges clay was baked in the laboratory, the temperature and length of time of baking being less than is given in the industrial process. It is probable that the greater part of the quartz did not change its condition, which no doubt accounts for its difference from porcelain in this respect. The Bordeaux earthenware was made from a very pure Dordogne clay, which contained about 10 per cent. of quartz. It was baked for three hours at 1,500° C. The Nevers earthenware was baked at 1,000° C, the normal temperature for this variety. The presence of lime accounts for its greater expansion; paste of this kind contains about 25 per cent. of calcium carbonate. The curves in the case of the different ceramic pastes must only be regarded as provisional, since the experiments were not sufficiently exact to allow the angular points in the expansion curves to be indicated, although these must have existed in most, on account of the presence of quartz.

The curves of expansion of glazes are very regular, the coefficient of expansion increasing very slightly with the temperature—C. A. M.

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*Adhesion of Aluminium and other Metals to Glass.* Charles Margot, Arch, des Sciences, Phys. et Nat., Geneva, 1895, 161. Proc. Inst. Civil Eng. **121**, iii., 1895, 105.

*See under X., page 753.*

### PATENTS.

*Improved Methods of Preparing Transfers for Use in Decorating Pottery Ware.* J. C. Bailey, Stoke-on-Trent. Eng. Pat. 11,875, August 3, 1894.

THE required design is produced upon a lithographic stone, and transfers obtained in lithographic varnish upon transfer paper in the usual way, and the design is then imprinted on the ware, dusted with the requisite colours and fired. The application of two or more colours may be facilitated by the use of suitable stencils.—B. B.

*Improved Methods of Obtaining Prints or "Transfers" of Designs, Patterns, or Pictures, and Reproducing such Designs, Patterns, or Pictures upon the surface of China, or the like Articles.* Sir H. Doulton, Lambeth, and J. Slater, Burslem. Eng. Pat. 15,041, August 7, 1894.

The design is painted in Brunswick black on glass and reproduced photographically upon gelatin, a gelatin printing surface being ultimately obtained in the usual manner. Mercuric oxide or "ammoniated mercuric chloride" is spread upon the printing surface and transfers obtained and transmitted on to the vitrified surface of china or earthenware. Colours are then dusted on with or without the aid of stencils, and the ware fired. The design may also be transferred to copper, the plates then etched with acid and transfers in mercuric oxide obtained therefrom and used as before.—B. B.

*Improvements in the Manufacture of Glass Plates.* T. Lefévre and L. Michau, Paris, France. Eng. Pat. 9714, May 16, 1895.

Glass is cast upon a table and a second layer of glass of a different colour then cast upon the first, the thickness of each element of the compound sheet being determined by the vertical height of its allotted roller, by the traverse of which the plastic mass is spread. Designs may be impressed upon the glass through one or more of the several layers forming the compound sheet. The designs are produced by the use of a descending plate bearing the device desired and moving with its lower face strictly parallel to the table. The designs may extend completely through the sheet of glass and the recesses produced may be filled in with coloured enamels.—B. B.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### PATENTS.

*An Improved Composition and the Production therefrom of Blocks, Slabs, Vessels, or like Articles, more especially intended for the Production of Paving Blocks or Slabs, or Conduits for Electric Cables.* C. Jost, Frankfurt o/M., Germany. Eng. Pat. 15,095, August 7, 1894.

2·5 parts by weight of "petroleum residue" is heated in a boiler to 80° C. and 8 parts of graphite stirred in. 10 parts of finely-powdered slate are then added and the stirring is continued until a dry sandy product results. 12 parts by weight of purified Trinidad asphalt are heated and added to the mixture prepared as above, and 25 parts of "asphalt in powder" added to the resulting material. The finished composition is moulded under a pressure of about 120 kilos. per sq. cm.—B. B.

*Improved Apparatus for Coating Paving Blocks, other like Blocks, and lengthy supple Subjects with Tar-Oil Pigments or other Liquids.* T. Willmot, Toongabbie, New South Wales, and M. T. Morgan, Arncliffe, New South Wales. Eng. Pat. 7968, April 22, 1895.

A tank filled with the preservative liquid (heated if necessary) is fitted with a perforated shoot, curved downwards in the middle so that it dips below the surface of the liquid. The blocks or other objects to be coated are filled in at the end of the shoot, pass through the liquid, and emerge at the other end between scrapers, which remove the adhering surplus of preservative material. Flexible articles, such as laths, may be similarly treated.—B. B.

*Improved Apparatus for Impregnating Wood with Liquids.* L. M. G. J. Lonstalot, Paris, France. Eng. Pat. 9247, May 9, 1895.

The apparatus consists of a vessel divided into longitudinal compartments and enclosed in a steam jacket. In place of septa forming the compartments, the vessel may consist of a series of horizontal tubes, the whole set being enclosed in a jacket. Closure of the cells may be made by a hinged door opening outwards and bearing on a rubber washer, the door when open falling back into a suitable recess. In this case the door may also be held up by a swinging cross-piece pivotted on its outer side to prevent its opening when a vacuum is formed in the compartment to which it belongs. Several members identical in design may be joined in series. The process of impregnation consists in raising the temperature of the contents of the cells, partially evacuating and injecting the preservative liquid. The apparatus may be supported on trunnions to facilitate loading and discharge.—B. B.

*An Improved Method and Apparatus for Testing Sand used for Building Purposes and for other Purposes of the like kind.* J. C. Cleghorn, Calcutta, India. Eng. Pat. 9792, May 17, 1895.

*See under* XXIII., *page* 770.

## X.—METALLURGY.

*Improvements in Metallurgy.* Dingl. Polyt. J. 1895, **296**, 45—47.

*Tin.*—By heating tin-plate scrap to 1,000° C. in the absence of an oxidising atmosphere, *e.g.* in a closed vessel, the tin almost completely separates from the iron and collects upon the bottom of the vessel, leaving the iron with a surface so clean that, if in the form of sheet, it may, for example, be used for ferrotype plates. (W. L. Brockway, of New York, in Ger. Pat. 66,350 of 1891.) G. Vortmann, in Vienna, and A. Spitzer, in Buda-Pest (Ger. Pat. 73,826 of 1893), treat tin scrap, ore, or waste tin compounds by fusing them in closed vessels with 50 per cent. of a mixture of 1 part of sulphur with 2 parts soda, and then leaching with water, or by digesting them direct with a solution of sodium sulphide. The resulting sodium sulpho-stannate solution is electrolysed with lead anodes and thin tinned copper cathodes.

*Arsenic Recovery in England.*—Arsenical pyrites containing 23—30 per cent. Fe and 12·5—14 per cent. As is hand-sorted and crushed, then, after mixing with coal of low value, it is roasted in reverberatory furnaces with condensing chambers attached. The impure arsenious acid deposited is refined by sublimation in rotating iron cylinders. Three men can thus prepare 300 tons $As_2O_3$ per month.
—W. G. M.

*Improvements in Metallurgy.* Dingl. Polyt. J. 1895, **296**, 112—114.

W. H. Greene and W. H. Wahl, of Philadelphia, prepare manganese free from iron and carbon from an impure manganese ore as follows:—The crushed ore is treated with sulphuric acid (sp. gr. 1·84) diluted with two or three volumes of water, which should dissolve the whole of the iron (down to 0·1 per cent.), but practically no manganese. The residual manganese dioxide is well washed, and converted into $Mn_3O_4$ by heating to 400°—500° C., and then into MnO by further heating in gaseous or volatile hydrocarbons or in carbon monoxide. Solid carbon should not be employed, lest some of the oxide become converted into metal, and combining with, fix a proportion of carbon. The pure MnO is then reduced by an equivalent weight of aluminium or magnesium, in a crucible lined with lime or magnesia; fluorspar or cryolite (or both) being added as a flux. The resulting manganese is free from silicon, carbon, and iron, and resists atmospheric oxidation well (German Patent, 70,773 of 1893). Lébédeff, who has patented the reduction of metallic oxides by carbon monoxide produced by the infiltration of carbon dioxide through a graphitic partition (see this Journal, 1891, **10**, 838; 1892, **11**, 923; and 1893, **12**, 694), states that sulphur, phosphorus, or arsenic may be eliminated from metals by similar means, owing to the dissociation of carbon monoxide in the presence of the metal, which combines with the carbon, whilst the resulting carbon dioxide oxidises the metalloid. Sternberg and Deutsch prepare ferro-molybdenum containing 35 per cent. Fe, 60 per cent. Mo, and 5 per cent. C. as a fused regulus, by heating a crucible, containing ferrous molybdate mixed with 27 per cent. of carbon, to an incipient white heat. Cupro-molybdenum, carrying 50 per cent. of Mo, may be made in a similar manner from cupric molybdate mixed with 21 per cent. of carbon.—W. G. M.

### *Cyanide Practice.* A. James. Inst. of Mining and Metallurgy, May 15, 1895.

This paper treats the subject in a general sense under the three headings:—(1.) The preliminary investigation of samples; (2) Plant; and (3) Extraction. The author states that the addition of oxidising agents to accelerate solution has proved ineffective in practice. "The solution itself contains more than sufficient oxygen for the reaction, as does also the charge to be treated, and as has already been pointed out, ferricyanide of potassium is also frequently present, so that any such addition is quite unnecessary." Cyanogen bromide is successful with metallic gold, but with ores or tailings there is stated to be no improvement in the results obtained, but there is an increased consumption of cyanide. In conclusion, the author states that the presence of a considerable amount of caustic potash or soda is essential to the regenerating reactions, and he advises the addition of it when starting with fresh solutions of cyanide. It is said not only to protect the cyanide, but actually to improve the extraction and to lessen the consumption.—A. W.

### *Improvements in Gold Extraction.* H. L. Sulman. Inst. of Mining and Metallurgy, February 20, 1895.

The author gives a full account of his cyanogen bromide and potassium cyanide process of gold extraction. He enters largely into the chemistry of the subject, and details many satisfactory experiments, both on a small and on a fairly large scale. It is found that a better solvent is obtained by adding the already formed haloid compound than by forming it *in situ*, besides which a saving of half the bromine is effected. The haloid cyanogen compounds are not themselves solvents of gold, and a mixture of them with potassium cyanide will remain stable for an indefinite time, the presence of gold determining the chemical upset of the system. Free silver will also rapidly dissolve in the mixture, but this metal is generally found as sulphide, upon which the haloid compound has no specific action, so that the silver extraction may be said to be unaffected.

The author sees no objection to cyanogen bromide as a commercial article. The assumptions as to its highly-poisonous nature have little foundation, and it is comparatively innocuous as compared with hydrocyanic acid. It is anhydrous, and may be exported in tins with an interior coating of paraffin-wax, and can be preserved for indefinite periods in well-closed vessels. In practice, the strength of the solution should never exceed 0·6 per cent. of potassium cyanide and 0·3 per cent. of cyanogen bromide, otherwise decomposition sets in with the formation of brown paracyanogen. The bromine need not be wasted, as the addition to the liquors of any substance capable of liberating it from the potassium bromide will enable it to re-form cyanogen bromide with the free cyanide present. In testing the liquors, cyanogen bromide is unaffected by silver nitrate, so that the free cyanide may be titrated with standard silver solution. The cyanogen bromide may be estimated by rendering it acid with hydrochloric acid, adding slight excess of potassium iodide solution and titrating with sodium thiosulphate using starch as an indicator. One c.c. of decinormal thiosulphate corresponds to 0·0053 grm. of cyanogen bromide.

For precipitating the gold, zinc fume, obtained by condensing metallic vapour, is recommended. It is a metallic flour coated with oxide, which, however, can be removed by shaking with a solution of ammonia, ammonium chloride or carbonate. The fume should not be used as a layer, since it clogs and prevents percolation; but as an emulsion, it forms an effective precipitant. With a consumption of less than half a pound of fume per ton of ore 97 to 98 per cent. of the total gold has been obtained. The precipitation is almost absolute, and solutions corresponding to the strength of the final waste liquors from the ordinary zinc boxes and from the Siemens-Halske process yielded, respectively, 98 and 96 per cent. of the small quantity of gold in them. The author has devised an apparatus by which the fume may be added in any definite proportion according to the rate of flow of the liquors.

If a small amount of coagulum be formed in rejected slime effluents it is found that the minute particles of ore and gold are rapidly precipitated, and for this purpose soap is added and then milk of lime. The sticky calcium stearate so produced coagulates and carries down all the solid particles in suspension. Although not tried on a practical scale percolation through such a precipitate 18 ins. deep was fairly rapid. 84·6 per cent. of the gold was obtained by cyanide from a slime so treated, whilst the original slime was valueless on account of its impermeability. The chloride of tin test gave no indication with the effluent when some gallons of it were evaporated to dryness, thus showing the complete arrest of metallic particles. The lime soaps are without action on potassium cyanide or potassic-aurocyanide, and do not hinder the extraction by cyanide of the gold in them. The cost for this soap treatment works out to about 3*d*. per ton of original ore.—A. W.

### *Treatment of Pyritous Concentrates by Cyanide.* A. T. Crosse. Eng. and Mining J. 1895, **59**, 559—560.

This paper was originally read before the Chemical and Metallurgical Society of South Africa. The author points out that the presence of insoluble basic ferric sulphate in concentrates, &c. causes a considerable decomposition of cyanide. It is not therefore sufficient that the soluble iron and free acid should be removed. The basic material may be removed by treatment with weak acid. Experiments showed that the cyanide destroyed by the untreated concentrates was 5·3 times as much as by some of the same material which had been digested with weak hydrochloric acid, whilst 51·8 per cent. and 84·3 per cent. were the respective yields of the gold present. Hyposulphite of soda was tried to convert the basic ferric sulphate into soluble ferrous sulphate, but it was only partially successful. Experiments were also tried with the object of utilising the fact that ferric hydrate, when heated to 121° C. under a pressure of one atmosphere, is partially dehydrated, and has no farther action on cyanide, but they failed, as there remained the ferrous hydrate to contend with. However, by heating the concentrates to just below dull redness or till sulphurous acid was given off, successful results were obtained, as the basic ferric salts were thereby converted into soluble ferrous salts and ferric oxide. The concentrates, after heating, should be thoroughly washed with water till free from the soluble iron salt, and then once washed with lime water. By then treating with cyanide in the usual way, 88 per cent. of the gold was obtained.
—A. W.

### *Adhesion of Aluminium and other Metals to Glass.* C. Margot. Arch. des Sciences Phys. et Nat. Geneva, 1895, 161; Proc. Inst. Civil Eng. **121**, iii. 1895, 105.

The author finds that on heating glass to the melting point of aluminium, the adhesion of the metal is very marked. It is possible to spread the aluminium over the surface of the glass with an iron spatula. It is suggested that this property may be utilised for cementing together the parts of glass apparatus used in laboratories.

Magnesium also adheres much more easily when heated, but the facility with which it is oxidised renders it less suitable for the purpose, and the same may be said of cadmium. Zinc, at moderately high temperatures, possesses similar properties.

Ordinary plumber's solder, alloyed with a small percentage of magnesium, can be spread upon hot glass like sealing wax; but unfortunately these alloys are speedily attacked by the moisture of the atmosphere.

Tin alloyed with 10 per cent. of aluminium spreads easily, and is more stable, but requires a higher temperature for its use; and an alloy of tin with from 2 per cent. to 5 per cent. of zinc was found to work well.

It is advisable not to raise the temperature too high, otherwise oxidation becomes energetic. An ordinary soldering iron may be used, but an aluminium bit is preferable. No flux is required, but the glass must be perfectly clean.

### *The Rate of Solution of Gold in Cyanide Solutions.* A. W. Warwick. Eng. and Mining J. 1895, **59**, 604—605.

Two years ago the author commenced some experiments to ascertain the rate at which gold is attacked by cyanide solutions and the influences which affect it. Small rectangular thin plates of gold were used, being weighed before and after the experiment. The loss in weight in milligrammes divided by the area of the gold in square centimetres gave the number of milligrammes of gold dissolved in a given time per square centimetre. The conditions varied as to (1) temperature, (2) strength of solution, (3) impurities in the cyanide, (4) rate of action upon gold-silver alloys, and (5) the action of other cyanides.

The curves show that with a slight increase of temperature the action of the cyanide is greatly accelerated. As regards the effect of the presence of a metallic cyanide, it was found that, while the rate of solution in pure cyanide was uniform, the action of cyanide containing zinc was to gradually deposit a grey film on the gold until all action ceased. The effects of nickel and copper were so much alike that separate curves could not be plotted. The result in each case was that the rate of solution or the decomposition of cyanide was not perceptibly affected until about 300 hours after starting the experiment. On the other hand, the presence of gold, added as the chloride, greatly accelerated the solution of the gold plate in the cyanide. This could not be due to cyanide of gold, since the action of pure cyanide does not increase as the dissolving continues. It is probably due therefore to the formation of cyanogen chloride, according to the following equation—

$$2AuCl_3 + 6KCN = 2KAu(CN)_2 + 4KCl + 2CNCl.$$

The author then tried experiments with cyanogen chloride, bromide, and iodide, with greatly accelerating results, but he doubts the practical efficacy of these substances. The accelerating influence he attributes to the halogen cyanide acting as an oxygen carrier. Consequently, he differs from Sulman's opinion that the reaction is independent of any supply of oxygen.

It is the nascent oxygen in the last equation which enables the potassium cyanide to act more readily on the gold, and which is therefore the real cause of the greater rapidity of solution.

Solutions of potassium ferrocyanide and sulphocyanide were tried for dissolving the gold, but they were both found to be slow solvents, the latter much more so than the former.—A. W.

### *Dry Assay for Lead.* M. W. Iles. School of Mines Quarterly, **15**, 336—345.

*See under* XXIII., *page* 770.

### *Electrolytic Copper-refining in North America.* E. Sederholm. Jeknisk Tidschrift, Afdelu. för kemisch. Metallurgi, 1895, 1.

*See under* XI., *page* 756.

## PATENTS.

### *An Improved Method or Process for the Treatment of the Ores of Nickel or Cobalt.* C. Hoepfner, Giessen, Germany. Eng. Pat. 11,307, June 11, 1894.

The oxide, carbonate, or silicate ores of nickel and cobalt are mixed with ores or mattes containing sulphides of copper, silver, or other valuable metals, and smelted to produce a matte from which the nickel, cobalt, and other metals may be economically separated and recovered. The powdered matte is treated, according to the patentee's previous specifications, with a solution of cupric chloride, which dissolves the sulphides with the formation of cuprous chloride. The solution is then electrolysed in a bath with a diaphragm between the electrodes. It is thus partly freed from silver and copper, and the residual solution, after precipitating the iron, if necessary, is again electrolysed to produce pure nickel and cobalt. The chlorine which is evolved, is utilised to reconvert the cuprous into cupric chloride.—A. W.

### *Improvements in connection with the Manufacture of Armour Plates.* J. E. Rogerson, Wolsingham, *viâ* Darlington. Eng. Pat. 11,868, June 19, 1894.

The fluid steel is run into a mould of the size and shape required for the finished plate, the mould having its internal surface composed of carbonaceous material on the sides corresponding to the surfaces of the plate that are to be hardened. The depth of the hardening may be increased by heating the plate to a cementing temperature, without removing it from the mould. Bars of iron may be introduced into the mould before teeming the metal, so as to form cores within the plate. The metal may be subjected to pressure during solidification.—W. G. M.

### *Improvements relating to the Manufacture of Tungsten Articles, and to Apparatus therefor.* A. Mieg, Heidelberg. Eng. Pat. 14,481, July 27, 1894.

Articles composed of tungsten (the patentee suggests shrapnel bullets) are made by mixing finely-divided metallic tungsten with 5 grains of a very fusible metal, and moulding the mixture under pressure at the softening or fusing point of the added metal, the composition of which is varied according to the purpose to which the object is to be applied. A special press may be used, in which round projectiles are prepared between dies, having hemispherical cavities, so adjusted that they do not quite meet, but leave a band on the pressed sphere, to be subsequently turned off. If preferred, the tungsten is pressed alone and then soaked in the fused soldering metal until saturated with it, the intention being in all cases to surround the grains of tungsten (or of tungsten mixed with other comparatively infusible metal) with a network of fusible alloy of suitable character.—W. G. M.

### *A New Metallic Alloy.* R. A. Smith, Plumstead. Eng. Pat. 15,891, August 21, 1894.

The alloy is formed by adding chromium to bronzes, German silver, or other well-known alloys in the proportion of from 1 to 7½ per cent. The chromium may be added as ferro-chromium, as oxide, or as a rich alloy of copper and chromium, and the metals are melted together in a crucible. No definite composition is given, but the alloy is stated to be especially suitable for heavy machinery bearings.—A. W.

### *An Improved Solder for Soldering Aluminium, Aluminium Alloys, and other Metals.* W. P. Thompson, Liverpool. From O. Nicolai, Wiesbaden, Germany. Eng. Pat. 17,820, September 19, 1894.

In a previous patent (No. 4980, 1894), the author claims the use of a solder consisting of a cadmium halogen salt. The efficacy of this "solder" is now increased by the addition of chloride of sodium, preferably in the proportion of two parts of the latter to ten parts of the former.

Zinc halogen salts are also suitable for aluminium solders, especially if mixed with one-fourth of their weight of chloride of sodium. The two salts should be mixed in solution and evaporated to dryness.—A. W.

### *Improvements in Enamelling Metal.* J. Cochran, Brooklyn, U.S.A. Eng. Pat. 7892, April 19, 1895. Date claimed under International Convention, November 19, 1894.

The article to be enamelled is given, by electrolysis, a thin coating of cobalt or "analogous oxidisable metal," and on this is applied the enamelling mixture, which is dried and burnt as usual. The invention relates especially to the treatment of steel, to which enamel does not properly adhere, and also to the production of mottled enamels, which are prepared by the action of acids on the steel base, the acid being applied either through the film of cobalt or in the glaze itself. The result of this acid treatment is to produce, where it is applied, a layer of oxide on the steel, which, showing through the enamel, gives it a darker colour than elsewhere.—F. H. L.

*An Improved Process for the Extraction of Gold from its Ores, and Apparatus employed therefor.* L. C. Daumas, Paris. Eng. Pat. 23,006, November 27, 1894.

A solution of sulphur chloride, impregnated with chlorine, is employed with heat and pressure to dissolve the gold, and the double chloride of gold and sulphur so obtained is decomposed, while hot, with powdered charcoal or other suitable material. The apparatus is very elaborate, and the parts with which the reagents come in contact are preferably made of glass or stoneware, whilst all joints are made of lead, coated with platinum foil. The specification, in which there are 13 claims with drawings, is not suitable for a detailed abstract.—A. W.

*Manufacture of Compressed Carbonised Steel, and Armour Plates and other Articles therefrom.* O. Imray, London. From W. E. Carey, Munhall, Pa., U.S.A. Eng. Pat. 7351, April 10, 1895.

The plate or ingot to be treated, is heated in contact with finely-divided carbon on the side or sides which are to be hardened, the temperature being gradually raised from 1,066° C. to 1,190° C. It is then slowly cooled to 870° C., and reduced in thickness by a hydraulic press, capable of giving a pressure of (say) 10·5 tons per sq. in. of plate area, until a sufficient reduction has been effected. The plate is next annealed by covering the hardened side with from two to four inches of carbon, and then a layer of dolomite, magnesite, or lime, in the state of powder, to exclude air, and heating the whole to a temperature of 730° C. for 12 hours. It is then slowly cooled during eight hours *in situ*, straightened, and machined to the required dimensions, when it is re-heated to 730° C. with the same precautions to prevent oxidation, cleansed from scale, and quenched by means of a copious water-spray applied on the carburised surface. If at all deformed by the hardening process, "it is re-heated to a low temperature, such as 93° C." and straightened. The depth of carburisation may be tested after the first heating, by cooling and drilling out samples, in which case the plate must be re-heated to 870° C. before compression. The carbon protection during re-heating is especially necessary when nickel steel is under treatment, as this material is very liable to scale.—W. G. M.

*Method of or Process for Improving or Perfecting Steel Armour Plates and other Steel Articles.* A. Reichwald, London. From F. Krupp, Essen, Germany. Eng. Pat. 8047, April 23, 1895.

It is sought to combine the maximum of hardness on the face of an armour plate with the maximum of toughness elsewhere. The plate is first improved in quality by heating to a temperature at which the molecules are capable of easy re-arrangement, followed by quenching; by this means it becomes extremely fine-grained, and is in the condition to acquire the highest possible toughness afterwards. It is then tempered and bent to shape, either as it cools, or when cold; in the latter case, the temperature being below that at which hardening could be effected, the plate may be suddenly cooled. After machining, the plate is so heated, unequally, that the face is at a temperature above the hardening point, whilst the back is at such a temperature that the maximum of toughness (but no hardness) is imparted by quenching. The whole plate is then suddenly cooled by immersion in a hardening liquid, or by spraying. In some cases only the face of the plate is quenched. The heating is best effected by exposing the face to the higher temperature, or by embedding the back in sand or placing it upon a cool hearth. The process is applicable to chrome-, tungsten-, nickel-, chrome-nickel-, cement-, and compound-steel plates. When the alteration in shape, caused by the first exposure to a very high temperature for the improvement of the grain, is of no consequence, the plate may be shaped prior to this treatment, and the intermediate heating for bending and machining may be dispensed with.—W. G. M.

*A New or Improved Resistance Regulator for Apparatus employed in the Separation of Amalgam and other Metallic Molecules from Sludge* E. Fischer, E. Klein, and F. Mahlstedt, Breslau, Germany. Eng. Pat. 9071, May 7, 1895.

This specification relates to apparatus for regulating the distance between electrodes leading a current of electricity into sludge, such as is produced in gold extraction by amalgamation. The cathode is a well of mercury, above which a rotating anode is suspended. This anode is raised or lowered by the action of a solenoid, "according to the resistance in the decomposition cell."—J. C. R.

*New or Improved Process and Apparatus for Reducing or Smelting Ores.* E. E. Lungwitz, Brooklyn, U.S.A. Eng. Pat. 9072, May 7, 1895.

It is proposed to smelt ores containing volatilisable metals under a pressure greater than that at which the metals would volatilise at the temperature existing at the time of reduction. For this purpose, a specially constructed cupola is employed, with arrangements for obtaining and maintaining a high pressure in the interior, so that a metal, such as zinc, when reduced from its ores, does not volatilise, but remains in a molten state and runs down under the slag ready for tapping.—A. W.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

*Carborundum: History, Physical Properties, and Chemistry.* J. A. Mathews. School of Mines Quarterly, Columbia College, U.S.A. 16, [1], 73—79.

A works, capable of turning out 300 lb. a day, has been established to manufacture "carborundum" (this Journal, 1893, 847). The manufacture is conducted in a furnace, the walls of which are built of vitrified bricks, upon a masonry foundation, 3 ft. wide by 8 ft. long. From the end walls project the carbon electrodes; these may be as many as nine in number, and each of them is 1 ft. long by 2 in. in diameter; the carbons of one end are separated from those of the other by a distance of 5 to $5\frac{1}{2}$ ft.

The charge, which is a mixture of 4 parts of coke, ground to an impalpable powder, with five of good glass sand and one or two of salt, fills the furnace, except the region between the electrodes, where is laid a core of loose carbon.

The current supplied by the dynamo is an alternating one, thus preventing any electrolytic action.

After the current has passed for about eight hours, and the furnace has cooled, a hollow cylindrical mass, 4 or 5 in. thick, of carborundum crystals, is found surrounding the carbon core, whilst a thin layer of soft, greasy-feeling graphite, separates the carbon from the carborundum. Beyond the latter is a thin layer of light-coloured, amorphous carborundum, and beyond this again, part of the charge, unaltered, except that the salt has been fused. The raw product is crushed in a pan by hard steel rollers, boiled for a week in dilute sulphuric acid to remove iron and sodium silicate, sifted, and the finest powders (distinguished as 1-, 3-, or 4-minute powder) graded by the length of time they are found to float upon water when stirred up therewith.

The carborundum is now fit for use as a polishing powder, or to be made up into grindstones of any size.

Carborundum crystallises in the hexagonal system, flattened rhombohedra being the usual forms. The crystals vary in size from a fraction of a millimetre to 3 mm. in their largest dimensions; they have a specific gravity of 3·12, and the colour, which is probably due to the small percentage of impurities, viz., $Fe_2O_3$, $Al_2O_3$, CaO, MgO, &c., varies from greenish (the usual tint) to yellow and sapphire-blue.

With regard to hardness, it is still uncertain whether carborundum is not harder than diamond; the difficulty of demonstration is caused by the brittleness of the crystals. Though not serviceable for the first rough treatment of diamond, it is successfully used for polishing it.

Upon analysis it is found to accord with the formula SiC, the reaction of its formation being represented as $SiO_2 + 3C = SiC + 2CO$. It is unaltered by any heat, short of that of the electric arc, and is entirely unattacked by the ordinary mineral acids. Prolonged treatment with HF and $H_2SO_4$, only slightly affect its weight, and this loss is probably due only to silica present as an impurity, and not to combined silicon. At a red heat, in a current of O, a trifling amount of carbon is lost, and this carbon, it is supposed, was present also as an impurity.

Analysis is effected by fusing carborundum with either caustic or carbonated soda for some time, when the entire mass becomes black, from the separated carbon, and sodium silicate is formed. Eventually the carbon burns off.

Carborundum appears to be suitable for most abrasive purposes, and there is especially a large application for it in glass grinding and cutting, "the same amount of material doing much more work and acting more quickly that any abrasive now used. Wheels made from carborundum are used in grinding the necks of the Westinghouse incandescent electric light globes, and unless the wheels grind from 12 to 15 times as many globes as the emery wheels formerly used, they are returned marked 'not good.'"

—E. R. B.

### *Electrolytic Copper-refining in North America.* E. Sederholm. Teknisk Tidskrift, Afdelu. för kemisch Metallurgi, 1895, 1. Through Dingl. Polyt. J. 1895, **296**, 284—288.

Ores and mattes are not electrolysed direct in America, only converter copper with 98—99·3 per cent. and blister copper with 99·5 per cent. of Cu, being thus treated. The vats are of pitched wood, either lined with lead, which is in the end more satisfactory, as in the new works in Salt Lake City; or unlined, as at Great Falls, in the works of the Boston and Montana Copper and Silver Mining Co. From 30 to 60 cm. space is allowed between the lowest portions of the electrodes and the bottom of the vat, to allow for the accumulation of slime and solid matter; and a cock is provided for the withdrawal of the slime into a channel, communicating with all the vats, and leading to a single reservoir. Along each side of the vat runs a square copper rod, one rod forming the positive, the other the negative lead, the anodes being so suspended that the supports rest on one of these rods at one end, but are insulated from the other rod by means of a slip of wood. The cathodes are similarly but conversely connected and insulated. Thus the electrodes (20 of each kind) in each bath are in parallel circuit, but the baths themselves are in series. Fresh solution is introduced through a pipe placed above the vats, and each vat (subject to some modifications) has an overflow pipe connected with a common reservoir. The solution is here brought up to the right acid strength; or if very impure, the copper is extracted electrolytically or by means of iron, refined, and cast into anode plates again. The Chicago Copper-refining Co., however, crystallise out the copper sulphate, and then recrystallise it to separate the co-precipitated arsenious oxide. Both products afterwards find a good market. The dynamos are of all possible types, the voltage depending upon the number of baths in series; but the larger works generally have a "Special Exciter;" it being found that a more constant current is obtained, by employing a special small motor for the magnetisation of the electro-magnets. The older machines usually gave a current of 6—30 volts, but now the interpolar voltage ranges from 100 to 200. At the Great Falls installation, for example, four Thomson-Houston four-poled dynamos, excited by two smaller machines, are used, and each generator gives a current of 1,000 ampères and 200 volts, the number of baths in operation being 288. The difference of potential in the baths is secondarily controlled by altering the space between the electrodes, as it is important that the voltage be not too high when the solutions are impure. The current strength varies from 70 to 150 ampères, which is much higher than that recommended in Europe. The systems of Stalmann, Smith, and Hayden are used in America, the second in one works only, the latter in many. In all of them the electrodes are placed in series, and (with some modifications) each plate serves both as cathode to the preceding plate and as anode to that which follows, until the original plate has been completely replaced. In the older (multiple) system, the anodes are cast direct from the reverberatory furnace or converter into plates 2·5—3 mm. thick. By running from the converter, as proposed by Thofern, labour is saved, but the metal is less homogeneous; and being unequally attacked in the vats, it tends to break up, so that large fragments of copper may fall with the slime to the bottom of the bath, which seriously interferes with the economical working of the process. The cathodes are usually thin sheets of electro-deposited (not rolled) copper, and the process is ultimately allowed to proceed until they are 8—12 mm. thick. The solution generally contains initially 150—200 grms. of crystallised copper sulphate and 50 grms. of sulphuric acid per litre, and must be kept up to this strength throughout. For very powerful currents, a stronger solution is employed. In use, the electrodes are removed every second day, the anodes being cleansed from slime, and the cathodes being freed from projections; both are then returned, unless the former are dangerously thin or irregular, when they are re-cast.

The problem of treating the anode slime has been attacked in many ways. Treatment with hot strong sulphuric acid dissolves most (but not all) of the silver, which may then be precipitated by means of granulated metallic copper; but this process is wasteful of acid. The silver, however, is fairly pure (99·5 per cent.). The residual silver left undissolved by the sulphuric acid, is in combination with selenic and antimonic acids. It remains thus undissolved along with some gold. Ulke dissolves the whole of the copper out of the slime by means of warm dilute sulphuric acid through which air is blown, thus leaving a residue which may contain 90 per cent. of silver. Usually, slime is smelted so that the copper passes into the slag, which is then treated in the blast-furnace, and a metal carrying 60—90 per cent. of Ag results; this is cast into ingots which are passed on to the silver refinery. The St. Louis Smelting and Refining Co. and another large works in Pittsburg are using the Moebius process (see this Journal, 1888, 571). Aluminium wire is employed to suspend the silver anodes in the dilute nitric acid and is said not to be attacked. With a current of 180 ampères and 100 volts (interpolar) passing through 70 vats in series, 14 kilos. of silver are obtained from each vat (980 kilos. in all) in 24 hours; the current density being 300 ampères per square metre.—W. G. M.

## PATENTS.

### *Electrical Deposition of Zinc and Alloys of Zinc, and Apparatus therefor.* R. Heathfield and W. S. Rawson, London. Eng. Pat. 5537, March 16, 1894.

Apparatus and methods are herein described for depositing on iron, steel, or other metallic articles, zinc or its alloys. The articles to be treated are first electrolytically coated with mercury from a salt of mercury, and then treated electrolytically in a zinc-salt solution. For the first electrolyte the ammonia-sulphate or ammonia-chloride solution may be employed, "using such an electro-motive force as causes a free disengagement of hydrogen." Ammonia-chloride of zinc, zincate of potash, or other zinc salt, may be employed for the zinc-depositing bath; and it is added, "in order to obtain a rapid and sound deposit we agitate the articles treated, or the liquid in the bath."—J. C. R.

*A New or Improved Process for the Electro-Deposition of Aluminium and Aluminium Alloys.* A. Y. B. Gomess, London. Eng. Pat. 7205, April 11, 1894.

The object of this invention is to obtain deposits of aluminium or alloys of aluminium electrolytically. The electrolyte employed is tartrate of aluminium $Al_2(C_4H_4O_6)_3$, in conjunction with the chloride of an alkali, to which may be added the iodide or bromide of an alkali.

The following are the compositions of certain baths which the inventor finds to answer in practice:—

I. Tartrate of aluminium $Al_2(C_4H_4O_6)_3$, 10 parts, chloride of alkali (preferably ammonium chloride $NH_4Cl$), ½ part, water, 100 parts.

II. Aluminium-ammonium-tartrate, 10 parts, water, 160 parts, and chloride of alkali (preferably ammonium chloride), 1 part.

A temperature of "from 80° to 115° F." is given as suitable at which to work the baths. The process may be carried on successfully "in a cold bath." Where aluminium is not employed for the anode, the strength of solution is maintained by adding freshly precipitated aluminium hydroxide. When an aluminium anode is used, the bath is neutral or slightly alkaline. "For the deposition of aluminium, the voltage found suitable is from 4 to 10 volts and upwards."—J. C. R.

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*Improvements in Electric Storage or Secondary Batteries.* J. E. Liardet, London. Eng. Pat. 14,847, August 2, 1894.

In the improved cell the positive electrode is formed either of a thin sheet of lead built in a composite form, or of a hollow lead tube, such plate or tube being perforated to allow of the free circulation of the fluid through the cell. The tube or casing is filled with shot, granulated lead, or lead filings, well mixed with pieces of lead. A rod or bar of lead, to which is made a suitable connection, is placed in the casing, and the whole charge is pressed into a solid mass. The negatives consist of thin perforated sheets of lead.—G. H. R.

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*Improvements in Methods of and Apparatus for Heating Crucibles by Means of Electricity.* A. C. Girard and E. A. G. Street, Paris, France. Eng. Pat. 15,632, August 16, 1894.

*See under* II., *page* 739.

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*An Improvement in Copper Castings for Electrical Purposes.* Siemens Brothers and Co., Limited, London. From E. Obach, Thüringen, Germany. Eng. Pat. 15,899, August 21, 1894.

This invention consists in mixing with copper of high conductivity, a small proportion of pure lead. Such addition of lead renders the metal much more fluid when in a molten state, thus enabling much sounder castings to be made than with pure copper alone. "It has been discovered that the addition of a certain proportion of pure lead, preferably from 0·5 to 1·5 per cent., detracts but very little from the conductivity of the metal, and, so far as experiments have been made, in a far less degree than the addition of either tin or zinc, which metals have hitherto generally been employed to improve the castings."—J. C. R.

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*Improvements in Galvanic Batteries.* G. Hübner, Gernsbach bei Baden, Germany. Eng. Pat. 21,330, November 6, 1894.

This relates to the use in dry batteries of the slimy liquid produced by treating wood cellulose with alkali, and adding carbon bisulphide as described in Eng. Pat. 19,934, October 19, 1894 (this Journal, 1895, 493), but omitting the use of oxide of lead. The cathode consists of a highly porous carbon cell filled with a plastic mass, formed by mixing the slimy liquid with granular retort carbon and the oxides of copper, iron, mercury, or silver. Tubes are inserted into the plastic mass to provide for its regeneration by the circulation of atmospheric air. The outer cell is composed of zinc, and the space between it and the carbon cathode is filled with the slimy material alone, and the cell is sealed with a layer of plaster of Paris.—G. H. R.

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*Improvements in or relating to Secondary Batteries or Electric Accumulators.* W. A. Boese, Berlin, Germany. Eng. Pat. 4610, March 4, 1895.

This invention is an improvement on that described in Eng. Pat. 11,532, June 20, 1892 (this Journal, 1893, 527), and consists in preparing the active material for plates for electric accumulators, by dissolving phenol-like bodies in alcohol, ether, or benzol, with or without the addition of fixed hydrocarbons, mixing them with lead oxide, and then forming the mixture into plates, which, when dry, are immersed in dilute sulphuric acid.—G. H. R.

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*Improvements in Insulating Material for Electric Purposes.* A. J. Boult, London. From The Virginia Phosphate and Paint Company, Washington, U.S.A. Eng. Pat. 8537, April 30, 1895.

An excellent insulator is said to be obtained by a combination of the titanic minerals, "menaccanite, rutile, anatase, and brookite" (found in a phosphate ore of Nelson County, Virginia, U.S.A., and constituting about 70 per cent. of the same), a hydrocarbon such as asphaltum, and a silicious material. To form this insulating compound the proportions given for every 100 parts are: 75 to 85 titanic mineral, 10 to 20 asphaltum, and about 5 of rice hulls.

The mineral is preferably ground to a fine powder and mixed intimately with the asphaltum by heat and stirring, adding the rice hulls either during or after the mixing of the other ingredients.—J. C. R.

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## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

*Report on Samples of Limestone and Hæmatite Paints, submitted for examination by the Agent-General for New Zealand.* Imp. Inst. J. August 1895.

*I.—Limestone.* The sample consisted of irregular lumps of a very dense and highly crystalline limestone, for the most part of a bright white colour, but with dark grey-coloured streaks and occasional rusty-yellow patches. An average sample was prepared and its constituents determined. The following figures were obtained:—Lime, 54·65; carbonic acid, 43·24; silicic acid, 1·11; ferric oxide and alumina, 0·135; magnesium, trace; moisture, 0·48 per cent.

It thus appears that this limestone is a very pure carbonate of lime, the impurities amounting at most to less than 2 per cent. (excluding water). A special examination was made for phosphorus, with a negative result.

*II.—Hæmatite Paints.* The samples were of two colours, yellowish-brown and purple-brown, the latter being evidently produced by exposing the original (yellow-brown) material to heat. Both corresponded in character to Calley's "brown" and "purple-brown" Torbay paints.

The brown paint contained somewhat over 2 per cent. of water, while the purple-brown paint contained somewhat less than 1 per cent. The proportion of siliceous matter varied from 9 to 20 per cent., and the ferric oxide in the original yellowish-brown paint, from 69 to 76 per cent.; in two samples of the purple-brown paint, 83 and 87 per cent. respectively.

Both paints are well ground. They have been submitted to practical tests in comparison with the Torbay paint in a well-known extensive Government establishment, in which Torbay and other iron oxide paints have been largely employed.

The New Zealand paint worked out well, with *good* body.

There was no sediment in pot as the work proceeded.

The Torbay paint worked out well, with *fair* body, nor was there in its case any sediment in pot as work proceeded.

The New Zealand oxide is a better paint than Torbay, so far as covering power is concerned, and the difference in amount of materials required in making up the New Zealand oxide as against the Torbay does not even bring the latter pigment up to the former.

The roasted purple-brown paint required exactly the same proportions of oil driers and turpentine as the yellow-brown paint; 26 lb. covered 130 yards supl., as against 146 yards for the same weight of the unroasted oxide.

The price paid for the Torbay paint, which was tried against the New Zealand samples, was 24*s.* 6*d.* per cwt., ground in oil *to paste*.

## PATENT.

*Improvements in or Relating to Damp-proof Paints or the like.* A. J. Boult, London, from G. Philipps, Brussels. Eng. Pat. 22,100, November 15, 1894.

See also Eng. Pat. 19,858, 1894 (this Journal, 1895, 169).
—F. H. L.

## (C.)—INDIA-RUBBER, &c.

### *Contributions to the Chemistry of India-Rubber.*

R. Henriques. Chem. Zeit. 19, 1895, 235 and 382.

The inferences drawn by Lobry de Bruyn and van Leent (this Journal, 1894, 986) from the loss of weight observed in articles subjected to the British Admiralty (dry heat) test, according to the author, are objectionable, as he contends that the amount of this loss depends more upon the amount of free sulphur than upon the quality of the india-rubber in the samples. A number of experiments carried out by the author with ground samples of vulcanised rubber showed in most cases an increase and not a loss in the weight of the samples.

These figures show that the alteration of the weight of india-rubber during the dry-heat test is of a too erratic description to be capable of definite interpretation. Indeed, this alteration appears generally to be a two-fold one, viz., one involving loss of weight through volatilisation of sulphur and increase in weight through oxidation of the india-rubber taking place simultaneously. These figures further show that well vulcanised india-rubber at from 100° to 120° C. undergoes considerable alteration and oxidation. Even the heating of india-rubber with exclusion of air causes a considerable change.

| Sample. | | Sulphur. | Increase or Loss in Weight at 100° C. | | | At 120° C. |
|---|---|---|---|---|---|---|
| | | | 2 Hours. | 4 Hours. | 6 Hours. | 2 Hours. |
| Para I. | Vulcanised | 6·44 | 0·1 | 0·5 | 0·75 | 1·56 |
| | Free S extracted | 3·30 | 0·84 | 1·74 | 2·34 | 3·30 |
| Para II. | Vulcanised | 7·76 | − 0·46 | − 0·7 | − 0·7 | − 0·66 |
| | Free S extracted | 1·86 | 0·68 | 0·7 | 1·01 | 1·44 |
| Para III. | Vulcanised | 8·24 | − 0·50 | − 0·4 | − 0·4 | − 0·4 |
| | Free S extracted | 3·39 | 0·6 | 1·3 | 1·8 | 2·64 |
| Para IV. | Vulcanised | 10·36 | 0·14 | 0·58 | 0·92 | 1·48 |
| | Free S extracted | 5·63 | 0·84 | 1·52 | 2·08 | 3·08 |
| Para V. | Vulcanised | 8·62 | 0·2 | 0·5 | 0·8 | 1·3 |
| | Free S extracted | 4·59 | 0·6 | 1·32 | 1·76 | 2·92 |
| Para VI. | Vulcanised | 5·49 | − 0·2 | − 0·35 | + 0·12 | + 0·84 |
| | Free S extracted | 3·74 | 0·1 | 0·24 | 0·78 | 2·22 |
| Columbia | Vulcanised | 9·17 | − 0·4 | − 0·28 | − 0·4 | − 1·00 |
| | Free S extracted | 3·21 | 0·24 | 0·64 | 1·04 | 1·92 |
| Sierra Leone | Vulcanised | 11·26 | − 1·0 | − 1·08 | − 1·4 | − 2·4 |
| | Free S extracted | 1·44 | 0·05 | 0·42 | 0·18 | 0·55 |
| Ceara | Vulcanised | 11·69 | − 1·8 | − 1·8 | − 1·8 | − 2·00 |
| | Free S extracted | 7·11 | 0·8 | 1·2 | 0·95 | 1·55 |

A sample of india-rubber which had first been extracted with acetone yielded another 0·75 per cent. of extract to benzine (petroleum spirit), and after heating this sample for two hours at 100°, a further 3 per cent. could be extracted. The above table shows further that vulcanised india-rubber which, by extraction with acetone, has been deprived of free sulphur, undergoes oxidation and decomposition much more rapidly than the original sample. From this fact the author infers that the free sulphur in india-rubber articles is not only not detrimental to india-rubber, but appears to exert a preserving action. India-rubber deprived of its free sulphur, on being heated for four hours to about 125° in a current of carbonic acid, showed a very considerable alteration, and in successive extractions it yielded 6·35 per cent. and 5·09 per cent. to carbon bisulphide, 6·50 per cent. to benzine, 4·30 per cent. to acetone. On the other hand, unvulcanised india-rubber can be heated thus to 120° C. for an almost indefinite time without showing any increase in weight. Experiments on the solubility of vulcanised india-rubber showed that erroneous results are obtained if the sample, between successive extractions, be dried at higher temperatures, owing to the oxidation and decomposition which take place at these temperatures, as shown above. Extraction in the Soxhlet tube gives the same figures as those obtained when the samples are allowed to stand in the cold with the solvent. The following figures were obtained with various solvents:—

*Para, I. (yielding to Acetone* 3·31 *per cent. of Sulphur,* 1·89 *per cent. of Resin).*

| Solvent. | Extraction | | | | |
|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. |
| Benzine (petroleum spirit), cold. | 1·65 | 0·75 | 0·45 | 0·30 | 0·30 |
| „ in Soxhlet | 1·75 | 0·56 | 0·40 | .. | .. |
| Chloroform | 1·45 | 0·67 | 0·60 | 0·66 | .. |
| Carbon bisulphide | 1·75 | 0·75 | 0·36 | 0·40 | .. |
| Acetone | 0·75 | 0·38 | 0·20 | 0·14 | 0·16 |

*Para, II. (yielding to Acetone* 5·13 *per cent. of Sulphur,* 3 *per cent. of Resin).*

| Solvent. | Extraction | | |
|---|---|---|---|
| | 1. | 2. | 3. |
| Benzine | 1·02 | 0·30 | 0·30 |
| Carbon bisulphide | 1·12 | 0·35 | 0·35 |
| Acetone | 0·67 | 0·14 | 0·16 |

*Columbia (yielding to Acetone* 6·25 *per cent. of Sulphur,* 2·65 *per cent. of Resin).*

| Solvent. | Extraction | | | |
|---|---|---|---|---|
| | 1. | 2. | 3. | 4. |
| Benzine | 2·72 | 0·70 | 0·46 | 0·40 |
| Carbon bisulphide | 3·32 | 0·48 | 0·44 | 0·44 |
| Acetone | 0·90 | 0·12 | 0·16 | .. |

*Sierra Leone (yielding to Acetone* 10·04 *per cent. of Sulphur,* 5·21 *per cent. of Resin).*

| Solvent. | Extraction | | | | |
|---|---|---|---|---|---|
| | 1. | 2. | 3. | 4. | 5. |
| Benzine | 9·80 | 1·16 | 0·50 | 0·38 | 0·28 |
| Carbon bisulphide | 7·00 | 1·10 | 0·48 | 0·36 | 0·38 |
| Chloroform | 5·90 | 1·80 | 1·10 | 0·94 | 0·56 |
| Acetone | 0·49 | 0·46 | 0·43 | 0·18 | 0·15 |

*Ceara (yielding to Acetone* 5·51 *per cent. of Sulphur,* 7·63 *per cent. of Resin).*

| Solvent. | Extraction | | | |
|---|---|---|---|---|
| | 1. | 2. | 3. | 4. |
| Benzine | 2·00 | 1·96 | 2·94 | 3·60 |
| Carbon bisulphide | 3·20 | 1·70 | 2·10 | 4·54 |
| Acetone | 1·75 | 1·71 | 2·59 | 1·36 |

In subjecting the formerly-mentioned samples, Para IV. and Para V., to the same treatment with solvents, quite normal figures, similar to the above, were obtained. But on weighing the extracted samples, which had been dried at air temperature, their weight, in spite of the considerable loss on extraction, was found to have considerably increased. This was found to be due to the great rapidity with which the extracted samples, on drying, absorb oxygen, an absorption which proceeds much more rapidly in the daylight than in the dark. On the other hand, it was found that the unextracted samples which still contain their free sulphur suffer much less from oxidation; so that the free sulphur appears to exert a distinct retarding action upon the oxidation of vulcanised india-rubber. The use of boiling nitrobenzene for dissolving the vulcanised rubber in rubber analysis does not, according to Henriques, in all cases lead to the desired result. The estimation of all the various possible constituents of the acetone extract of india-rubber samples, Henriques considers unnecessary, and thinks that the organic constituents of india-rubber articles should only be estimated as india-rubber on the one hand, and fatty substances, including all kinds of organic rubber substitutes and oils, on the other. The india-rubber resins, he thinks, should count as rubber, as they form part of the natural product. The smallest quantity of sulphur of vulcanisation which Weber, for well-vulcanised articles, stated to be not less than 2·2 per cent., may, according to the author, be considerably less. Likewise the facts, that vulcanised india-rubber is slightly soluble in carbon bisulphide, and that india-rubber and sulphur will combine at 100° C., which were contested by Weber, have been reconfirmed by further experiments. The author also adheres to his statement that the action of chloride of sulphur upon india-rubber has not yet been proved to be of the simple description which Weber assumed it to be.—C. O. W.

## PATENTS.

*Improvements in Stoves for Vulcanising and Deodorising Waterproof Garments.* I. Frankenburg, Salford. Eng. Pat. 14,375, July 26, 1894.

On the inside of the roof of the drying stove is fixed a number of pulleys and guides so arranged that an endless chain, part of which is always outside the chamber, may travel in a circuitous direction all round the stove. From this chain depend loops and hooks on which the various articles may be suspended, and the apertures through which the garments, &c. enter and leave the chamber are covered by curtains to retain the heat, but are pushed aside by the passage of the articles themselves. By this device, entry of workmen into the stove is avoided.—F. H. L.

*Improvements in Treating Bully-Tree Gum.* R. Hutchison, Prestwick, N.B. Eng. Pat. 16,664, September 1, 1894.

The inventor describes the preparation from this gum of a substance which he calls "Bullite," of which various articles "of a compact, moderately hard, and springy character" may be manufactured. The gum is dissolved in a steam pan in twice its weight of oleic acid, and the portion which separates out again on cooling, is taken out and washed with alkali to remove the fatty acid.—F. H. L.

*Improvements in the Method of Producing Ornamental and other Designs upon the Surface of Textile and other Fabrics.* L. Mistovski, Heywood, Lancashire. Eng. Pat. 1297, January 19, 1895.

*See under* V., *page* 748.

## XIV.—TANNING, LEATHER, GLUE, SIZE.

*Dog-Skin as used for Gloves in Germany.* J. Soc. Arts, 1895, **43**, 780.

Although somewhat harsher and less firm on the flesh side than some calf-skins, dog-skin has such a fine texture and so excellent a grain that it is preferred for glove manufacture. Dog-skins are usually made black and treated like other black skins, but, on account of their loose and delicate texture, great care must be exercised in treating them. They should be only lightly limed, and are therefore passed through the pits by themselves. Thorough cleansing after liming is necessary, and the skins must be kept in constant motion, when placed in the fresh tan, if the grain is to be even; and throughout the deterioration of the grain must be guarded against. A mixture of equal parts of blubber-oil, tallow, and dégras is subsequently used; and, for black skins, a clean black-lead powder. After dyeing in this way, the skins are thoroughly beaten, first on the flesh- and then on the grain-side, after which they are oiled to prevent the grain becoming hard through the added pigment.—W. G. M.

*Composition of Chamois Leather.* von Schroeder and Pässler. Dingler's Polyt. J. 1895, **295**, 211—215.

A description is given of the process adopted for producing chamois leather, the details of which are essentially the same as those of the method commonly employed in English practice.

Some preliminary determinations of the moisture in commercial chamois leather, conducted in the manner previously described (this Journal, 1894, 1073), showed that air-dried samples may be taken as containing an average of 22 per cent. of water.

The authors agree with Fahrion's view (Chem. Zeit. 1893, 394), that the tanning of chamois leather is due to the combination of the hide fibre with the products of oxidation of the oil while these are *in statu nascendi.* They consider that these oxidation products, which are formed during the heating of the skins, are saturated hydroxy acids derived in large measure from the physetoleic acid always present in fish-oils. It will be noted, however, that only a portion of the oil with which the skin is impregnated becomes a part of the leather in this manner; for much of the oil can be extracted from the finished leather by oil solvents, in a condition partly unchanged and partly oxidised, quite apart from that which is removed as dégras or sod-oil in the finishing process.

The methods of analysis used in determining the composition of the samples of leather are described in detail, but it need only be stated here that the "combined oil" —*i.e.*, the altered fatty matter which is incapable of extraction by carbon bisulphide—is calculated on the basis of the percentage of nitrogen found in the anhydrous, fat- and ash-free leather. This system of calculating the degree of tannage and the percentage of nitrogen which is to be regarded as normal for various classes of hides and skins, are given in this Journal, 1893, 279, 610.

The following table comprises the analytical results, calculated on the anhydrous leather; as mentioned above, the average percentage of water may be taken as 22:—

| Chamois Leather made from | Buffalo Hide. | Calf-Skin. | Doe-Skin. I. | Doe-Skin. II. | Sheep-Skin. I. | Sheep-Skin. II. | Mean. |
|---|---|---|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Ash | 6·26 | 7·17 | 6·75 | 5·49 | 4·19 | 5·23 | 5·85 |
| Fat { soluble in $CS_2$ | 2·07 | 3·43 | 4·88 | 2·46 | 4·74 | 6·69 | 4·05 |
| Fat { insoluble in $CS_2$ (combined) | 2·96 | 8·33 | 9·17 | 3·83 | 4·40 | 2·00 | 5·11 |
| Hide substance | 88·71 | 81·07 | 79·20 | 88·22 | 86·67 | 86·08 | 84·99 |

In order to compare these figures with those indicating the composition of other kinds of anhydrous leather, the following table is appended. The water in the first three kinds, when they are air-dried, averages 18 per cent., and 25 per cent. in the last kind:—

| —— | Rhenish Sole-Leather. | North German Sole-Leather. | Upper Leather (not dressed). | Alumed Leather. |
|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Mineral matter | 0·61 | 0·71 | 1·01 | 21·00 |
| Fat | 0·44 | 0·54 | 1·00 | 0·40 |
| Aqueous extract } tannin | 4·24 | 6·43 | 4·52 | .. |
| Aqueous extract } not tannin | 2·77 | 4·91 | 2·13 | .. |
| Hide substance | 54·74 | 47·68 | 55·09 | 78·60 |
| Combined tannin | 37·20 | 39·73 | 36·25 | .. |

The ash of chamois leather is high compared with that of vegetable-tanned leather; it is derived from the lime and from the alkali with which the leather is washed to remove excess of oil.

To find whether the portion of fatty matter soluble in $CS_2$ is at all essential to the leather, some leathers were thoroughly extracted with this solvent, softened in water, and dried; they were then found to be similar in properties to unextracted leather.

That the mean quantity of combined fat in chamois leather should amount to so little as 5·11 per cent. is surprising, and it is interesting to compare the small yield of leather obtained by chamoising with that produced by other tannages. The following table makes such a comparison:—

1 part of hide substance yields 2·23 parts of Rhenish sole-leather.
1 part of hide substance yields 2·56 parts of North German sole-leather.
1 part of hide substance yields 2·21 parts of undressed upper leather.
1 part of hide substance yields 1·70 parts of alumed leather.
1 „ „ „ 1·51 „ chamois leather.

—A. G. B.

## PATENTS.

*A New or Improved Compound or Material applicable for Use as a Wood Substitute.* O. Thiele, Stargard, Pomerania, Germany. Eng. Pat. 13,823, July 18, 1894.

This material is made by mixing together camphor, stone-nut shavings or residues, collodion-wool (pyroxylin) dissolved in camphor, and colouring matters. The mixture is pressed and dried and then further pressed in suitable moulds at a temperature of 130°—150° C. The stone-nut residues are used either whole, or they are first washed, ground, and boiled in water. If it be desired to make a transparent material, the paste resulting from the boiled nut residues is impregnated with a solution of ammoniacal copper oxide. To further purify the substance, it is successively treated with dilute hydrochloric and hydrofluoric acids, chlorine water, dilute alkalis, and, if necessary, with alcohol and ether, finally washing with pure water, and drying. The dried substance thus obtained, may be impregnated with a 2 per cent. solution of tungstate of soda. Among the principal articles for the manufacture of which the finished material is specially adapted, are cartridge cases, cavalry horse-collars, and waterproof boots.—S. P. E.

*Improved Process of Tanning with Mineral Agents.* M. J. Völcker and M. W. G. Bergmann, Eisenberg, Germany. Eng. Pat. 9713, May 16, 1895.

After unhairing and fleshing, the hides are placed in a rotating tumbler-drum, and are subjected for from ½ to 2 hours to the action of ammoniacal vapours, "which thoroughly remove calcareous and sebaceous matter," and so act upon the substances of the hide that the finished leather is flexible, strong, soft, and elastic. The hides are then treated with a solution containing 10 per cent. of alum and 5 per cent. of sodium chloride for from 3 to 12 hours, according to their thickness. This is accomplished in a tumbler drum at a temperature of 25° to 35° C. They are finally tanned with a 5 per cent. solution of chromic acid or chromic salts, also heated. After from 2 to 4 hours, the hides are washed and treated with hydrogen sulphide to decompose and fix the soluble chromic compounds. By adding suitable salts, the hydrogen sulphide may be utilised also as a dyeing agent. The leather is finished in the usual way.—W. G. M.

*A New or Improved Process of and Apparatus for Liming, Bateing, or Tanning Hides and Skins.* C. Heitemeyer, Hoboken, N.J., U.S.A. Eng. Pat. 9953, May 20, 1895.

The skins are suspended singly from hooks at the sides of the vats, so that each hangs freely and transversely to the long axis of the vat. The liming, bateing, or tanning liquor is stored in a reservoir at one end of the row of vats, and in this it may be refreshed and brought up to full strength as required. A vat, being stocked with hides as above, is filled with the required liquor from the reservoir; when the hides are saturated, the liquid is caused to circulate by means of a pump, so that it is drawn off at the bottom at one end, whilst it is reintroduced at the top at the other end. Thus no handling of the skins is necessary. After a time the vat is emptied, the liquor being returned to the reservoir, and the skins are exposed freely to the air for a suitable period; then the liquor is again applied, as before, these processes being repeated many times subsequently. The valves and pump are controlled from a platform surrounding the vats. It is claimed that the various processes may be accomplished in one-third of the customary time.—W. G. M.

## XV.—MANURES, Etc.

*Use of Potash in Fruit Growing.* Gard. Chron. 3, 18, 6.

W. E. Britton, in the *American Agriculturist*, calls attention to the use of potash fertiliser in orchards. Potash and phosphoric acid promote the vigour of the tree and increase the quantity and quality of the fruit, while excess of nitrogen tends towards an increased growth and wood production at the expense of the crop of fruit. The experience of many large fruit growers favours the use of potash in manuring orchards. It is most commonly applied in the form of potassium chloride, from 200 to 300 lb. per acre being considered an economical dressing if the orchard is so treated annually. Kainit may be used instead, but double the quantity must be used. The author considers that the practice of applying potash or phosphoric acid is sometimes carried too far, and considers that if a complete fertiliser were used, it would in many cases give better results. The result of experiments in New Jersey on fertilising peach orchards shows that the best results were obtained with a mixture of potassium chloride and sodium nitrate. One of the best sources of potash for orchards is wood ashes, from 40 to 50 bushels of dry ashes per acre; but the chloride is a more reliable and constant form of applying the alkali. An apple orchard in full bearing may receive as much as 1,000 lb. per acre, but it is noted that in some soils a much better effect is obtained from potash than in others; a small portion of the orchard should therefore be treated experimentally before applying the potash or potash and nitrate dressing to the whole.

## XVI.—SUGAR, STARCH, GUM, Etc.

### *Review of Recent Improvements in the Sugar Industry* M. L. Lindet. Bull. de la Soc. d'Encouragement pour l'Ind. Nat., February 1895, 147—169.

In this paper a summary of new suggestions for processes in connection with the sugar industry is given in outline, special attention being devoted to those actually adopted.

I. *Cleansing the Beetroot.*—In many works this is commenced in the hydraulic transporters. These are canals lined with cement, constructed on an incline, and leading from different parts, where the beets are dug, to the washing building. The beets thrown in, are carried along by a current of water and reach the washers freed from the largest part of the adhering soil. At the end of the canals they are from 1 to 1·5 metre below the surface, and some apparatus is therefore necessary to raise them. This may easily be effected by Maguin's wheel elevator.

In many places Loze's stone-removing washer has been set up. It consists of a box containing water, into which the beets fall. A current of water from below drives them to the surface, where they are caught by a grating and removed, while the stones fall to the bottom.

The brushing and wiping machine of Denis Lefèvre is made use of in certain factories. In this the beets are rubbed by a series of rotatory brushes while water runs over them.

Perforated drying tables actuated by a to-and-fro movement are often used to remove the water from the beets before weighing.

II. *Diffusion.*—(*a.*) *Root-cutting.*—The only important modification consists in the placing of a horizontal rotatory brush above the knives, the object of which is to remove ligneous fibre.

(*b.*) *Diffusion Battery.*—These have not been modified. It is usually preferred to have them with lateral doors to discharge the exhausted roots, while the juice passes through a hole at the bottom. Rousseau Decker in 1890 proposed having the two parts of the battery separate, but this appears now to have been abandoned.

(*c.*) *Utilisation of Spent Roots.*—Desiccation of the spent roots has not found much favour among French manufacturers, although used in several German works. The furnace most generally used is that of Büttner and Meyer. This is of solid masonry and has four floors. The pressed roots fall on the top floor, and, pushed by agitators and shovels, travel over the other floors to the bottom. Simultaneously a mixture of hot air and coal-gas enters at the top at 450°, and passes out through a ventilator at the bottom, removing the water vapour with it. One thousand kilos. of the dried roots produced represent an expenditure of 1,000 kilos. of coal.

In the Mackensen furnace, which consists of three rotatory cylinders, the gas and air also pass in the same direction as the roots, whilst in the Schulze and Schaerzel furnaces they pass in the opposite direction.

III. *Purification of the Juice.*—(*a.*) *Filtration before or after de-Albuminisation.*—The crude juice holds in suspension a certain amount of ligneous and pulpy matter. Many manufacturers consider mere filtration insufficient, and think it necessary to again filter the juice after the albumin has been coagulated at 75°—80° C. This removal of albumin, first proposed by Possoz and Perier in 1863, was again brought forward by Boury and Provins in 1881. More recently, Bouvier has shown that when the juice is warmed with 1 per cent. of lime, there is real defecation. But juice thus treated does not appear to show a higher standard of purity than that submitted to carbonating without it.

The chief advantage consists in the removal of substances which would foul the heating tubes, and it is questionable whether the result is worth the trouble involved. There is, moreover, the additional disadvantage that the de-albuminised juice is very difficult to filter. To obviate this, Bouvier has devised a decantation filter, in which the suspended matter is retained by vegetable fibre placed in baskets, which can be replaced in the apparatus when clogged.

Daix and Bouchon have also proposed methods of filtration through cotton or woollen fibre, and even through coke. Quite recently, Bouvier has suggested the removal of the coagulated albumin by making an emulsion of the liquid with oil, which, rising to the surface, carries the impurities with it.

(*b.*) *Use of Anhydrous or Slaked Lime.*—There has been much discussion of late as to whether any material advantage is gained by using these instead of milk of lime. Aulard recommends anhydrous, and Mittelmann slaked lime. The addition of the water in the milk of lime is avoided, and in the case of the less dense juices better extraction is possible, but whether there is a greater degree of purification is a moot point. In the removal of the lime from the sugar juice, the tendency of the latter to become caramelised by heat may be obviated by the use of Koenig's liming apparatus.

(*c.*) *Carbonating Tanks.*—Several manufacturers have constructed these deeper than those ordinarily employed, the object being to render the absorption of gas as complete as possible.

(*d.*) *Continuous Carbonators.*—In the exhibition of 1889 two kinds were exhibited. That of Horsin-Deon, which consists of a series of eight trays arranged as in a filter-press, with compartments in which the carbon dioxide meets the limed juice; and that of Barbet, in the form of a cylindrical metal tank in which the juice enters from above and the gas from below. The Lucke carbonator and the Mollet-Fontaine carbonator are constructed on the same principle, while in the Reboux carbonator the limed juice passes upwards through a series of zigzag brass tubes, the carbonic acid being introduced through concentric pipes. The working of these apparatus being difficult to regulate, they have not yet met with any general acceptance.

(*e.*) *Double Carbonating.*—French manufacturers are now in the habit of working denser juices than was formerly done.

(*f.*) *Filtration from Scum.*—Large filter-presses have almost entirely replaced small filters, and those most generally used have a surface of a square metre. Last year an apparatus for continuous filtration was brought out by M. Droeshout, which will probably be widely adopted.

(*g.*) *Use of Baryta.*—The purification of sugar juice by means of baryta was first tried by Manoury and afterwards by du Beaufret, but the results do not seem sufficiently satisfactory to lead to the general adoption of any of the processes.

(*h.*) *Substitute for Carbonating.*—Vivien and Lafranc have proposed a method in which the juice is treated with a mixture of fluosilicate of lead, ferrous fluosilicate, and ferric fluosilicate.

(*i.*) *Replacement of Carbonating by Electric Purification.*—Many experiments have been made since 1884 with the object of partially or completely replacing the process of carbonating, but up to the present time they have been more successful in the laboratory than in practical working.

(*j.*) *Treatment of the Juice, Syrup, &c., with Sulphur Dioxide.*—There is a general agreement that sulphur dioxide is a valuable purifying agent, but care must be taken to prevent the liquid becoming acid to any extent, lest inversion should take place. In certain cases, however, the point of neutrality may be safely passed, as where there are many organic salts present, the liberated organic acids not being so active in producing inversion as are the mineral acids.

(*k.*) *Mechanical Filtration of the Juice and Syrup.*—The necessity for rapid work has caused filtration through cotton tissues, known as *Puerez tissues*, to be widely adopted. In most of the French factories these are used in mechanical filters, the liquids being forced through under pressure.

IV. *Evaporation of the Juice.* — (*a.*) *Increasing the Power of Evaporating Apparatus.*—The most notable improvement in this direction has been the introduction of apparatus in which the liquid does not fill the tubes, but only trickles over the sides. With this end in view various *tubes à ruissellement* have been constructed. These contain an inner concentric tube projecting a little from the top of the main tube. The liquid enters by apertures between the two tubes, trickles over the inner surface of the main tube, while the vapours escape by the centre tube. This invention has not found much favour with manufacturers, who assert that they can attain the same result by partially filling the ordinary tubes.

(*b.*) *Coolers.*—With the object of avoiding mechanical loss many manufactures attach metal boxes, known as *Hodeck Coolers*, to their apparatus. The vapours pass through these before entering the condenser.

(*c.*) *Barometrical Condensers.*—Where water is abundant these are often advantageously introduced. They consist of a brass cylinder, where the vapours are condensed by a strong current of cold water. The hot water passes out by a conduit, and is carried away by a current of water from a weir.

(*d.*) *Horizontal Evaporation Tanks.*—Here the tubes are horizontal and the vapour circulates in the interior instead of the exterior. They have been adopted in several countries, but their superiority is not yet established.

(*e.*) *Apparatus for increasing the Rate of Evaporation.*—A most important modification has been the multiplication of the number of tanks and the utilisation of the heat of the vapours formed on evaporting the juice. The saving of charcoal often amounts to as much as 30 per cent.

V. *Boiling and Crystallisation of the Sugar.*—(*a.*) *Boiling Apparatus.*—In many factories the old cylindrical boilers have been replaced by rectangular ones surmounted by domes. These have the advantage of being capable of containing a large number of horizontal tubes, and thus giving an immense heating surface. Various modifications are in use. The Reboux boilers in which the mass is kept in motion by mechanical agitators, ensures the prevention of the formation of small crystals.

(*b.*) *Methodical or Systematic Boiling.*—The foreign matters which accumulate in the syrup surrounding the crystals do not interfere much until the liquid becomes too viscous to prevent the crystals being formed. M. Steffen has proposed a means of obviating this, by adding at this point syrup of equal purity and afterwards of lesser purity, than the syrup enclosing the crystals. To be successful the work must be done very slowly, and the syrup added should previously be diluted to 25°—27° B. This system favours the growth of large crystals from the small ones.

(*c.*) *Cooling the boiled Mass and Crystallisation in Motion.*—With the object of increasing the size of the small crystals Schutzenbach has suggested cooling in small portions of 100 kilos. in airy chambers, but in this method the cooling is not regular. A better process is to place the syrup in cylindrical boxes with an outer cooling jacket of water, and having within powerful agitators to keep the mass in motion. The Stammer-Bock apparatus has been widely adopted.

(*d.*) *Modifications in the Work of the Second and Third Crystallisations.*—A process has been introduced in which by crystallising in motion and using syrup previously subjected to the turbine a great saving in the time of the second and third crystallisations is effected. Unfortunately the plant required is very expensive.

*VI. Turbinage.*—The chief problem has been to discover a method of continuous turbinage. The most successful attempts in this direction are the machines designed by Szczeniowski and Pontkowski, and those of Lizeray and Dumoulin, which give results so satisfactory as to lead to the hope of their being generally adopted.

Broadly speaking, the object of later improvements in the sugar industry has been to economise hand labour, animal charcoal, and general expenses. The first has been realised by making the various operations continuous, and the last by increasing the daily output and diminishing the number of days occupied in manufacture.—C. A. M.

## PATENTS.

*An Improved Process of and Apparatus for Evaporating or Concentrating Saccharine and other Liquids.* A. Crerar, London. Eng. Pat. 16,235, August 25, 1894.

The apparatus consists of a closed copper or iron pan fitted with a double conical bottom. The inner bottom is perforated with holes, and the space between it and the outer wall, is connected by pipes radiating from the outside of the chamber to an annular air-supply pipe. The top of the pan, provided with a "goose-neck" and "save-all" (or spray catcher), is connected to a suction pump. The air (preferably heated by some suitable means) drawn in through the perforations in the inner bottom, when the exhaust is operated, bubbles through the liquid under treatment, maintaining it in a state of constant agitation, and effecting its rapid concentration.—H. T. P.

*Improvements in Apparatus for Extracting Juice from Canes, Roots, and the like.* A. G. Berry, Glasgow. Eng. Pat. 5897, March 21, 1895.

An improved form of press consisting of an open-topped cylinder into which the material (in small pieces) to be extracted, is charged by means of a hopper. At the bottom of the cylinder is a perforated piston, which can be raised right to the top of the apparatus by a powerful hyhraulic ram. The top of the cylinder is closed by a second piston, which can be lifted clear of the vessel when required, and is operated by a smaller overhead ram. Outlets for the expressed juice are provided at the base of the apparatus, and for the same purpose, the upper wall of the cylinder is perforated, and surrounded by a jacket communicating with an exhaust pump. In addition, pipes perforated to a certain height rise from the bottom of the vessel and pass through both pistons. In operation, the cylinder is charged, the upper piston lowered down and locked, and the work of compression effected by raising the lower piston. To render the extraction complete, the upper piston may be raised, the mass moistened with water or treated with steam, and again pressed. Finally, the lower piston is raised flush with the mouth of the cylinder, and the residual "cake" removed *en bloc* by a suitably fitted revolving scraper.—H. T. P.

*An Improved Steam Pan for Boiling Sugar or other Liquids.* G. Fletcher, Litchurch, Derby. Eng. Pat. 11,525, June 13, 1895.

*See under* I., *page* 736.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Note on Bacillus Subtilis.* A. J. Brown. Journ. Fed. Inst. Brew. 1895, **4**, 423—426.

Van Laer has shown that *Saccharo bacillus pastorianus* is the organism which causes ales to become sour, and not *Bacillus Subtilis* as hitherto commonly supposed. The author has found that cultures of *Bacillus Subtilis* do not grow in malt-wort or in ale, when these liquids are normally acid, also that this bacillus is an aërobic organism, and cannot, therefore, develop under the usual conditions of brewing or storing ales. A solution of cane sugar is inverted and then completely oxidised by this organism, and by its action on dextrose a volatile lævo-rotatory substance with a high-reducing power was observed.—J. L. B.

### *Investigations on Pure Yeasts.* J. Wortmann. (Analytical portion by R. Aderhold.) Zeits. f. Spiritusindustrie, 1895, **18**, 79, 95, and 103.

This investigation was undertaken in order to try and determine whether a definite species of wine yeast retains its specific physiological characters when grown in different nutrient media, or whether such characters change with the composition of the must. But at the same time it was intended to throw light on the relation of the yeast to the fermentation and on whether the products formed, such as alcohol and glycerin have a definite relationship to each other, to the yeast, or to the composition of the must. With this aim it was desirable to experiment on the one hand, with as many different musts as possible, with the same yeast and on the other, with different yeasts on the same musts. 41 musts were collected from different wine districts in three-litre tins and were sterilised by boiling at the time of collection. 117 cultivations were made in a special glass-house built for the purpose and maintained at a temperature of 17—24° C. Large scale experiments were also started on similar lines but the results of these latter are not yet known. The principal yeasts used were those characteristic of Johannisberg, Wurzburg, and Ahrweil wines. In the inoculation as nearly as possible 1,000 cells were added to each cubic centimetre of must. At the end of the fermentations the numbers of yeast cells found, varied between 31,600 and 153,000.

The prepared flasks were all inoculated on the same day, and at the end of five days all were in active fermentation. In those flasks inoculated with Johannisberg yeast, there was, besides the main portion of the yeast at the bottom, a cloudy collection of yeast on the sides of the vessels. The Wurzburg yeasts showed the same appearance but to a much less degree, the other yeasts did not show it at all. At the end of 14 days, the principal fermentation had ceased in all cases, but on shaking up, a further slight fermentation occurred. This is probably due to a large number of the yeast cells at the bottom of the flask being practically out of contact with the liquid and to the top layer of the yeast deposit being surrounded by a layer of liquid rich in alcohol.

The results obtained may be summarised as follows :—

The musts containing the Ahrweil yeast, gave, in most cases, the greatest increase in the number of cells, those containing Johannisberg yeast, a less increase, and those containing Wurzburg yeast the least increase.

As a whole, each yeast maintained its specific characteristics, whatever the must in which it was inoculated.

The Wurzburg yeast yielded wine containing most extract (*i.e.* used up for its own development least extract), the Ahrweil yeast the least, the Johannisberg yeast coming between these. The Ahrweil yeast also removed most mineral matter and most nitrogen from the must.

Wurzburg yeast produced most glycerin, Johannisberg less, and Ahrweil least, and in general the more active the fermentation, the more glycerin is formed.

In alcohol formation all three yeasts were pretty equal, but the Johannisberg yeast was found to be more sensitive to the influence of alcohol in restraining fermentation. The alcohol production appears to stand to some axtent in relation to the increase in the number of cells.

The estimation of the bouquet was rendered difficult by the sterilisation, which gave a boiled odour to all the musts, but there could be no doubt that the Johannisberg yeast gave a richer bouquet than either Wurzburg or Ahrweil. Whilst the bouquet is undoubtedly dependent to a considerable extent on the composition of the must, it requires the right yeast to develop it properly. The author believes that much may be done in this direction by a judicious selection of yeasts. For instance, a combination of Pfalz must and Rheingau yeasts gives very satisfactory results. In the same way, real Moselle wine cannot be obtained from Moselle must, without the intervention of the characteristic Moselle yeast.—L. T. T.

### *Quantitative Separation of Amorphous Nitrogenous Organic Compounds contained in Beer.* H. Schjerning. Zeits. Anal. Chem. **34**, 1895, 135—147.

(This Journal, 1894, 1103). The author has continued his investigations of beer worts and in the present paper, besides verifying and correcting his previous results, he gives a preliminary account of the nature and character of the precipitates already investigated by him. The results are summarised as follows :—

1. The Sn precipitate is identical with the absolute Pb precipitate, and the absolute Ba with the Pb – Sn precipitate.

2. The total quantity of the ammonium salts in the malt is completely dissolved in the wort, independent of the temperature of mashing; and the amount of ammonia is neither increased nor diminished during the process.

3. The greatest solubility of the nitrogenous compounds contained in the malt as also the highest degree of peptonisation, occur at about 60° C.

4. The results favour Mulder's view, that the amorphous nitrogenous organic componnds contained in the wort are formed from a highly complex proteïn substance, or from one of its products of decomposition.

5. *a.* The Sn precipitate (abs. Pb) appears to contain the proteïns most nearly allied to the albumins, and may therefore be designated "albumin."

*b.* The nature of the precipitate Pb – Sn (abs. Ba) is still unknown, but it appears to be a decomposition product of a nucleïn, and the name "denucleïn" is provisionally suggested for it.

*c.* The abs. Fe-precipitate seems to be derived from a proteïn with properties intermediate between the albumins and the real peptones, whence the name "propetone."

*d.* The abs. Ur-precipitate must be looked upon as a genuine "peptone."

6. From the experiments, it follows that the peptone is formed at the expense of the albumin, and that the formation of propeptone takes place chiefly at the expense of the denucleïn.—J. S.

### *Fractional Fermentation of Cane Sugar with Pure Yeasts.* Hiepe. Journ. Fed. Inst. Brewing, 1895, **3**, 288—327.

Morris and Wells (this Journal, 1892, 764) investigated the fractional fermentation of worts and finished beers; but with few exceptions, restricted their experiments to ordinary brewery yeast. The author has employed pure culture, single-race yeasts. The yeast was added to a 10 per cent. solution of cane sugar; at stated intervals portions were withdrawn, evaporated to a syrup, and made up to the original volume; the specific gravity, optical activity, and cupric reducing power of the solution were then determined. The amount of unaltered cane-sugar was estimated as follows:—Some yeast was added to 10 c.c. of the solution, the temperature maintained for 6—7 hours at 135°—145° F., and then left overnight at the ordinary temperature. Under these conditions inversion is completed without fermentation. From the data so obtained the author determines the amount of cane sugar, dextrose, and levulose in the unfermented residue, and calculates—

1. The quantity of inverted cane sugar.
2. The quantity of fermented solid matter.
3. The quantity of fermented dextrose.
4. The quantity of fermented levulose.

These results show—

Firstly, that inversion and fermentation proceed together, but that inasmuch as the former begins and ends before the latter, at these respective stages inversion alone and fermentation alone takes place. In the intermediate stage both processes go on simultaneously.

Secondly, that the products of the inversion of cane sugar are not fermented as soon as formed, and that they are found in excess in the liquid until the completion of fermentation.

Thirdly, that the inversion products do not ferment at the same rate, but dextrose ferments more quickly at the beginning, being always present in less quantities than the levulose.

The author also recounts experiments to show that some pure yeasts, while carrying out the inversion of cane-sugar, exhibit a decreased fermentative activity.—J. L. B.

### *Influence of Oxygen on Alcoholic Fermentation.*

D. Iwanowsky, Botanisches Centralbl. **58**, 344.

The author has carried out at the Botanical Laboratory of the St. Petersburg Academy, a long series of experiments on this subject, in which special precautions were taken to obviate sources of error, and especially to prevent the increase of alcohol, in the medium surrounding the yeast. For this purpose, the yeast was spread on porous plates or filter paper, and the nutritive medium allowed to drop on to the surface at such a rate, that the yeast was just covered, but the medium which had passed through the layer of yeast and so contained alcohol, could filter away freely.

The results of the investigation, shew that the Fermentation Energy (expressed in grms. of sugar, fermented by 1 grm. of dry yeast in 24 hours) remains the same in the presence or absence of oxygen. The reproductive power of the yeast, however, rapidly decreases in the absence of air. Previous results of an opposite character have probably been due (*a*) to the disturbing influence of accumulation of alcohol, and (*b*) to the fact that in anaërobic cultivations, the reproduction and increase of the yeast very soon cease, and so the average quantity of yeast, generally calculated as the mean between the initial and final quantities is, in the case of anaërobic cultivations, not the true average. Pedersen's results for instance, recalculated with these points taken into consideration, give results analogous to those of the author.—L. T. T.

### *Influence of Oxygen on the Amount of Alcohol and of Carbonic Acid formed during Fermentation.*

E. Giltay and J. H. Aberson. Zeits. f. Spiritusind. 1895, **18**, 2.

As the result of experiments with known quantities of yeast in media of known composition, and with and without excess of air, the authors draw the following conclusions—

In air cultivations, a considerable quantity of sugar is oxidised, and more sugar is destroyed than in control cultivations carried on out of contact with the air.

The increase in weight (dry), and also the proportion of sugar decomposed to the average quantity of yeast present, are greater in the presence of air, but the proportion of sugar decomposed to increase of dry weight, is less.

The proportion of sugar broken up into alcohol and carbonic anhydride to the average weight of yeast present, is less in the presence of air.

When enriched air containing 50 per cent. of oxygen was employed, the sugar oxidised was about double that oxidised when ordinary air was used, and with pure oxygen the quantity increased from two to three-fold.—L. T. T.

### *Note on Gluten Turbidity in Beers.*

O. Reinke. Wochenschr. f. Brauerei, 1895, 213—214.

It is frequently observed that beers—especially pale beers—when cooled to about − 1° R, develop a gluten turbidity, which only disappears when the beer is again heated to 10°—25° R. Again, pasteurised beers are liable to be troublesome in this respect at comparatively high temperatures (12° R.), the turbidity only disappearing at 25°—40° R.

For the prevention of the trouble, it is well to avoid the use of barley rich in nitrogenous substances, when pale beer for pasteurising is to be brewed. If such material must be used, the growth on the floors should be continued as long as possible, at not too low a temperature; and during curing, the kiln should be loaded rather deeply. In general, care should be taken to use only malt that has been stored sufficiently long; the peptonising mash temperature (40° R.) must be carefully observed, and the concentrated "Dickmaischen" thoroughly boiled; excessive sparging should be avoided, and the "goods" not allowed to cool to 40° R., prior to the production of the second wort. In the after-treatment of the wort, points to be attended to are: thorough boiling of the hopped wort, and the selection of hops suitable as regards tannin content: thorough hot and cold aeration, and sufficient cooling of the wort ($3\frac{1}{2}$° R.), prior to pitching; the use of vigorous yeast, thorough rousing and aeration during fermentation, and employment of a higher final temperature; slow cooling to 3° R., prior to racking. The composition of the brewing liquor, as regards the amount and nature of the salts present, is also of influence.

In beers, naturally quite free from gluten turbidity, a veil may be produced at temperatures below 2° R., by the addition of sulphurous acid, sulphites, and the salts of copper and certain other metals. For instance, by the action of the lactic or sulphurous acid in beer, on copper and brass vessels or fittings, copper salts are formed in solution which may produce a decided veil of a most troublesome nature, with difficulty dispelled by heating the beer. The use of phosphor-bronze valves, &c., has been recommended.
—H. T. P.

### *Saccharification of Malt more Slowly in the Brewery than in the Laboratory: An Explanation.*

Windisch. Wochenschr. f. Brauerei, 1895, 270—271.

In practice, the saccharification of the "Dickmaische" frequently proceeds far more slowly than might be expected from the results of laboratory experiments. Indeed, in many cases, the transformation of the starch is, of necessity, allowed to remain incomplete. According to the author this state of affairs must be wholly attributed to the inadequate nature of the rake-machinery usually employed. As a rule, the mash-copper is fitted with some form of endless chain-stirrer, which just suffices to preserve the mash from burning, but utterly fails to effect a thorough mixing of the same. Consequently, the heat of the mash is far from uniform; and, although the fixed thermometer at the side of the vessel may indicate the saccharifying temperature (48°—52° R.), the heat at the centre, and especially at the surface, will be much less (variations up to 18° R. were observed), so low, in fact, that the starch is not appreciably acted upon. A perfect command over the mash-copper temperature is, however, of the greatest value as a means of regulating the conditions of saccharification, and, therefore, the carbohydrate constitution of the wort. At present such control of results is only possible in the mash-tun. The use of powerful and efficient rake-machinery in the mash-copper is therefore urgently recommended.
—H. T. P.

### *The Most Frequent Causes of the Want of Stability of Beers in Cask and Bottle.*

Windisch. Wochenschr. f. Brauerei, 1895, 214.

When beer becomes turbid in cask or bottle the cause is often to be sought for in the excessive growth of bacteria or yeasts. Bacterial turbidity is seldom met with, and can in most cases be ascribed to gross negligence in regard to cleanliness of plant, &c. Yeast turbidity, however, is more frequent; and the means usually relied upon for its avoidance are: (1.) The attainment of as high a degree of fermentation as possible; (2.) A high percentage of carbonic acid.

Beers as sent out usually contain more or less fermentable matter, which under favourable conditions of temperature may give rise to an after-fermentation, and consequent formation of new yeast-cells. It is most desirable, therefore, to ascertain from time to time whether the maximum degree of fermentation is being reached. It must be remembered, however, that this by no means implies a high degree of attenuation; the latter depends entirely on the composition of the wort. In practice, a sample of the beer is fermented for 8—10 days at the room temperature with a considerable excess of the usual pitching yeast, the drop in gravity being observed by means of a saccharometer. If the loss be at all large, the beer cannot be absolutely relied upon to remain bright. In the production of stable beer, it is of importance that fermentation in the tun be practically complete. Only sufficient fermentable matter must be left to afford the necessary "condition" in the storage vessel.

The retarding influence of carbonic acid on yeast development is well known; and beers rich in the gas (0·4 per cent.), even if they contain fermentable matter, will frequently remain sound under trying circumstances. In this connection, it is pointed out that the usual mode of bottling beer involves the loss of much gas. The correct method—very seldom practised—is to draw the beer straight from the storage vessel.—H. T. P.

*Ratio of Dextrose to Levulose in Sweet Wine and Honey, and its Bearing on the Detection of Adulteration in these Articles of Diet.* J. König and W. Karsch. Zeits. Anal. Chem. 1895, **34**, 1—18.

*See under* XXIII., *page* 773.

*Volumetric Estimation of Sugar in Wine by Fehling's Solution.* A. Bornträger. Zeits. Anal. Chem. 1895, **34**, 19.

*See under* XXIII., *page* 773.

*Detection of Flurine Compounds in Wine.* G. Nivière and A. Hubert. Monit. Scient. 1895, **45**, 324.

*See under* XXIII., *page* 773.

## PATENTS.

*An Improvement in the Purification of Alcohol, Spirits, and the like.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 13,153, July 6, 1894.

The spirit is mixed with an electrolysed solution of sodium chloride, prepared as described in Eng. Pat. 18,370 of 1893 (this Journal, 1894, 170), a little magnesium chloride is added, and the mixture redistilled.

In some cases it may be necessary to further electrolyse the mixture before redistillation, in which case it is passed through an apparatus as described in Eng. Pat. 1993 of 1887 (this Journal, 1888, 126). Or the spirit may be mixed with sodium chloride and magnesium chloride and then electrolysed.

About 100 gallons of raw spirit can be purified in 1—2 hours by 33 gallons of electrolysed solution containing 400 lb. of salt and 40 lb. of magnesium chloride.—A. L. S.

*Apparatus for the Preparation of Wort.* C. Rach, Chicago, U.S.A. Eng. Pat. 13,364, July 10, 1894.

The apparatus consists of a "cooker" in which cereals can be subjected to the action of steam and water under pressure, in combination with that of stirrers, whereby the cereals are swelled and softened to such an extent, that when conveyed into the mash tun, where they are mixed with malt, they are readily converted into dextrin and sugar. The specification is accompanied with drawings giving full details of the apparatus.—A. L. S.

*An Improved Manufacture of Barm or Yeast.* G. Bartlett, Leicester, and W. Pearsall, Birmingham. Eng. Pat. 15,517, August 15, 1894.

A hopped wort is prepared, and a quantity of mineral matter (chiefly phosphates) is added; this is then concentrated in vacuo to a syrup.

When required for use, the syrup is diluted with water and ordinary brewer's yeast added. After 24 hours, the fermenting liquid is mixed with flour to form a sponge or dough, which is employed in the usual manner.—A. L. S.

*Improvements in the Manufacture of Beer.* A. W. Billings, Eng. Pat. 15,833, August 20, 1894.

The inventor proposes to aërate the wort whilst in the copper or hop back. He recommends a modification of the apparatus described by him in Eng. Pat. 8952 of 1892 (this Journal, 1892, 833) and Eng. Pat. 17,912 of 1893 (this Journal, 1894, 896), and proposes to inject air underneath the strainer plates.—A. L. S.

*Improvements in and relating to Distilling Apparatus, chiefly designed for the Manufacture of Pure Grape Spirit and of Whiskies free from Fusel Oil.* P. L. F. E. Vignier, Fulham, Middlesex. Eng. Pat. 22,270, November 17, 1894.

This is an improvement of a previous process of the inventor (Eng. Pat. 20,430 of 1890; this Journal, 1891, 379). Instead of two distillations being necessary, as in the ordinary process of making whiskies, &c., the inventor performs the two distillations at the same time and in the same vessel, he has also a special condenser for separating the fusel oil.—A. L. S.

*Improvements in the Malting of Grain.* J. W. Free, New York, U.S.A. Eng. Pat. 2372, February 2, 1895.

The inventor proposes to induce a current of air and to pass it through the maltings and kiln by the aid of a chimney and furnace. The air is either cooled or warmed before admission to the malt house.—A. L. S.

*Improvements in the Manufacture of Diastasic Ferments.* C. L. Hart, Chicago, U.S.A. Eng. Pat. 6207, March 26, 1895.

A mixture is made of sand (90 lb.), starch (10 lb.), and water (10 lb.), and the whole heated by steam until the starch is gelatinised. Wheat or maize flour is a convenient form of starch to employ. The steamed mass is cooled to 100° F., and then mixed with a small quantity of the spores of maize smut (*ustilago maydis*). This is spread on trays and placed in a room kept at 80° F., the air of which is kept humid. The mould spores grow rapidly and in about 36 hours the moisture is shut off, when the product quickly dries; if the growth be allowed to continue longer, spores are formed which are useful for subsequent operations.

The finished product, either before or after drying, is extracted with water; when it yields a solution rich in diastase, and which can be employed as a substitute for malt.—A. L. S.

*Improvements in the Manufacture of Ferment Leavens.* G. D. Hart and C. L. Hart, Chicago, U.S.A. Eng. Pat. 7997, April 23, 1895.

Maize grits are stewed until their starch cells are thoroughly gelatinised; the mass is cooled to 35°, and mixed with "Moyashi" (the spores of Aspergillus Oryzæ), a body used by the Japanese saké brewers. The mould soon commences to grow, and the product is Koji. This is mixed with a little water and pressed yeast, when in about 3—6 hours a slight fermentation takes place; the mass is then broken up and dried, a little steamed starch being added if necessary. The leaven is then ready for use.

In place of Moyashi, other parasitic smuts may be substituted, such as are native to maize (Ustilago Maydis), to wheat (U. Tritici), to rye, (Claviceps Purpurei), to barley (Ustilago Hordei), and to oats (U. Avenæ). Also the spores of edible mushrooms, the common puff ball, and ordinary brewer's yeast. The maize may also be replaced by other starchy materials, such as that of potatoes, beans, &c.—A. L. S.

*An Improved Method of Charging Liquids with Gas.* J. Schneible, New York, U.S.A. Eng. Pat. 8006, April 23, 1895.

The essential feature of this invention is that instead of having the gas at a higher pressure than the liquid, and injecting it into the liquid, the liquid is at the higher pressure. A stream or jet of the liquid meets the gas, and both together are forced into an absorption chamber, in which a greater pressure is maintained than that of the gas when it meets the liquid.—R. B. P.

*A Process and Apparatus for Infusion and Extraction of Hops.* E. Heinemann, Dortmund, Prussia. Eng. Pat. 8319, April 26, 1895.

The hops to be used in a brewing, are first boiled with wort in a closed vessel heated by a steam jacket; after the boiling is completed, the wort is drawn off by a pipe furnished with a strainer to keep the hops back in the boiler; these hops are then washed by weak wort running over them.—A. L. S.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (*A.*)—CHEMISTRY OF FOODS.

*Formalin as a Milk-Preservative.* S. Rideal. Analyst. 1895, **20**, 157—158.

When formalin is added to milk in the proportion of 1 part of formaldehyde to 10,000 of milk, the sample remains "fresh without curdling," for seven days.

In determining the strength of a formalin solution first titrate with N/100 NaOH to ascertain the acidity, then agitate a known volume with excess of standard ammonia solution, and distil the excess of ammonia into standard acid and titrate back. 180 parts by weight of formaldehyde combine with 68 parts by weight of ammonia (compare Trillat, this Journal, 1893, 789).

To detect formaldehyde in milk the author distils a portion and tests the distillate with Schiff's reagent (magenta bleached by sulphurous acid). The test cannot be applied directly to milk, since all samples give a pink colour with Schiff's reagent.—A. G. B.

*Use of Formalin as a Preservative of Milk Samples.* E. J. Bevan. Analyst, 1895, **20**, 152—154.

The addition of a few drops of formalin (40 per cent. solution of formaldehyde) to milk is a convenient method of preserving the sample for analysis. It is, however, to be noted that such addition is liable to cause an increase in the total solids of the milk, particularly if the analysis be performed after the lapse of a few days; thus, a milk containing 13·24 per cent. of total solids yielded 13·47 per cent. when 5 c.c. were evaporated with two drops of formalin, 13·77 per cent. when six drops were used, and 14·10 per cent. with 10 drops. One c.c. of the formalin evaporated with 5 c.c. of water left no residue.

The following figures indicate that in many cases formaldehyde is not volatilised when its solution is evaporated with that of another substance :—

| Solution of | Total Solids, Per Cent. | |
|---|---|---|
| | From 5 c.c. of the Solution. | From 5 c.c. of the Solution, to which 1 c.c. of Formalin has been added. |
| Albumin and milk-sugar (equal parts). | 7·59 | 9·29 |
| Albumin | 3·82 | 4·12 |
| Milk-sugar | 4·62 | 7·28 |
| Cane-sugar | 4·82 | 6·90 |

A salt solution also showed an increase of weight when evaporated with formalin, and in this case a small quantity of white substance insoluble in water was formed, from which it seems probable that part, at all events, of the observed increase is due to polymerisation of the formaldehyde to a non-volatile compound.

In many cases the author finds that the increase caused in the total solids of a milk by the addition of formaldehyde is four times as great as the weight of the formaldehyde employed, and he attributes the gain to the conversion of milk-sugar into galactose. If the milk contain 4 per cent. of milk-sugar, and this be completely converted into galactose, there will be an increase of 0·2 per cent. of total solids; the increase found will have varied from 0·11—0·20 per cent.—A. G. B.

*Action of Formalin on Food Stuffs.* T. Weigle and S. Merkel. Chem. Zeit. Rep. 1895, 142.

One part of formalin in 5,000 of milk will preserve the sample for 100 hours at 25° C.; 1 in 10,000 will keep the milk for 50 hours at 25° C. The albuminoids in milk are rendered insoluble in a mixture of sulphuric and acetic acids by formaldehyde; furthermore, the casein can only be precipitated in thick clots from milk containing formalin, not in the fine flocculent condition in which it is precipitated from normal milk. Formaldehyde renders the albuminoids of milk less digestible; the casein of samples containing one part of formalin in 500 was insoluble in pepsin and hydrochloric acid.

Butters to which this preservative has been added increase in acidity very slowly. The saccharification or starch by diastase is favoured by formaldehyde, whilst alcoholic fermentation is much delayed.—A. G. B.

*Ratio of Dextrose to Levulose in Sweet Wine and Honey, and its Bearing on the Detection of Adulteration in these Articles of Diet.* J. König and W. Karsch. Zeits. Anal. Chem. 1895, **34**, 1—18.

*See under* XXIII., *page* 773.

## PATENTS.

*Improvements in and connected with Apparatus for Preserving Animal and Vegetable Food and other Substances.* T. H. Lee Bake and H. A. Leverett, both of London. Eng. Pat. 13,587, July 13, 1894.

The meat to be preserved is wrapped in coarse cloth and placed in a tank, which is then filled with dilute salicylic or boric acid. The lid is now put on, its rim forming an airtight joint, by means of a water lute, and nitrogen gas is admitted through an inlet tap, displacing the solution already referred to. Or, the meat may be simply wrapped up in cloths previously dipped in acid water and placed in the empty tank from which the air is expelled by a strong current of nitrogen.—L. de K.

*Improvements in or relating to the Sterilisation and Preservation of Milk.* R. G. Nash, Dublin. Eng. Pat. 13,712, July 16, 1894.

The inventor claims the construction of an apparatus for filtering, heating, sterilising, and cooling milk.

The milk is first passed through three separate wedge-shaped strainers, each connected with a compartment. The first strainer packed with muslin, retains the coarser impurities. By means of a pipe, the milk is then led to the bottom of a filter through the trays and filtering medium (clean gravel), through which it rises so as to overflow into a steam jacketed vessel. Here the milk, kept in agitation, is heated to about 160° F. After being thus sterilised, it is allowed to trickle over the exterior of a refrigerator into a pan, from which it gently flows on to a strip or bag, and thence into the milk can.—L. de K.

*Improvements in or applicable to Vessels for Preserving Food, or for Sterilising or Disinfecting Articles by Heat.* J. Raab and F. Bingler, both of Ludwigshafen a/Rh., Germany. Eng. Pat. 14,183, July 24, 1894.

The chief claim of the inventors is the means for preventing access of air to vessels from which it has been previously expelled by heat.

The opening of the vessel has a thick rim. After the vessel is filled with food stuffs a lid having a raised edge or rim is placed thereon, and temporarily held in position by clamps. On the lid is a capsule with openings covered externally by a band of india-rubber. On heating the vessel, the air escapes through the openings of the capsule, and any remaining germs are killed by the heat. On cooling, the pressure of the outer air presses the rubber band into the openings of the capsule and also presses down the lid, thus hermetically closing the vessel. The clamps then lose their hold and drop off.—L. de K.

*Improvements in Preserving Extracts from Lemon and the Like.* B. Biggs, Cardiff. Eng. Pat. 15,168, August 8, 1894.

The improvement consists in adding to the juice and the extract from the peel of fresh lemons and limes, from 5 to 25 per cent. of acetic acid. Sugar may be added if desired. The claim is for the preparation of a product free from any musty taste.—L. de K.

*An Improved Process and Means used therein to Effect the Preservation of Perishable Substances.* D. A. Sutherland, London. Eng. Pat. 15,558, August 15, 1894.

The filled but open tins containing meats, game, or fruit are subjected to compressed carbonic acid, about 100 lb. per square inch, so as to be thoroughly saturated with the gas. The tins are then at once closed, the gas which partly escapes from the contents preventing access of air during the soldering. Or the tins may be closed with a lid provided with a simple flap or valve which opens inwards, and after being soldered, they are returned to the pressure chamber. The gas opens the valve and so fills the tin with high-pressure carbonic acid, which, after the tin is taken out of the chamber, closes the valve.—L. de K.

## (*B.*)—SANITARY CHEMISTRY.

*Permanganate of Lime as a Water Steriliser.* Pharm. J. July 20, 1895, 69.

M. Bordas, at the Academy of Medicine, called attention to the advantages of permanganate of lime for the purification of water on account of the readiness with which it decomposes in the presence of organic matter, splitting up into oxygen, oxide of manganese, and lime. He found that the salt possesses very great oxidising power and considerable destructive action on micro-organisms. He asserted that the antiseptic properties of this salt are much superior to those of bichloride of mercury, and, moreover, it has the distinct advantage of being neither poisonous nor caustic. M. Bordas estimates that the addition of ten milligrammes of permanganate of lime to a litre of water is sufficient to effect complete sterilisation in five minutes, and from comparative experiments with various antiseptics, more especially permanganate of potash, he comes to the conclusion that the sterilising power of the latter salt is about a hundredth part of that of the permanganate of lime.

## PATENTS.

*Improvements connected with the Filtering of Water and other Liquids.* C. E. Chamberland, Paris. Eng. Pat. 11,090, June 7, 1894.

This invention relates to apparatus in which the liquid to be filtered is caused to pass through hollow porous bodies, and particularly to porous bodies of the kind described by the same inventor in Eng. Pat. 5339, March 22, 1884. Two ends are aimed at: (*a*) to indefinitely sterilise the water, (*b*) to make the delivery of the filtrate regular and constant.—R. B. P.

*Improvements in and connected with Apparatus for Burning Garbage and House Refuse.* H. E. Newton, London. Communicated by the Pinhoe Patent Refuse Destructor Co., Sydney, New South Wales. Eng. Pat. 12,893, July 3, 1394.

The refuse is discharged on to a table in a room, where it is roughly sorted, and material obviously non-combustible is removed; it is then tipped through an opening in the floor of the room down an inclined shoot, which is provided with doors at the top and bottom. When the bottom door of the shoot is opened, the refuse falls into a furnace where it is consumed, but so long as it remains in the shoot it is dried by the heat of the waste gases from the furnace, which pass up below the shoot. The steam and other gases evolved from the drying refuse are withdrawn from the shoot and injected into the ashpit below the furnace, whence they pass up through the fire. The products of combustion from this furnace, together with a sufficient excess of air, are made to pass through a second furnace to consume any noxious gases, and are finally led away through a series of scrubbing chambers into the chimney. The heat of the second furnace is utilised to raise steam for an engine, which may drive a ventilating fan placed in the sorting room, or do any other useful work.—L. A.

*Improvements in or connected with Destructor Furnaces for the Treatment of Town Refuse.* S. Willoughby, Chiswick, Middlesex. Eng. Pat. 14,784, August 2, 1894.

Above the furnace proper, an inclined, horizontal, revolving flue is fixed, through which a regulated supply of heated air can be admitted to the products of combustion beyond the bridge. The refuse to be destroyed is fed into a hopper, and in passing down the flue is consumed by the heated air, and the ashes fall into a pit. The heated products of combustion are utilised to raise steam in a tubular boiler, after which they are washed by jets of water on their way to the chimney. The gases may be passed through a second furnace if material of a very offensive nature is being consumed.—L. A.

*Improvements in and relating to Apparatus for Lighting, Extracting, and Destroying Sewer and such like Gases; also for Ventilating, Heating, and Consuming Smoke.* C. Horton, Birmingham. Eng. Pat. 14,967, August 4, 1894.

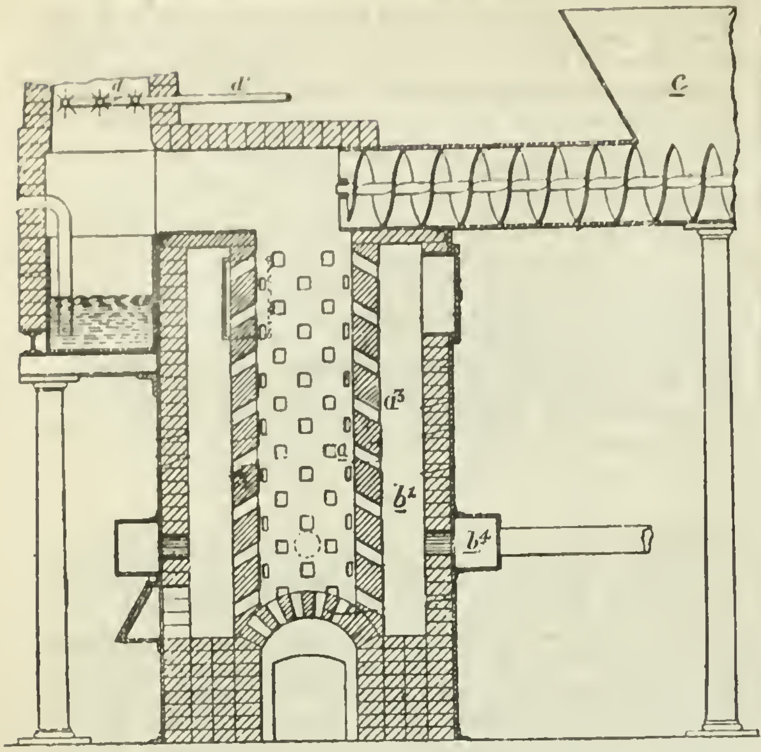
Various arrangements are shown and described, in all of which the sewer or other gas to be purified, is made to form part of the air supplied to an atmospheric gas burner either of the incandescent or ordinary non-luminous type. —L. A.

*An Improved Apparatus specially adapted for Disinfecting, Heating, Fumigating, and generally for Sanitary Purposes in Dwelling Houses, Hospitals, and other Buildings.* M. Wilson, London. Eng. Pat. 15,222, August 9, 1894.

A tray containing a cake of slow-burning material, is enclosed within the lowest compartment of a vessel, the middle compartment of which contains a solid or liquid disinfectant, and the upper is dome-shaped and perforated with holes, and contains coils of absorbent material. A taper tube dips from the upper compartment below the liquid in the middle compartment, and evaporation takes place from the surface of the liquid in this tube only, which empties and refils like a bird fountain. The absorbent material continues to give off vapour, even after the apparatus has cooled down. The vessel described is enclosed within a perforated outer casing, and may be safely placed in any desired situation.—L. A.

*Improvements in or connected with Destructor Furnaces for the Treatment of Town Refuse and Road Sweepings.* S. Willoughby, Chiswick, Middlesex. Eng. Pat. 15,526, August 15, 1894.

The destructor is shown in vertical section in the figure. The refuse is fed into the hopper *c*, and is conveyed by the screw into the vertical cylindrical shaft *a*, having perforated walls. This is surrounded by the annular furnace $b^1$, supplied with air-blast from the annular box $b^1$, and the heated gases from this furnace, passing through the perfo-



Destructor for Town Refuse.

rations $a^3$, consume the refuse, and the products of combustion pass through water-spray from the sprinkler $d^1$ and escape into the chimney.—L. A.

### (C.)—DISINFECTANTS.

*Investigations respecting the Disinfecting Power of Soap Solutions.* Max Jolles. Zeits. für Hygiene, 1895, 130; Proc. Inst. Civil Eng. **121**, 1895, 21.

As the outcome of the experiments the author observes that, in the case of the typhoid bacilli, the disinfecting properties of a soap solution are much more marked at low temperatures (4° C. to 8° C.) than at ordinary temperatures. There is, practically, little difference in the disinfecting powers of the dissolved soap at any range of temperatures between 18° C. and 30° C. When rags infected with the germs were treated in the soap solution the action of the soap was very marked, and even a 1 per cent. solution was injurious to the germs in 15 minutes, and a 6 per cent. solution resulted in the entire destruction of all germs with an exposure of equal duration.

A 3 per cent. solution was fatal in one hour, and in a 1 per cent. solution no germs remained capable of development after two hours' immersion. The tests of the soap solution with the *bacillus coli communis* were not quite so favourable to its disinfecting action as in the former case, but this would be readily understood because of the far greater powers of resistance which these bacilli are known to possess. At low temperatures a 2 per cent. solution was fatal in six hours. As the temperature rises the action of the solution diminishes, but even in the case of these bacilli an 8 per cent. solution destroyed all germs in 30 minutes, a 6 per cent. solution in one hour, and a 3 per cent. solution in 6 hours. The author concludes that, in consequence of its antiseptic action, soap furnishes a powerful and safe disinfecting agent for certain of the most prevalent disease germs.

### PATENT.

*Improvements in the Manufacture of Antiseptic Agents.* J. Y. Johnson, London. From F. v. Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 15,361, August 11, 1894.

On account of their poisonous, caustic, or otherwise objectionable qualities, the substitution derivatives of phenol (methyl-, chloro-, bromo-phenol, &c.) have been but little used as antiseptics. The subject of this patent is a process for the conversion of such phenolic substances into the corresponding carbonates. The latter are neutral, crystalline bodies, as a rule practically odorless, tasteless, and non-poisonous and therefore far more suitable for antiseptic purposes. The conversion into carbonates is effected by the action of phosgene (carbonyl chloride) on the substituted phenols—

$$2C_6H_4.OH.R' + COCl_2 = (C_6H_4.OR')_2CO + 2HCl.$$

The reaction is brought about under pressure at an elevated temperature, if necessary, in presence of an indifferent solvent, such as benzene. In most cases, however, a preferable method is to dissolve the phenol in an equivalent quantity of soda solution, and then add carbonyl chloride until neutrality is attained.—H. T. P.

## XIX.—PAPER, PASTEBOARD, Etc.

### PATENTS.

*Improvements in or applicable to Paper-making.* J. Hargreaves and T. R. Hewlett, Manchester. Eng. Pat. 11,264, June 11, 1894.

The improvement is effected by the employment of an artificial ochre composed of a mixture of equal parts of sulphate of iron and slaked lime, or chloride or sulphate of lime dissolved in sufficient water to make it of the consistency of milk. This mixture is preferably added to the fibres whilst in the rag engine. The effect is to cleanse and stain the fibres as well as size them, and also purify the effluent water.—S. P. E.

*Improved Process of Preparing Paper Stock.* T. C. Cadwgan, Anderson, Indiana, U.S.A. Eng. Pat. 9987, May 21, 1895.

This process relates to the preparation of paper stock from straw, rags, manilla, &c., after leaving the bleaching tanks. In this condition the pulp is made to flow down an inclined trough, in which it meets with one or several jets of water under pressure, by which means it is washed and partly disintegrated. From this trough the pulp falls into a washing and disintegrating apparatus, and thence into an inclined vessel or beating engine having three sets of beating rolls and bed plates somewhat of the ordinary type. From the lower end of this engine, the washed and disintegrated stock falls into a second washing apparatus, and thence passes to a refiner.—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Method of Preserving Solutions of Hydrogen Peroxide.* S. Zinno. Bull. Soc. Ind. Mulhouse, 1895, 78—79.

The method consists in the addition to oxygenated water (hydrogen peroxide solution) of pure crystallised naphthalene. One grm. of naphthalene should be added to each litre of the liquid, the hydrocarbon itself undergoing no change even at a temperature of 40° C.

In a report on the process, C. Schoen states that "10-volume" oxygenated water loses in two months, when naphthalene is added, 15 per cent. of its original strength; without this addition, 35 per cent. With a 1-volume solution the figures are 15 and 37 per cent. respectively.

—R. B. B.

*Croton Oil. An Enquiry into the Nature of its Vesicating Constituent.* W. R. Dunstan and Miss L. E. Boole. Pharm. J., July 6, 1895, 5.

The vesicating constituent, or more strictly, the pustule-producing constituent of croton oil, has been the subject of investigation for 40 years.

A substance was isolated by the authors which they propose to name "croton-resin." To its presence the vesicating property of the oil is due. Its empirical formula is $C_{13}H_{18}O_4$, and its molecular formula at least $(C_{13}H_{18}O_4)_2$. It cannot so far be crystallised, nor can crystalline derivatives be obtained from it.

It was prepared by saponifying that part of croton oil that is soluble in strong alcohol, with a mixture of lead oxide and water, and repeatedly fractionating an alcoholic solution of the lead salts with water. The later fractions, which possessed the greatest vesicating power, ultimately furnished, when submitted to a series of fractionations, a resinous substance having extraordinary powers as a vesicant. The evidence so far obtained, points to the conclusion that the constitution of this vesicating constituent may be that of a lactone or anhydride of complicated structure.—W. S.

*Formalin as a Milk Preservative.* S. Rideal. Analyst, 1895, **20**, 157.

*See under* XVIII. A., *page* 766.

*Valuation of Alkaloids and Drugs.* C. C. Keller. Schweiz. Wochenschr. f. Chem. u. Pharm. 1894, Nos. 5 to 13; Zeits. Anal. Chem. 1895, **34**, 111.

*See under* XXIII., *page* 773.

*Detection of Geranium Oil in Presence of Oil of Roses.* R. Jedermann. Zeits. Anal. Chem. 1895, **34**, 51.

*See under* XXIII., *page* 772.

*Estimation of Antipyrine.* F. Schaak. Amer. Journ. Pharm. **66**, 631.

*See under* XXIII., *page* 773.

### PATENTS.

*The Manufacture or Production of Acid Derivatives of Alkylic Salts of Paramidophenyl Carbonic Acid.* H. E. Newton, London. From The Farbenfabriken, vorm. F. Bayer and Co., Elberfeld, Germany. Eng. Pat. 15,348, August 11, 1894.

According to the patentees, the derivatives of *p*-amidophenol of the general formula—

$$(Ac)HN.C_6H_4O.CO_2\cdot \mathit{Alkyl}, \text{ or}$$
$$(Ac)(Ac_1)N.C_6H_4O.CO_2.\mathit{Alkyl}$$

(Ac or $Ac_1$ represent any organic acid radical such as $—CO.CH_3$ or $—CO.OC_2H_5$), are valuable products for therapeutical purposes, exerting as they do an action similar to that of phenacetin. Three methods are proposed for the preparation of such compounds:—

1. By the action of acid anhydrides or chlorides, or similar agents, on the ethers of *p*-amidophenyl-carbonic acid ($NH_2.C_6H_4O.CO_2$.alkyl).

2. By the action—in presence of an alkaline hydroxide—of the ethers of chloro-carbonic acid, or other haloid carbonic acid, on *p*-amidophenol itself; or on some derivative of that body containing an acid radical in place of the amido-hydrogen.

3. By treating the compounds obtained as under 1 and 2—and still containing one available amido-hydrogen atom—with acid anhydrides or chlorides.

Several examples are given, in which the details to be observed in individual cases, are drawn up.—H. T. P.

*The Manufacture and Production of Benzo-sulphonimides, or their Nitro- or Halogen Substitution Derivatives.* G. W. Johnson, London. From F. v. Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 8661, May 1, 1895.

Effected by the direct oxidation, by electrolysis, of toluene sulphonic-amide in alkaline solution. After electrolysis, the solution is precipitated with hydrochloric acid, and the washed precipitate neutralised with soda. By this means, the benzo-sulphonic-imide is dissolved, and may be reprecipitated from its solution by acid, whilst unaltered toluene-sulphonic-amide remains behind. The nitro- or halogen substitution derivatives are obtained by treating the corresponding toluene-sulphonic-amide compounds as above.

—H. T. P.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### PATENT.

*Improvements relating to the Manufacture of Photographic Printing Paper.* H. H. Lake. From Arndt and Troost, Frankfort a/M., Germany. Eng. Pat. 20,353, October 24, 1894.

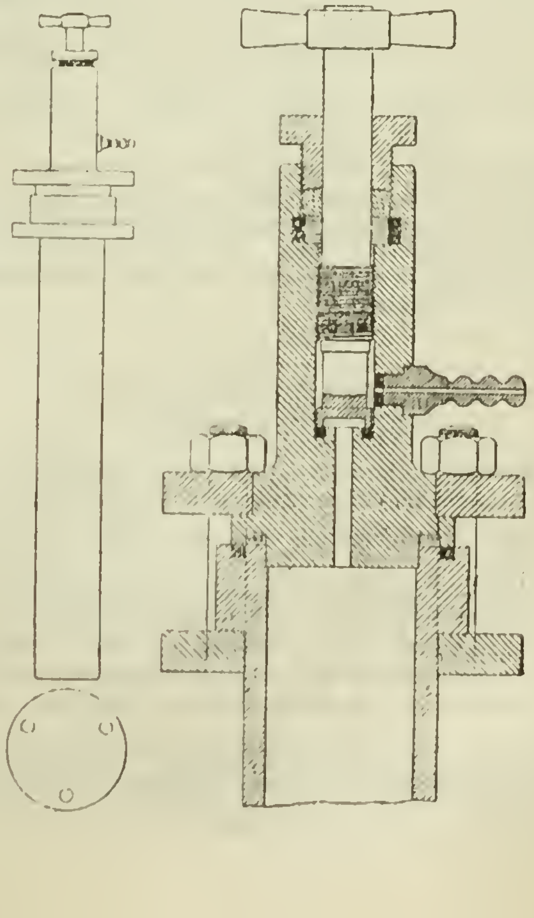
The improved photographic printing paper contains, in addition to the silver salt, an iron compound. According to the inventor, the combination of the silver and iron salts gives more permanent results than the silver salt alone, and furthermore the iron salt, owing to its being reduced in the light, serves to precipitate the silver. The paper employed should be free from chlorine and woody fibre. A solution recommended, consists of 80—100 grms. of iron ammonium citrate, 12—20 grms. of silver nitrate, 15—20 grms. of tartaric acid, and 10—15 grms. of gelatin dissolved in 1,000 c.c. of distilled water.—S. P. E.

## XXIII.—ANALYTICAL CHEMISTRY.

### *APPARATUS, ETC.*

*Digester to Replace Sealed Tubes in Laboratory Work.* Report by G. Freyss and E. Noelting. Bull. Soc. Ind. Mulhouse, 1895, 88—91.

The aim of the inventor, Dr. A. Pfungst, is to combine the advantages of a digester and a sealed tube. The new apparatus does not resist the action of acids and alkalis so well as glass tubes, but the essential parts are constructed of aluminium bronze or enamelled steel, and resist the action of most reagents. If the interior enamel would be affected, a glass tube open at the top may be fitted inside the steel tube, which will stand a pressure of 200 kilos. The accompanying figure shows the simplicity of the apparatus.



To fill the tube, unscrew the three screw-nuts and lift the cover; on closing it, press the three screws gradually without forcing. These screws are of delta metal, the tube itself of hammered steel enamelled inside. To be sure it is tightly closed, a vacuum is produced within the tube, which is then connected with a manometer; if the vacuum is maintained the tube is well closed. Communication of the tube with the lateral orifice of the cover is made and interrupted by a male screw and stuffing-box, and by regulating this, a gas can be allowed to escape very slowly in order to collect it for quantitative estimation.

To heat the tube to a desired temperature it is placed vertically in a copper tube containing oil or other liquid of high boiling point.

The steel tube may be also employed to surround a sealed glass tube, in order to counterbalance interior pressure in the latter, and minimise risk of explosion.

Experiments with the new apparatus have yielded satisfactory results.—R. B. B.

## PATENTS.

*A New or Improved Machine or Apparatus for Testing and Recording the Strengths of Textile Fabrics, Fibrous Materials, Fibres, Leather, and other like Materials or Substances.* J. W. Fawcett and W. Shambrook, both of Huddersfield. Eng. Pat. 13,650, July 16, 1894.

The load is applied to the material being tested, by means of a screw, and its intensity is recorded by the compression of a spiral spring through which the load is applied.
—R. B. P.

*An Improved Method and Apparatus for Testing Sand used for Building Purposes, and for other Purposes of the like kind.* J. C. Cleghorn, Calcutta, India. Eng. Pat. 9792, May 17, 1895.

The apparatus consists of a graduated glass tube, closed at one end. The sand to be tested, is dried, and filled into the tube to a determined point, then removed, and water substituted, the sand being afterwards added to the water, and the real as distinct from the apparent volume of the sand thus ascertained. The difference is of course equal to the volume of the air spaces enclosed by the sand. Impurities in the sand may be estimated by shaking it with water in the tube, and reading the alteration in the volume of the sand consequent on the washing out of the impurities.
—B. B.

## INORGANIC CHEMISTRY.—QUALITATIVE.

*Test for Mercuric Chloride in Calomel.* Moniteur, **45**, 1696.

The calomel (2 to 3 grains) is mixed with a drop of 10 per cent. alcoholic soap solution and a drop of freshly-prepared alcoholic solution of guaiacum resin, and the mixture well stirred with 2 c.c. of ether. On evaporating the ether solution the presence of mercuric chloride is indicated by an intense green coloration.

## INORGANIC CHEMISTRY.—QUANTITATIVE.

*New Method of Standardising Acid Solutions.* E. P. Perman and W. John. Chem. News, 1895, **71**, 296.

The *rationale* of method may be briefly indicated as follows:—

On adding dilute sulphuric acid to a solution of borax, sodium sulphate is formed and boric acid set free. 1 mol. of borax requires 1 mol. of sulphuric acid to neutralise it, using methyl-orange as indicator. Sulphuric and hydrochloric acids may be standardised by operating on these lines.

Boric acid set free by the stronger acids, acts upon litmus or phenolphthalein, so that these indicators cannot be used.

*New Volumetric Method for the Determination of Phosphoric Acid in its Pure Solutions.* R. Segalle. Zeits. Anal. Chem. 1895, **34**, 33—39.

The author has investigated various methods for the above purpose, with the following result:—

1. By far the most accurate results are obtained by Glücksmann's method. In this, the phosphoric acid is precipitated by an excess of "magnesia mixture" of known strength in ammonia, the precipitate filtered off, and the ammonia left in solution is titrated by standard acid. From the equation—

$$H_3PO_4 + MgSO_4 + 3NH_3 = MgNH_4PO_4 + (NH_4)_2SO_4$$

it will be seen that $H_3PO_4 = 3NH_3$.

2. The following modification is recommended as being more convenient and simple. To the phosphoric acid solution, contained in a graduated flask, an excess of standard ammonia (preferably normal) is added, followed by an excess of a saturated neutral solution of magnesium sulphate. The liquid is then diluted to the mark, well shaken, and filtered, and the residual ammonia titrated in an aliquot part of the filtrate.

3. On account of its simplicity, the modified method is well adapted for ascertaining the strength of the solutions of phosphoric acid employed in pharmacy.—H. T. P.

*Dry Assay for Lead.* M. W. Iles. School of Mines Quarterly, U.S.A., **15**, 336—345.

A comparison of wet and dry assays of a certain lead ore containing about 52 per cent. of lead, showed that the fire, or dry, assay yielded on the average 1·891 per cent. less than the wet or "chemical" test. After giving further examples, the author states that the whole practice of dry assay for lead is faulty and should be discontinued for commercial purposes, and he suggests the use of a chemical method with a deduction of 2 per cent. from the results to meet the existing market customs, as is now so extensively done in the assay of copper ore.—A. W.

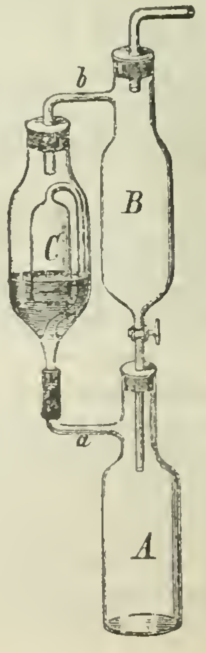
*New Method for the Gas-Volumetric Determination of Nitrogen in Nitrates.* F. Gantter. Zeits. Anal. Chem. 1895, **34**, 25—32.

The method is based on the following reactions:—

$$\text{I. } N_2O_5 + P_2O_3 = N_2O_3 + P_2O_5,$$

$$\text{II. } N_2O_3 + 2\,NH_4Cl = 2\,N_2 + 2\,HCl + 3\,H_2O,$$

which take place simultaneously, when a solution containing a nitrate, phosphorous acid, ammonium chloride, and sulphuric acid is heated. The author employs the gas-evolution apparatus shown in the subjoined drawing, the nitrogen given off being measured by the volume of water



it displaces in the gas-volumeter previously described (Zeits. Anal. Chem. **32**, 553). The following is the *modus operandi*:—3 c.c. of the nitrate solution, containing not more than 0·3 grm. of substance ($KNO_3$) is placed in the flask A, together with 0·5 grm. each of ammonium chloride and crystallised phosphorous acid, and 2 c.c. of dilute sulphuric acid (2 vols. $H_2SO_4$ to 1 vol. water). The pipette B is filled with 5 c.c. of the same acid, and the absorption-bulb C is charged with sodium hydrate solution. The apparatus is then placed in the cooling cylinder, connected to the measuring tube, and the evolution flask gently heated by a small flame. The reaction commences slowly, but rapidly increases in intensity, and must be carefully regulated—the flame being withdrawn—to avoid the escape of unreduced nitrous acid (indicated by the liquid becoming yellow, and the appearance of brown fumes). When the passage of gas-bubbles has almost ceased, the acid in the pipette is allowed to flow into the flask, and the liquid slowly heated to boiling. After a time, the liquid in the absorption tube will be observed to remain almost stationary—owing to the fact that only HCl gas is evolved at this stage. But, in order to render the decomposition of the nitrate complete, boiling must be continued until steam passes, and a portion of the liquid distils over into the side tube. At the same time excessive concentration of the sulphuric acid must be avoided or the results will come out high.

The method may be employed for the determination of small quantities of nitrate nitrogen (for example, in drinking water), and is, of course, also applicable to the assay of nitrites, in which case the phosphorous acid must be omitted. The test analyses given indicate the great accuracy of the process.—H. T. P.

### *Use of Sodium Peroxide in Analysis.* W. Hempel. Zeits. Anorgan. Chem. **3**, 193.

Sodium peroxide is an excellent substitute for the ordinary "fusion mixtures," and is especially well adapted for the dry oxidation of mineral substances. Chromium and manganese ores, for example, when heated with twice their weight of peroxide, yield almost immediately a yellow or green melt, as the case may be. Wolfram, fused with four times its weight of the reagent, is converted in a few minutes into sodium tungstate. Titaniferous iron ore, also, is rapidly and completely decomposed. In this case the fused mass may be extracted with hot water, and the insoluble residue of ferric oxide and titanic acid treated with strong sulphuric acid, and evaporated to a small bulk. The residual liquid is then poured into a large volume of cold water, and the titanic acid precipitated from the solution at a boiling temperature by passing through it sulphur dioxide.

Sulphur compounds are oxidised with explosive violence. The reaction may be moderated, however, by the addition of sodium hydrate, two parts of the latter and four of peroxide being used to one part of substance.

Fusion with peroxide may be advantageously employed in the case of zinc blende and galena, when a full analysis is required, since any iron remains in the insoluble residue, whilst the zinc and lead pass into the alkaline solution. (See also this Journal, 1894, 909.)—H. T. P.

### *Estimation of Antimony as Antimony Tetroxide.* O. Brunck. Zeits. Anal. Chem. **34**, 1895, 171—174.

Bunsen, who first recommended the estimation of antimony as tetroxide, himself pointed out in a later publication, that the method was unsatisfactory since 0·1 grm. of the $Sb_2O_4$ could be decomposed or volatilised in six hours, and that often the contents of the crucible never attained a constant weight. The author, however, finds that Bunsen's old method is quite as accurate and much easier than the more modern methods, provided that the $Sb_2O_4$ be ignited in presence of air. If the ignition be performed with the crucible lid on, the reducing gases from the flame are reflected into the crucible, and, consequently, the $Sb_2O_4$ is reduced to $Sb_2O_3$, which becomes volatilised. On the other hand, if the ignition be performed without the lid, the contents of the crucible rapidly attain a perfectly constant weight.—J. S.

### *The Estimation of Sulphurous and Sulphuric Acids in the Products of Combustion of Illuminating Gas.* U. Collan. Zeits. Anal. Chem. **34**, 1895, 148—158.

Various experimentalists have maintained that the sulphur in illuminating gas is burnt directly and almost completely to $SO_3$ or $H_2SO_4$. The author, however, has shown that these conclusions are open to criticism, on the ground that $SO_2$ in alkaline solution is easily oxidised to $SO_3$ in contact with excess of unburnt oxygen, and that, as a matter of fact, over 90 per cent. of the sulphur is burnt to $SO_2$.

The method of procedure was as follows:—The products of combustion (after it had been proved that neither unburnt gas nor the products of combustion from a gas free from sulphur exercised any reducing effect on a solution of $CrO_3$) of 50 litres of the gas were passed through a solution of $CrO_3$ of known strength contained in a Drehschmidt's apparatus (this Journal, 1889, 570). The total sulphuric acid was determined in one portion of the solution whilst the unreduced $CrO_3$ was determined in the other. The following results were obtained in four experiments:—(I.) 93 per cent.; (II.) 89 per cent.; (III.) 99 per cent.; and (IV.) 93 per cent. of S oxidised to $SO_2$.

Hence most of the sulphur is only burnt to $SO_2$. The first three experiments were made with a smoky flame, whilst the fourth was made with the flame of an ordinary Bunsen burner.—J. S.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *Test for Hydroxylamine.* A. Angeli. Gaz. chimica italiana Gaz. del Farm. **3**, 48.

Sodium nitroprusside is added to the neutral solution, which is then made strongly alkaline with caustic soda. On warming the solution a beautiful magenta-red coloration is immediately produced. The reaction is very delicate, but the presence of an excess of ammonium salts is detrimental.

Hydrazine and other inorganic reducing agents do not give the above reaction, but phenylhydrazine shows a red coloration in the cold, which disappears on warming.—J. S.

### *Discrimination between Aldehydes and Ketones, especially between Aldehydic and Ketonic Sugars.* A. Villiers and M. Fayolle. Comptes rend. **119**, 75.

A solution of rosaniline which has been decolorised by sulphurous acid, (preferably with the smallest quantity necessary) recovers its colour on the addition of aldehydes. It has also been stated that ketones, ordinary acetone for example, behave in the same way, but the authors find that perfectly pure ketones do not bring back the colour. The tests ought to be performed in closed vessels as the reagent itself becomes red on long exposure to the air.

In this way the authors have been able to discriminate between aldehydic and ketonic sugars. Grape sugar, invert sugar, galactose, and the reducing dextrins behave in the same way as aldehydes, whilst levulose and sorbin behave as ketones. A concentrated neutral solution of the sugar ought to be employed as acids interfere with the reaction, and of course perfectly pure samples of the sugars must be used. Cane sugar, maltose, and lactose produce at first no coloration. After some days, however, the solutions begin to colour, and the authors consider this a proof of the fact that these sugars are slowly inverted by water with production of aldehydic sugars.—J. S.

### *Discrimination between α- and β-naphthol, &c.* Aymonier. Zeits. Anal. Chem. **34**, [2], 228.

On adding a few drops of a solution of 1 grm. of potassium bichromate and 1 grm. of nitric acid in 100 c.c. of distilled water, to an aqueous or dilute alcoholic solution of the naphthols, a black precipitate is formed if α-naphthol be present. β-naphthol, salol, benzonaphthol, naphthalene, thymol, &c., do not give the black precipitate.—J. S.

### *Detection of Geranium Oil in Presence of Oil of Roses.* R. Jedermann. Zeits. Anal. Chem. 1895, **34**, 51—53.

Panajotow (this Journal, 1892, 61) has described two tests for the above purpose, which were subsequently adversely critised by Schimmel and Co. (Zeits. Anal. Chem. **31**, 358), and declared to be worthless. This opinion the author fully confirms. Numerous samples of undoubtedly genuine oil of roses (from Roumelian districts), examined by the author, were found to yield turbid alcoholic solutions when treated with sulphuric acid, the turbidity being particularly marked in the case of oils produced from white roses. Similarly with Schiff's reagent. In all cases (with one exception), a fine blue coloration was developed after a few hours. In no instance, however, was the prior production of a reddish coloration observed.

Conclusions as to the genuineness of oil of roses based on its specific gravity are equally unreliable, partly owing to the small difference of density between rose and geranium oils, partly because rose oils derived from different districts vary considerably in specific gravity. (Specific gravity of the elæoptene of rose oil, 0·873—0·8735 ; of the stearoptene, 0·813, the amount present ranging from 7—30 per cent ; of geranium oil, 0·882—0·895). A gross addition of geranium oil can, in any case, be detected by the odour alone.

Another test is founded on the supposed difference in rotatory power of the two oils. But, according to the author, the elæoptene of rose oil, and geraniol (the chief constituent of oil of geranium) are isomeric, and, so far as rotatory power is concerned, absolutely identical. In fact, no reliable method for discriminating between these oils exists, and the consumer must, in great measure, rely on the trustworthiness of his source of supply.—H. T. P.

### *Detection of Formalin.* H. D. Richmond and L. K. Boseley. Analyst, 1895, **20**, 154—156.

The authors review the tests for formaldehyde which have already been published (Legler, Ber. 1883, **16**, 1333 ; Lösekan, *ibid.* 1889, **22**, 1565 ; Eschweiler, *ibid.* **22**, 1929 ; Plöchl, *ibid.* 1888, **21**, 2117 ; Kleeberg, Ann. 1891, **263**, 283 ; Pulvermacher, Ber. 1893, **26**, 2360 ; and Trillat, this Journal, 1893, 789). Schiff's reagent (magenta bleached by sulphurous acid) is not characteristic of formaldehyde, nor is it sensitive unless the proportion of sulphurous acid has been carefully adjusted ; the red coloration appears on merely warming the reagent, on blowing air through it, or on exposure to air. In applying it to milk, the casein is precipitated with a little sulphuric acid, filtered, and the reagent added to the filtrate.

Hehner's test, the blue colour developed when milk, formaldehyde, and sulphuric acid are mixed, is not applicable if the formaldehyde be present in excess, say 0·5 per cent. The colour is due to the albuminoids of milk, and is developed also by egg albumin and by peptone, but not by gelatin. To obtain the reaction, sulphuric acid (94 per cent.) is added to the milk, when a blue ring is formed at the junction of the liquids. It is better to distil the sample and to test the distillate by the addition of peptone and sulphuric acid.

A test which the authors believe to be characteristic of formaldehyde consists in distilling the sample into a solution of diphenylamine in dilute sulphuric acid (not in excess), and boiling the mixed liquids ; a white flocculent precipitate, often coloured green if the acid used contain nitrates, is deposited if formaldehyde be present.

Trillat's observation (compare this Journal, 1893, 789) that after a certain time formaldehyde cannot be detected in foods, is confirmed.—A. G. B.

### *Formalin as a Milk Preservative.* S. Rideal. Analyst, 1895, **20**, 157.

*See under* XVIII. A., *page* 766.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Difficulty in Detecting Chlorine in Methylene Blue ; also Notes concerning Methylene Blue.* W. Lenz. Zeits. Anal. Chem. 1895, **34**, 39—48.

In a brief paper which appeared in the Pharm. Zeit. **39**, 63, and which reappears, in abstract, in the present more extensive treatise, the author states that Methylene blue for medicinal purposes, as commercially obtainable, usually occurs in the form of greenish, metallic needles, consisting of the base itself, *free from chlorine.* The latter conclusion was founded on the observation that the samples in question gave no precipitate when tested with silver nitrate. Further investigation, however, has revealed the interesting fact that hydrochloric acid was in reality present. In all cases chlorine could be readily detected by the flame test (a copper wire, when heated to redness in a flame in which a substance containing chlorine is being burnt, imparts to the flame a bluish-green coloration). A weak solution of the colouring-matter gives no precipitate with silver nitrate, even after long standing ; but on addition of nitric acid, a deep blue precipitate—with difficulty seen in the coloured liquid, and hence easily overlooked—slowly appears. The precipitation of the chlorine is, however, by no means complete. Even at a boiling temperature, and when a large excess of the reagents is employed, only about 80 per cent. of the total chlorine is thrown down. This peculiar behaviour may be explained on the assumption that silver chloride forms with Methylene blue a soluble double salt, which is only slowly decomposed by nitric acid. For the quantitative estimation of the chlorine, satisfactory results may be obtained by the following "wet" method. The finely-powdered Methylene blue is ground to a thin paste with dilute soda solution, and powdered potassium permanganate added in small doses. The mixture becomes strongly heated, and solidifies after a time. The reaction is complete when greenish or bluish streaks are no longer discernible on triturating the mass. The latter is then moistened with soda solution, dissolved in water, the excess of permanganate destroyed by the addition of alcohol, the precipitate filtered off, and, after acidifying with nitric acid, the chlorine precipitated in the usual way.

The method is, no doubt, applicable in other cases of a similar character, *i.e.*, when the precipitation of chlorine in the ordinary way is prevented by the presence of organic matter, and the author strongly recommends it for this purpose. It was found possible, also, to oxidise the sulphur of Methylene blue quantitatively to sulphuric acid by a slight modification of the process. To this end, the Methylene blue should be dissolved in very dilute soda solution, the permanganate must be used in considerable excess, and the mixture must on no account be allowed to become heated during reaction. The liquid is then allowed to stand for eight days, to complete the oxidation, subsequently heated with hydrochloric acid until free chlorine is expelled, largely diluted, and the sulphuric acid precipitated in the usual way. In this way, satisfactory results were also obtained with sulphanilic acid ; but in the case of coal-tar saccharine, only a small proportion of the sulphur could be oxidised.

In conclusion, the author mentions that a specimen of Methylene blue recently examined by him contained 35·87 per cent. of (sulphated) ash, consisting chiefly of calcium salts, and 1·73 per cent. of chlorine. The exercise of some degree of care when selecting a sample for medicinal use is, therefore, obviously necessary.—H. T. P.

### *Quantitative Estimation of Hydrazine.* J. Petersen. Zeits. Anorg. Chem. **5**, 1.

Hydrazine is acted on by boiling Fehling's solution according to the equation—

$$N_2H_4 + O_2 = 2H_2O + N_2.$$

The author, however, was unable to obtain constant results by titration, but perfectly accurate results are obtained if the nitrogen, which is liberated, be collected and measured. Hydrazine may also be titrated in hot solution with permanganate in the usual manner, if the temperature be kept at about 60°—70° C., and the solution contains from 6 per cent. to 12 per cent. of sulphuric acid. The reaction takes place according to the equation—

$$17(N_2H_4.H_2SO_4) + 13O = 13H_2O + 7(NH_4)_2SO_4 + 10N_2 + 10H_2SO_4.$$

—J. S.

### *Estimation of Antipyrine.* F. Schaak. Amer. Journ. Pharm. **66**, 631.

Antipyrine may be estimated colorimetrically. The principle of the method depends on the fact that the bluish-green coloration of nitrosoantipyrine is still visible in solutions as dilute as 1 in 20,000. In concentrated solutions a crystalline precipitate of the same colour is formed.

For purposes of comparison the author employs a solution of 0·02 grm. of antipyrine in 25 c.c. of water, which after the addition of 1·6 c.c. of a 1 per cent. solution of sulphuric acid and 0·8 c.c. of a 1 per cent. solution of sodium nitrite is diluted to 100 c.c.

The powder or liquid to be examined is extracted with chloroform, which is afterwards evaporated off. The residue is dissolved in water (1:500), sulphuric acid and sodium nitrite are added, and the solution is then diluted with water until it possesses the same colour as the standard.—J. S.

### *Detection of Fluorine Compounds in Wine.* G. Nivière and A. Hubert. Monit. Scient. 1895, **45**, 324.

In view of the practice of adding fluorides to wine, the author describes the method he has adopted for their detection and estimation.—A. K. M.

### *Valuation of Drugs.* C. C. Keller. Schweiz. Wochenschr. f. Chem. u. Pharm. 1894, Nos. 5 to 13. Zeits. Anal. Chem. 1895, **34**, 111—118.

The author has extended his process (this Journal, 1893, 718), for the determination of alkaloids to a whole series of vegetable substances. The method is, in general, carried out as follows:—Prior to analysis, the respective drugs should be dried (preferably over lime or sulphuric acid), powdered, and sifted. A sieve having 27 meshes per cm. (No. V. of the Swiss and German Pharmacopœias) will usually suffice; but a finer one (No. VI., 37—40 meshes per cm.) is occasionally required. From 10—25 grms. of the material are employed, according to richness in alkaloid. The drug, best contained in an ordinary medicine bottle of 200—300 c.c. capacity, is shaken for about 5 minutes with a suitable solvent (ether, chloroform, &c.), and an excess of alkali (usually 10 per cent. ammonia) then added. The mixture is again violently agitated, and allowed to digest for ½ hour with intermittent shaking. If a little water be now added (the quantity required varies in individual cases and must be found by trial), and the mixture well shaken for 2—3 minutes, the insoluble matter will ball together, allowing the greater part of the ether layer to be poured off bright. From the ethereal solution, the alkaloid is separated by agitation with dilute hydrochloric acid (0·5—1·0 per cent. of HCl), three successive portions of 25, 15, and 10 c.c. respectively being used for extraction. The acid solution is then rendered alkaline by ammonia and extracted three times with chloroform-ether (3:2), or pure ether. From the pure solution of alkaloid thus obtained, the solvent is removed by distillation—and if chloroform have been used, the remaining traces expelled by moistening the residue 2—3 times with ether, evaporating each time. Finally, the residue is dried for 15 minutes in a steam chamber and weighed. For titration, the alkaloid is dissolved in 5—10 c.c. of absolute alcohol, free from acid, water added until the solution becomes turbid, and titrated with $\frac{N}{10}$ or $\frac{N}{20}$ hydrochloric acid, using hæmatoxylin as an indicator. The details to be observed in individual cases, such as Rhizoma hydrastis, Semen sabadillæ, Tubera aconiti, Folia aconiti, Folia belladonnæ, Secale cornutum, are given in the paper.—H. T. P.

### *Volumetric Estimation of Sugar in Wine by Fehling's Solution.* A. Bornträger. Zeits. Anal. Chem. 1895, **34**, 19—25.

For the above purpose, Soxhlet's method of titration is usually recommended, the Fehling's solution being employed in the undiluted state. The result is that large volumes of the reagent are required, and in case of wines poor in sugar, a previous concentration of the sample becomes necessary. The author, therefore, adopts that modification of the process in which the Fehling is employed, diluted with 4 volumes of water. Only 10 c.c. of the copper solution are used, and after addition of a measured volume of wine, diluted to 55—60 c.c., and boiled, &c. in the usual way. Operating in this manner, solutions containing as little as 0·1 per cent. of sugar, may be directly titrated, without the prescribed limit of total dilution (60 c.c.) being exceeded. Nor is a concentration of the wine absolutely necessary in the case of even weaker solutions, since the error introduced by its omission is insignificant and negligible. On the other hand, strong solutions must be diluted until they contain about ½ per cent. of sugar, otherwise the volume required in the titration is too small to be measured with accuracy. As regards the statement of results, the author is of opinion that they should be calculated as invert sugar, and not as dextrose.—H. T. P.

### *Ratio of Dextrose to Levulose in Sweet Wine and Honey and its Bearing on the Detection of Adulteration in these Articles of Diet.* J. König and W. Karsch. Zeits Anal. Chem. 1895, **34**, 1—18.

The object of the authors has been to determine whether reliable conclusions may be deduced as to the purity of sweet wine and honey from the relative proportions of dextrose and levulose contained in them.

*Sweet Wines.*—To gain some knowledge of the changes occurring during the fermentation of grape-must, experimental fermentations were made with genuine musts, and also with musts and wines to which cane sugar or extract of raisins had been added, the dextrose and levulose being determined at intervals. Finished wines were also examined. The results are tabulated. It appears that—

1. In original grape-musts, the ratio of dextrose to levulose ranges between 100:77 to 84. During fermentation—in accordance with our previous knowledge on the subject—dextrose disappears more rapidly than levulose, and, in a comparatively short time, levulose preponderates over dextrose in the ratio of 1½ to 6:1. These remarks equally apply to the products of the inversion of added cane sugar. The extent to which the sugar ratio is altered in favour of levulose depends on the degree to which fermentation is carried. Strong musts containing 34—44 per cent. of extract ferment slowly, and fermentation practically ceases when the alcohol formed reaches 11—14 per cent. In such cases the levulose-dextrose ratio seldom exceeds 150:100. It is noteworthy, however, that raisin-extracts, even when weak, ferment slowly, and suffer very little alteration in sugar ratio.

2. Cane sugar, when added to finished wines, is completely inverted by the tartaric acid naturally present, after about two months of storage.

In regard to the adulteration question no decisive deductions can be made from the results. The utmost that can be said is the following:—If a sweet wine contain considerably more levulose than dextrose, the probability is that it has been produced by fermentation; on the other hand, a decided excess of dextrose indicates that no fermentation has taken place, whilst in presence of nearly equal amounts of the respective sugars no reliable conclusions can be drawn, at least not until the possible variations of the sugar ratio in the must, have been established by a series of experiments. The question whether cane sugar has been used can only be decided by reference to other data, such as ash, phosphoric acid, nitrogen, and non-sugar extract.

*Honey.*—The form of adulteration most commonly met with, consists in the addition of some kind of starch glucose or syrup, and the methods suggested for its detection are mostly based on the determination of the unfermentable dextrinous matters thus introduced into the honey. These methods have become worthless since the discovery has been made that certain varieties of honey (pine honey) are naturally dextro-rotatory and contain a substance resembling dextrin.

The samples examined included natural and artificial honeys and starch sugars. The levulose and dextrose were determined both before and after precipitation of the dextrin, &c. by alcohol, and by two different methods: Soxhlet's, based on the difference in reducing power of levulose and dextrose on Fehling's and Sachsse's solutions, and Neubauer's, which takes into account optical activity and reducing power. The results obtained, in many cases, exhibit considerable discrepancies, not only as between the two methods, but also before and after treatment with alcohol. It is concluded, therefore, that honey contains one or more carbohydrates, not identical with levulose or dextrose, dextro-rotatory in character and possessing at times a greater reducing power than dextrose. Attempts to separate the foreign body have failed. The general conclusions are :—

1. For the determination of dextrose and levulose in honey Neubauer's process is not suitable, nor does Soxhlet's method, although to be preferred, yield accurate results, owing to the presence in honey of foreign bodies.

2. The ratio of levulose to dextrose varies very greatly (100 levulose : 72·5 to 109 dextrose). Even larger variations were found by Soxhlet and Sieben (100 levulose : 47·3 to 131·8 dextrose).

3. Obviously, therefore, the sugar ratio is no guide to the detection of adulteration, since a considerable proportion of glucose could be added to a honey deficient in dextrose without raising the proportion of the latter to an abnormal extent.

4. The optical behaviour of honey after the substances precipitable by alcohol have been removed is, however, an indication of value. After such treatment, all the specimens of dextro-pine honey examined became distinctly levogyratory, whilst mixtures of honey with 25 per cent. of glucose syrup retained a right-handed rotation. It remains to be seen whether all *d*-honeys behave similarly. Assuming this to be the case, the detection of added glucose becomes a simple matter.

The treatment with alcohol is effected thus :—20 grms. of honey are dissolved in water to a bulk of 20 c.c., and strong alcohol is added very slowly, the mixture being agitated continually until the volume measures 250 c.c. After 2—3 days, the liquid is filtered, an aliquot part evaporated to get rid of alcohol, redissolved in water, clarified if necessary, and the rotation observed.—H. T. P.

## SCIENTIFIC AND TECHNICAL NOTES.

### *Ashcroft Process for Treating Zinc-Lead Sulphides.* Eng. and Mining J. 1895, **60**, 26.

How to treat economically low-grade silver bearing zinc-lead sulphide ores, and save the three metals at costs that will make their extraction profitable, is one of the great metallurgical problems that has occupied a vast amount of attention in several countries but especially in Australia, where the absolute necessity for its solution has been even more pressing than in the United States.

The old way of crushing and concentrating in jigs is being applied to the Barrier ores of the South Broken Hill mine by Mr. R. H. Hancock, general superintendent of the Moonta and Wallaroo Mining and Smelting Company. The clean separation of mixed zinc-lead sulphides has rendered plain jig work unsatisfactory in many cases, and concentrating tables are of too limited capacity for a large output.

The necessities of the Barrier mines indicate the opening for the invention of a thoroughly satisfactory process for treating these low-grade refractory ores. When this problem is solved it will find wide application in nearly every mining country, for wherever lead is mined zinc comes in more and more as depth is attained.

### *Arsenic in Imported Hides.* Chem. and Drug., Aug. 1895.

Prof. Riche has made his report to the Committee of Hygiene of the Department of the Seine on the danger of arsenic contained in imported hides. The soaking of South American and tropical hides (generally preserved for the voyage by arsenical preparations) presents little danger to the tanners; but the labourers who unpack and handle the hides while yet dry are liable to skin diseases, ulcerated hands, &c. A still graver danger is present in many cases, for when the animals have been attacked by anthrax, the arsenical preparations do not destroy the risk of infection to human beings, as Dr. Proust's experiments on guinea-pigs have proved. Riche recommends that sulphide of sodium should be substituted for arsenic in leather-dressing and morocco work.

### *Cinnamon Oil.* Imp. Inst. J., Aug. 1895.

Genuine cinnamon oil is obtained from the chips and cuttings from the quills. Inferior oil is obtained from a mixture of the bark (chips) and leaf. The Dutch paid the greatest attention to the distillation of the oil. They were the first to introduce the present process of distilling. Capt. Percival describes it as follows :—

"The fragments and small pieces which happen to be broken off in packing up the bales are collected and put into large tubs, about a hundredweight into each, with just as much water as is sufficient to cover them completely. This mass is left for six or seven days to macerate, and is afterwards poured, by little and little, into a copper alembic, to which a slow fire is applied. The water which comes over, called *Aqua Cinnamoni*, is received in glass vessels of a peculiar construction, and it is nearly of the colour of milk, the oil floating on the top of the liquid in the glass recipient. The process is slowly and cautiously conducted, one tub being usually distilled off in 24 hours. Two commissaires (who were members of the Council of Justice in the time of the Dutch) are appointed to superintend the whole of the process, and one of them is always required to be present to prevent the apothecary who conducts the distillation from smuggling any of the oil. After remaining for some time in the recipient the oil is carefully skimmed off under the eye of the commissaires and put into large bottles, which are sealed with the Government seal and brought to the Governor, by whom they are placed in a chest secured in the same manner. The reason of all these precautions is the great scarcity and value of this oil. It is only made at the Company's laboratory at Colombo, and the quantity is much less than can be procured from an equal weight of any other spice."

The fruit is somewhat like an acorn, but not so large. When ripe it used to be gathered up and put in nurseries for germination, but this is seldom done now. Says an old historian :—" . . . . . It is gathered by the natives for the purpose of extracting oil from it. The process they employ is to bruise the fruit, boil it, and skim off the oil. This they use for the hair and body on great occasions, and also for burning in their lamps. When mixed with cocoanut oil it gives an extremely good light. The kings of Candy use it for this purpose, and formerly commanded their subjects to bring them a certain quantity as a yearly tribute. When any ambassadors are sent to these princes they always burn this oil during the time of audience."

There are no records extant, nor information attainable, indicating that either the Portuguese or Dutch conquerors manufactured any oil from the fruits. Neither during the early period of the British sway, nor now, is the process practised. Perhaps the mention of it here may lead to some experiments in this line, which may ultimately result in a marketable oil.

### *Salicylate of Magnesia free from Tint.* R. van Gool. Chem. and Drug., Aug. 31, 1895, 356.

The small trace of iron in magnesium carbonate, even the purest, is sufficient to tint the salicylate prepared from it. The author neutralises dilute sulphuric acid with $MgCO_3$, slightly acidified with HCl, and adds a little potassium sulphocyanide until the colours cease to darken (iron). The whole is shaken with ether to remove sulphocyanide, and (the iron being thus removed) the solution is evaporated and crystallised. The sulphate thus prepared is used to make a pure carbonate, which is then saturated with salicylic acid.

# New Books.

Chemisch Technisches Repertorium. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen. 1894. Zweites Halbjahr. Erste Hälfte. Mit in der Text gedruckten Illustrationen. Berlin, S.W. 1895. R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstr. 26. London: H. Grevel and Co., 33, King Street, Covent Garden.

The first issue for the second half-year of 1894 of Dr. Jacobsen's Repertory of Chemical Technology. It contains reports of the progress of the following branches of chemical industry:—I. Building Materials. II. Dyestuffs. III. Fats, Oils, Illuminating and Heating Materials. IV. Fermented Liquors. V. Tanning, Leather- and Glue-Manufacture. VI. Textiles. VII. Glass and Earthenware. VIII. Wood and Horn. IX. Indiarubber and Gutta Percha. X. Cements and Adhesives. XI. Lakes, Varnishes, and Paints. XII. Metals. This issue contains 148 pages of subject-matter, and is illustrated with numerous woodcuts.

The Manufacture of Explosives. A Theoretical and Practical Treatise on the History, the Physical and Chemical Properties, and the Manufacture of Explosives. By Oscar Guttmann, Assoc. M. Inst. C.E., F.I.C., Member of the Societies of Civil Engineers and Architects of Vienna and Budapest, &c. Whittaker and Co., 2, White Hart Street, Paternoster Square, London. 1895. Price 2 guineas.

This work is issued in two 8vo volumes, bound in cloth. Vol. I. contains Preface, Table of Contents, Table of Notes to the Illustrations, and 348 pages of subject-matter, illustrated by 147 admirably executed wood engravings; Vol. II., besides the title page and table of contents, contains 386 pages of subject-matter, illustrated by 175 engravings. An Appendix follows, containing 12 pages of matter, with four illustrations, and then follow 12 pages of Addenda, with two illustrations, and thereafter a copious Bibliography arranged as a Chronological Index. Finally, there are indexes of names of authors or inventors and of subject-matter. To give an idea of the character of the work, the author's remark in his preface is quoted, viz., "This book is not intended for teaching the Manufacture of Explosives, but to give trustworthy and detailed advice to experts, whether makers or consumers."

The following extract of the Contents will give a notion of the extent of the ground covered in this work:—Chapter I. Potassium Nitrate, Sodium Nitrate, Ammonium Nitrate, Barium and Lead Nitrates, Sulphur, Charcoal, Lampblack, Woodpulp, Flour, Cotton, Glycerin, &c., Acetone, Nitric Acid, Sulphuric Acid. II. General Properties of Explosives. III. Composition, Manufacture, Compressed Powder, Packing, Re-shaking. IV. Powders with Substitutes for Saltpetre, Powders without Sulphur, &c. V. Absorbing Powders for Dynamite. VI. Black-powder Factories. VII. Physical Properties of Black Powder, Chemical Examination, Mechanical Properties. VIII. Guncotton, Manufacture, Compressed Guncotton, &c. IX. Other kinds of Nitrocellulose. X. Explosives derived from Sugars. XI. Nitroglycerin. XII. Explosives from Aromatic Hydrocarbons. XIII. Fulminate of Mercury. XIV. Fulminate of Silver and Fulminate of Gold. XV. Utilisation of Waste Acids. XVI. Dynamite. XVII. Blasting Gelatin and Gelatin Dynamite. XVIII. Sprengel's Explosives and Safety Blasting Materials. XIX. Smokeless Powders. XX. Caps and Detonators. XXI. Fuses. XXII. Apparatus for the Examination of Explosives. XXIII. Storage and Carriage of Explosives. XXIV. Construction of Explosive Factories in General.

Treatise on the Evaporation of Saccharine, Chemical, and other Liquids by the Multiple System in Vacuum and Open Air; also the Construction and Working of the Different Systems. Second Edition. Compiled by James Foster, M.I.M.E. With 181 diagrams and 49 large plates. 1895. Sunderland: Thos. Reed and Co. London: Simpkin, Marshall, Hamilton, Kent, and Co. London and New York: E. and F. N. Spon. Glasgow: W. and R. Holmes. Amsterdam: J. H. De Bussy. Price 21*s.*

8vo volume, bound in cloth, and containing Tables of Contents, of Patents, and of Illustrations, preceded by a short Preface to the Second Edition. There is also a useful list of Tables given in the text, and also one of plates exhibited at the end of the work. The Introduction then follows, and fills 13 pages. The subject-matter covers 732 pages, the latter 10 of which are chiefly occupied by Tables of Useful Notes. The bulk of the work is composed, in addition to the author's own work, of extensive abstracts of the several treatises of leading continental authors, &c., such as the following:—I. Horsin-Déon's Treatise on the Triple-effect System. II. Hugo Jelinek's Treatise. III. E. Peclét's Treatise. IV. Francisco Sach's Treatise. V. E. J. Maumené's Treatise. VI. A. Payen's Treatise. Then follows (pages 577—597) a series of calculations for the different parts of multiple effect systems.

Among the illustrations, 35 represent vacuum pumps, 17 exhibit forms of vacuum pans, and 92 various kinds of evaporating apparatus, whilst the plates at the end of the work illustrate on a larger scale the patent evaporators of Foster and Campbell, Foster, Chapman, Browne, Yaryan, Lillie, Fletcher, Slaiter, and Watson and Robertson, &c.

Jahrbuch der Elektrochemie. Berichte über die Fortschritte des Jahres 1894. Im wissenschaftlichen Theile bearbeitet von Dr. W. Nernst, Director des Instituts für Physik, Chemie, und Elektrochemie. Im technischen Theile bearbeitet von Dr. W. Borchers, Lehrer an der kgl. Maschinenbau- und Hüttenschule zu Duisberg. 1895. I. Jahrgang. Price M. 10 = 10*s.* Halle a S.: Verlag von Wilhelm Knapp. London: H. Grevel and Co., 33, King Street, Covent Garden.

This "Jahresbericht" now appears for the first time. It is divided into two sections, the first treating of Electro-Chemistry as a branch of Pure Science, the second treating the subject from the point of view of its Industrial Applications. Section I. is under the care of Prof. W. Nernst, of the University of Göttingen, Section II. under that of Dr. W. Borchers, Lecturer in the Royal Engineering and Mining Academy of Duisberg. The volume is one of 8vo size, bound in paper cover, and containing Preface by the joint editors, Table of Contents, and text covering 261 pages. Of the latter, whilst the subject treated as Pure Science covers 62 pages, that under technical treatment fills 199 pages. An Alphabetical Index of Authors and Inventors, and of subject-matter, ends the volume.

The text is illustrated by 163 admirably executed engravings; and as regards the subdivision of that text, it will be best understood by the following excerpt of the Contents:—I. Theoretical Electro-Chemistry: The General Scientific Aspects of Modern Electro-Chemistry. Electrolytic Conduction. The Electrostatic Field of the Ions. Theory of Galvanic Current Production. Electrolysis and Polarisation. Thermo-electricity of the Electrolytes. Apparatus for Electro-chemical Measurement. II. Applied Electro-Chemistry. Production of Electrical Energy: I. Electrical Energy from Chemical Energy (Galvanic Elements). II. Electrical Energy for Chemical Purposes. Accumulators: I. Lead Accumulators. Advance of the Technology of Accumulators. II. Accumulators without Lead and Lead Compounds. Electro-magnetic Production. Electro-thermic Apparatus and Methods. Metals: Special Metallurgy. General Consideration of Metallic Deposition. Metalloïds. Alkali and Chlorine Industry. Analysis: I. Arrangements for Carrying Out Analytical Work.

2. Methods of Depositing (Precipitation) and Separation. Inorganic Compounds. Organic Compounds. Bleaching and Disinfection. Dyeing and Tanning. Apparatus for various Electrolytic Operations. Bibliography for the Year 1894.

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Elektro-Metallurgie. Die Gewinnung der Metalle unter Vermittlung des Elektrischen Stromes. Von Dr. W. Borchers. Zweite vermehrte und völlig Umgearbeitete Auflage. Erste Abtheilung. Mit 87 Text-Abbildungen. Price 6*s*. London: Williams and Norgate, 14, Henrietta Street, Covent Garden. Edinburgh: 20, South Frederick Street. Oxford: 7, Broad Street.

This Electro-metallurgical work is issued as an 8vo volume, bound in paper covers, and containing an introduction, principally dealing with the subjects of Electrolysis and Electro-thermic Work, and 146 pages of subject-matter. The text is illustrated with 87 beautifully executed wood engravings, and treats of the subject—Electro-Metallurgy—as applied to the following matters:—Alkaline and Alkaline-Earth Metals. Group I.: Magnesium, Lithium, Beryllium. Group II.: Sodium, Potassium. Group III.: Calcium, Strontium, Barium. Earth Metals: 1. Aluminium. 2. The Cerium Metals.

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An Introduction to the Study of Disinfection and Disinfectants. Together with an account of the Chemical Substances used as Antiseptics and Preservatives. By Samuel Rideal, D.Sc. (Lond.), Fellow of University College, London, &c., &c. London: Chas. Griffin and Co., Ltd., Exeter Street, Strand. 1895. Price 12*s*. 6*d*.

This work embodies an attempt to summarise and review the voluminous literature on the subject of Disinfection, scattered through our own and foreign scientific and medical publications. In it the composition and properties of Disinfectants are exclusively dealt with. The book is an 8vo volume bound in cloth, and containing Preface, Table of Contents, Introduction, and 292 pages of subject-matter, illustrated with 25 woodcuts. These are followed by a final Chapter (Chap. XV.) on Methods of Analysis (pages 299—316), and a complete Bibliographic Index, which is well sub-divided (pages 317—322). The work ends with an Alphabetical Index of Subjects. The subject-matter is arranged as indicated by the following principal headings:—I. Introductory. II. Mechanical Disinfection. III. Disinfection by Heat. IV. Chemical Disinfectants. V. The Non-Metallic Elements and their Derivatives. VI. and VII. Metallic Salts. VIII., IX., and X. Organic Substances. XI. Compounds related to the Alcohols. XII. Practical Methods. XIII. Personal and Internal Disinfection. Food Preservation. XIV. Legal Statutes and Regulations. XV. Methods of Analysis.

It may be added that in addition to the ordinary illustrations, a large plate is given, showing the plan to scale, of the New Disinfector and Incinerator erected and worked by the Newington Vestry.

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Photometric Standards. Report made to the Board of Trade by the Committee appointed by the Board "to inquire into and Report to them upon the subject of the Standards to be used for testing the Illuminating Power of Coal-gas," together with Appendix thereto. (C.—7743.) *Price* 4½*d*.

It is stated that the method at present in use for measuring the illuminating value of gas has been objected to, alike by the Metropolitan gas referees and the London County Council, as being of an unsatisfactory nature; that the London gas companies are alive to the defects in the present system, and that legislation is admittedly necessary for the purpose of substituting a more reliable standard for that now in existence; but that, in view of the difference in opinion as to what the substituted standard should be, the President of the Board deemed it advisable that, before his support was given to any legislation, the whole question should be considered by a committee that would command the confidence of the various interests affected.

That Committee in their report, which is dated March 1895, now give their recommendations, which are printed *in extenso*, together with the evidence taken before them.

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# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

(*From the Board of Trade Journal.*)

### Brazil.

#### *Tariff Changes.*

The *French Journal des Tarifs et Traités de Commerce*, in its issue of 6th June last, notifies the following changes in the Customs Tariff of Brazil:—

The duty on matches, as fixed by the law of December 30th, 1891, has been trebled, and the duties on tobacco and salt have been doubled.

The duties on fermented drinks (Art. 120 of the tariff), liqueurs (Art. 126), alcoholic drinks (Art. 127), and articles comprised in class 27, have been increased by 40 per cent.

The tax on sulphur of carbon has been diminished by 50 per cent.

Taxes affecting liquids have been fixed as follows:—

15 per cent. on casks containing oils.

18 per cent. on casks containing fermented and alcoholic drinks.

### United States.

#### *Customs Decisions.*

Crystal carbonate is dutiable at 25 per cent. *ad valorem* under paragraph 60.

### British India.

#### *Valuation of Aniline Dye.*

In Customs Circular No. XV., dated the 27th June last, which has been received at the Board of Trade from the India Office, the Government of India has notified that aniline dye (dry), assessable to duty *ad valorem* under the Indian Tariff Act, is to be valued at 1 rupee 8 annas per lb.

### Spain.

A despatch, dated 24th July last, has been received at the Foreign Office from Sir H. Drummond-Wolff, Her Majesty's Ambassador at Madrid, enclosing copy of Royal Orders making the following changes in the Customs tariff now in force:—

Silicate of soda and silicate of potash, whether in solid or liquid form, are to be included under partida No. 107, instead of under partida No. 5 as hitherto. The duty is thus increased from 40 centimos to 4 pesetas 55 centimos for column 1, and from 30 centimos to 3 pesetas 80 centimos for column 2 per 100 kilogrammes.

### Cyprus.

#### *Importation of Dynamite.*

By an Order of the High Commissioner of Cyprus in Council, dated 30th May last, published in the *Cyprus Gazette* of 7th June,

1. The importation of dynamite and kindred articles, viz., nitroglycerine, gun-cotton, fulminate of mercury or of other metals, into any port or place of the Island of Cyprus other than the port of Larnaca, is prohibited.

2. No person shall import into the port of Larnaca any quantity of dynamite, or of the aforesaid kindred articles, without the permission of the High Commissioner previously obtained. Such permission shall be given in writing, under the hand of the Chief Secretary, and shall be subject to such conditions as the High Commissioner may deem it expedient to impose.

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### THE BELGIAN MARGARINE TRADE.

In a report, dated May 22nd last, Mr. George W. Roosevelt, United States Consul at Brussels, states that the consumption of margarine in Belgium during the past few years has been very considerable. The country produces from 2,000,000 to 3,000,000 kilos. (4,409,000 to 6,613,000 lb.) annually. The present consumption requires an annual importation of about 12,000,000 kilos. (26,455,000 lb.)

Very nearly the entire quantity of margarine consumed in Belgium is imported from Holland. It is estimated that the annual consumption in Belgium of this article amounts to 15,000,000 kilos. (33,069,000 lb.)

Statistics show a falling-off in the importation of fatty substances other than butter and margarine, which proves that the latter product has almost entirely replaced fats of inferior quality which were formerly used. The consumption of margarine steadily increases, and is now sold in all the cities of this country under a distinctive name. The Belgian Government is favouring the manufacture of margarine, not only to supply the home demand, but, if possible, to compete with Holland for the English market. England imports annually more than 65,000,000 kilos. (143,300,000 lb.) of this product, valued at 90,000,000 frs., principally from Holland, which makes a speciality of mixing American oleomargarine with oil and milk.

To secure a part of the trade with England, the Belgian Government proposes to establish a duty of 20 frs. per 100 kilos. (220·46 lb.) on all imported margarine, and an excise duty of 5 frs. on home production. The remittal of the excise tax will be authorised by law on exportation.

In France, margarine, oleomargarine, alimentary fats, and similar products are liable to a Customs duty of 15 frs. per 100 kilos.; and lard, 14.50 frs. per 100 kilos. In Germany, artificial butter is taxed 25 frs. per 100 kilos. Pork, goose, and other melted fats, also margarine and beef marrow are taxed 12.50 frs. per 100 kilos. The Belgian Government wishes to confine the duty to natural butter, margarine, mixtures of fats and oil, and, excepting milk, will permit all raw materials free entry.

To produce 100 kilos. of margarine at least 65 kilos. (143·3 lb.) of oleomargarine, 20 kilos. (44·2 lb.) of vegetable oil, and 30 kilos. (66·43 lb.) of milk are required; half of the latter is eliminated in the form of water.

Very little oleomargarine is manufactured in Belgium. Large quantities are produced in Austria and France, but nearly the entire continent of Europe receives its supply from New York and Chicago. Importation is almost exclusively viâ the port of Rotterdam, which received, in 1893, more than 35,000,000 kilos. (72,651,800 lb.)

Some time since, France sent a commission to Holland for the purpose of studying the methods employed there for the suppression of frauds in butter-making, and also to ascertain if the manufacture of margarine has been favourable to agricultural interests. The report contains the attestation of seven mayors of communes in southern Holland, showing that since the introduction of the margarine industry in that country, not only has the price of milk increased, but also the number of cattle, which plainly shows that the industry in question has become a source of profit to the farmers.—*Board of Trade Journal.*

### ASPEN WOOD FOR MATCHES.

The U.S. Consul at Annaberg reports that the manufacture of matches in Germany, which has risen to be an industry of importance, employs pine, poplar, aspen, linden, and birch woods. Of these woods aspen has proved itself indispensable by reason of its natural qualities and the ease with which it can be worked up. It is distinguished by its large structure, ready combustibility, freedom from knots, and uniformity of substance.

The flame of a match, as is well known, is conveyed to the wood from the igniting composition by sulphur, as in the case of lucifers, into which the splints are dipped. In the case of Swedish matches, the sulphur is substituted by paraffin. The sulphur, where this is used, remains on the outside of the wood and dries at once. The paraffin, however, must penetrate into the wood, partly because the matches would otherwise stick to each other, but principally because the paraffin becomes fluid again at even low degrees of heat, and would penetrate the igniting composition and render it useless. For safety matches, therefore, a wood is required which has light and spongy pores, as found only in the aspen, whose bright white colour further gives it an agreeable appearance. Poplar has a grey colour and is brittle; birch wood becomes yellow and is seldom obtainable in stout logs. These woods are also slow of combustion. Pine and fir woods take up little paraffin owing to the resin they contain.

In order to keep the pores as open as possible, and, also, to work up the wood to the greatest advantage, the aspen splint is produced by flaking. Aspen possesses the quality of being flakable to a very high degree. The flaking is done by causing a knife to revolve round a log which rotates on its own axis. The wood is divided into ribbons of the thickness and width of a match; these ribbons are laid evenly, one above the other, and cut into square splints. In consequence of the uniformity of the annual layers, aspen wood produces perfectly homogeneous ribbons or splints. This is not the case when other kinds of wood, like fir, &c., are flaked. The absence of all structure or grain further enables aspen wood to be flaked into thin shavings, which are worked by other machines into the familiar match-boxes. Just this fact that both match splint and box shavings can be produced by one machine from one material, calls for the employment of aspen wood. Attempts have been made to flake fir and pine woods as substitutes for aspen, but it is not known that any results of importance have been obtained. The reason why the last-mentioned woods cannot be flaked is, probably, because of the difference in the annual rings between the spring and fall wood—that is, between the inside of the ring and its extreme outside the difference is too great. The fall wood is too solid, the spring wood too soft, and the annual rings are of varying thicknesses, according to the location of the tree, while, even in the case of pine, the knife is apt to slip and cut ribbons of unequal thickness. In the case of aspen wood, each ribbon is like the other—a circumstance which is of the utmost importance for the further processes.

Match manufacturers require that the aspen wood should be free from rotten pith, and, as far as possible, free from knots—free from pith, otherwise the wood cannot be fixed in the flaking machine; free from knots, because the wood round the knots is decayed. The wood should further be straight-grown and of loose texture. The aspen is available for match-making as soon as the trunk has a diameter of eight inches. The demand is greatest for trunks with a diameter of 10 to 20 inches. To attain this size, a period of 25 to 60 years is necessary, according to the nature of the soil, position, &c. Trunks from 20 to 35 years old are preferred.—*U.S. Consular Reports.*

### THE RUSSIAN OIL INDUSTRY.

Consul Stevens, stationed at Batoum, forwards to the Foreign Office a long and useful report upon the condition of the Russian (Caspian) oil industry up to March, 1895. From this document we learn that the exports of mineral oils from the port of Batoum decreased during 1894 to the extent of 6,053 tons in lubricating, and 115,002 tons in refined oils, whilst the exports of crude oil increased by 2,862 tons, and those of illuminating distillate by 74 tons. The United Kingdom took less crude, lubricating, and refined oils, but more illuminating distillate. To India and Malta less refined oil was sent, the falling-off with the former being as much as 75,342 tons. The annexed table gives a clear insight into the distribution of the Russian oils and oil-products:—

*Return of Shipments of Petroleum Products from Batoum during the Years* 1893–94.

| | Crude and Crude Residuum. | | Total Lubricating Oils. | | Illuminating Distillate in Bulk. | | Refined Oils (Illuminating). | | | | Total. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Bulk. | Cases. | Total. | | | |
| | 1894. | 1893. | 1894. | 1893. | 1894. | 1893. | | | 1894. | 1893. | 1894. | 1893. |
| To— | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. | Tons. |
| United Kingdom | 3,304 | 5,170 | 11,104 | 19,791 | 19,559 | 13,193 | 93,619 | .. | 93,619 | 113,648 | 127,586 | 152,095 |
| Austria-Hungary | 4,534 | 1,314 | 3,689 | 4,768 | 88,779 | 106,186 | 10,917 | .. | 10,917 | 11,728 | 107,919 | 123,996 |
| Belgium | 7,566 | 6,916 | 18,306 | 17,380 | 513 | 852 | 25,302 | .. | 25,302 | 32,655 | 51,687 | 57,803 |
| Bulgaria and Servia | 13 | 12 | 111 | 170 | .. | .. | 1,521 | 8,252 | 9,773 | 9,842 | 9,897 | 10,024 |
| Cochin-China | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2,581 | .. | 2,581 |
| China | .. | .. | .. | .. | .. | .. | .. | 23,405 | 23,405 | 37,838 | 23,405 | 37,838 |
| Egypt | .. | .. | 170 | 232 | .. | .. | .. | 25,933 | 25,913 | 20,481 | 26,113 | 20,713 |
| France | 8,184 | 5,402 | 21,410 | 23,317 | 32,480 | 21,114 | 6,129 | .. | 6,129 | 5,993 | 68,233 | 55,826 |
| Germany | 2,838 | 2,476 | 24,893 | 18,149 | .. | 1,170 | 1,943 | .. | 1,943 | 1,098 | 29,674 | 22,893 |
| Holland | .. | .. | 374 | 95 | .. | .. | 10,712 | .. | 10,712 | 5,610 | 11,086 | 5.705 |
| India | .. | .. | .. | .. | .. | .. | .. | 89,550 | 89,550 | 164,892 | 89,550 | 164,892 |
| Italy | 139 | 2,298 | 77 | 2,639 | .. | .. | 8,557 | .. | 8.557 | 18,222 | 8,773 | 23,159 |
| Japan | .. | .. | .. | .. | .. | .. | .. | 10.034 | 10,034 | 36,437 | 10,034 | 36,437 |
| Java | .. | .. | .. | .. | .. | .. | .. | 20,893 | 20,893 | 78,895 | 20,893 | 78,895 |
| Manila | .. | .. | .. | .. | .. | .. | .. | 5,112 | 5,112 | 8,526 | 5,112 | 8,526 |
| Malta | .. | .. | .. | .. | .. | .. | 3,487 | .. | 3,527 | 3.055 | 3,527 | 3,055 |
| Roumania | .. | .. | 1,014 | 1,091 | 2 | .. | .. | 6,306 | 6,306 | 4,099 | 7,322 | 5,193 |
| Siam | .. | .. | .. | .. | .. | .. | .. | .. | .. | 2,085 | .. | 2,085 |
| Spain | .. | .. | .. | 1,276 | 427 | .. | 1,432 | .. | 1,432 | .. | 1,859 | 1,276 |
| Turkey | 85 | .. | .. | 608 | 427 | .. | .. | 86,587 | 86,887 | 66,010 | 87,230 | 66,629 |
| Africa | .. | .. | .. | .. | .. | .. | .. | 603 | 603 | 630 | 603 | 630 |
| Suez Canal | .. | .. | .. | .. | .. | .. | 112,531 | 65 | 112,596 | 57,111 | 112,596 | 57,111 |
| Other countries | 1 | .. | 9 | 33 | .. | .. | .. | 1,593 | 1,596 | .. | 1,606 | 33 |
| Total exports | 26,664 | 23,899 | 81,445 | 89,552 | 141,769 | 142,515 | 276,150 | 278,336 | 554,836 | 681,129 | 804,705 | 937,395 |
| Russia | 2,024 | 1,927 | 4,554 | 2,500 | 7,705 | 6,876 | 99,623 | 3,277 | 106,174 | 94,883 | 120,757 | 10,1866 |
| Total shipments | 28,688 | 25,826 | 85,999 | 92,052 | 149,465 | 149,391 | 375,773 | 281,613 | 661,310 | 776,312 | 925,462 | 1,043,581 |

Other tables compiled by the Consul show the following particulars:—Number of wells producing, December 1894, 381, against 317 December 1893; total production of crude oil in 1894, 4,903,210 tons, against 5,436,318 tons in 1893; crude oil pumped into reservoirs in 1894, 4,793,534 tons, against 5,238,116 tons in 1893; stock of crude oil at wells, December 31, 1894, 147,773 tons, compared with 313,760 tons December 31, 1893; total stocks of crude oil and naphtha products at the wells and in Baku:—

| Products. | Jan. 1, 1891. | Jan. 1, 1892. | Jan. 1, 1893. | Jan. 1, 1894. |
|---|---|---|---|---|
| Crude— | Tons. | Tons. | Tons. | Tons. |
| At wells | 77,421 | 148,386 | 262,902 | 316,128 |
| In Baku | 80,645 | 177,419 | 211,289 | 240,322 |
| Illuminating oils | 85,483 | 114,515 | 132,257 | 166,128 |
| Lubricating oils | 11,290 | 16,129 | 11,290 | 14,516 |
| Residuum | 241,935 | 435,483 | 516,130 | 609,683 |
| Total | 490,774 | 891,932 | 1,133,868 | 1,246,777 |

Owing to the low price of refined oil in 1894, a much smaller quantity of it was despatched from Baku that year, and the oil-refiners are now paying more attention to residuum, for which there is a stronger demand at more profitable prices. The demand for residuum for fuel is said to be practically unlimited, and it is estimated that the output of it this year will reach 3,300,000 tons or even more. The natural result of this state of things will be to diminish the production of refined oils, under the effects of the conviction that it does not pay the Russian refiners to produce illuminating oils for export. If sufficient residuum is not made crude oil will be sold for fuel—indeed, the well-owners are already agitating in that direction—and the refiners may find themselves deprived of the most lucrative branch of their business. Hitherto the refiners have controlled the industry, but if the crude oil is sold just as it is raised the well-owners will become the "bosses." Consul Stevens details the reasons for the formation of the Russian Oil Syndicate, but the union so created does not appear to have been very successful, and further negotiations are in progress between it and the Russian Government largely in relation to the question of lower railway rates. The Consul touches upon the Russian kerosene trade with the United Kingdom, and attributes the successful competition of the Americans to the greater ability, better administrative powers, and greater enterprise of the latter. He gives, also, a summary of the principal causes which have led to the crisis in the Russian petroleum trade, as gathered from an official review of the industry; but we need not reproduce this, inasmuch as the causes mentioned simply indicate disunion, irregular supplies, insufficient means of storage, a want of capital amongst the producers, and a general absence of business capacity. If these faults can be remedied, it is possible the Russian oil trade may become prosperous, whereas, if the existing state of things continues there is little hope of Russian illuminating oils being available in this country or other leading markets of the world. Probably the Americans were well aware of this when they made the recent advance in prices.—*Ironmonger*.

## GENERAL TRADE NOTES.

### BREWERIES IN BRITISH INDIA.

A communication has been received at the Board of Trade from the India Office with reference to breweries established in British India, from which it appears that the quantity of beer brewed during 1894 amounted to 6,121,905 gallons, of which more than half was bought by the army commissariat, the remainder being left for consumption by the civil population. The average purchases of the commissariat for the last five years (1890–94) have amounted to about 2,897,000 gallons yearly, the total average production in the same period having been about 5,285,000 gallons. The army, therefore, consumes about 55 per cent. of the production and the civil population about 45 per cent. The quantity taken for the troops does not, however, represent the whole consumption of malt liquor by the troops, for they also consume imported beer to a substantial extent, though it is imported by the trade and no longer by Government.

The quantity of beer imported into India has averaged 2,849,167 gallons yearly in the last five years, and the quantity brewed in India in the same period has averaged, as noted above, 5,285,000 gallons, the local production being thus nearly double the quantity imported.

Twelve out of the 22 breweries are located at stations in the Himalayas from Murree to Darjeeling, and much of the beer is brewed there. A good deal is also brewed at Lucknow, Rawalpindi, Poona, Bangalore, at and near Ootacamund, and at Quetta and Mandalay. Last year the quantity brewed in the plains exceeded two million gallons, though in the beginning of the industry, and for a considerable period thereafter, it was supposed to be impossible to brew in the plains. The largest of the breweries is at Murree, where about 811,000 gallons were brewed last year. The next largest is at Poona, where the brewing of last year amounted to about 795,000 gallons. About one-third of the whole production is brewed in the Punjab.

The capital employed in the brewing industry (so far as it is known) is Rx. 170,000.

The commencement of the industry dates from 1850, when a brewery was established at Mussooree. This was followed by another at Kasauli in 1852. These were followed by the brewery at Murree in 1860 and at Simla in 1862.—*Board of Trade Journal.*

### The Sicilian Sulphur Industry.

During the recent discussion in connection with the vote for the commercial and agricultural departments in the Italian Chamber of Deputies the condition of the Sicilian sulphur industry was mentioned. Nothwithstanding the fact that Sicily produces nearly four-fifths of the world's output of sulphur, and has practically a monopoly of the article, the sulphur industry in Sicily has been long in a very precarious condition, and the price has fallen to about one-third of what it was 20 years ago, chiefly owing to the competition of the various mineowners among themselves, and to the fact that Sicilian sulphur is hardly any longer used in the manufacture of sulphuric acid. Against this diminished employment must be put the increased use of sulphur as a disinfectant, and in viticulture. At present there is an exceedingly heavy stock of sulphur in Sicily, and many mines have been compelled to cease operations, with the result that thousands of men are thrown out of work. The owners of sulphur mines demand from the Government a reduction in the taxes, and the abolition of the export duty on sulphur. At the beginning of the year it appeared that a better time was in store for the industry, inasmuch as the Italian Government had promised to assist in forming a great sulphur monopoly and to establish a bounty on the exportation of the article. The Minister concerned, however, has not kept his promise in this repect, and on June 23 last a meeting of persons interested in the welfare of the sulphur industry in Sicily passed a vote of censure on the Government. A few days later, when the vote for the Ministry of Commerce and Agriculture came up for discussion in the Chamber, a number of deputies of all parties demanded that Government aid should be promptly given to the industry. After a long debate, the Ministry of Commerce promised that prompt attention should be given to the matter.—*Chemist and Druggist.*

### An English Linseed Oil Factory in Roumania.

*Chamber of Commerce Journal, August* 1895, 151.

The English linseed oil factory started at Galatz last year for crushing linseed and cotton seed for oil, has been making satisfactory headway, and will probably be a success as long as the high tariffs on imported oils are kept up. Owing to the almost complete failure of the local linseed crop the factory has had to deal almost entirely with imported seed, a certain amount of which was allowed to be imported free of duty. For the oil extracted there is good local demand at remunerative prices, but owing to the extreme cheapness of forage in Roumania there is no demand for the seed-cake for fattening cattle, &c., and this has to be exported to England to find a market. Efforts are being made, but so far unsuccessfully, to push the consumption of cake locally. Two or three other oil-mills have been set up in other parts of the country.

### Importation of Indian and Persian Opium into China.

A recently-issued Consular report, in commenting upon the remarkable decrease in the amount of opium imported into Amoy, in China, during the last year, gives some interesting particulars regarding the consumption of this drug. Until recently large consignments of Bengal, Persian, and Malwa opium found their way to this port, but producers are now handicapped from a variety of reasons. Tchang and the surrounding districts produce steadily increasing quantities, which are shipped to Amoy without any great restrictions being imposed in the way of duty, nor is care taken to prevent the sophistication of the high-priced Indian and Persian opiums with the inferior native production. If to this be added the high export duty which is levied on Malwa opium in Bombay, and the fact that the crop in Persia was a comparative failure last year, it can easily be seen how favourable are the conditions commercially for the successful production of native opium. Another reason which has militated against the importation of Indian and Persian opium, is that large quantities of morphine, to the amount sometimes of 800 ozs. per month, are now imported into Amoy, and the use of this alkaloid is, to a certain extent, replacing opium. After making due allowance for the amount used medicinally, there remains a large proportion for which victims to the morphine habit are accountable. Medical opinion has shown that this habit is more injurious than opium smoking, as, although persons addicted to morphine injection are able to abstain from the opium pipe, yet on ceasing to use the alkaloid, opium itself is indulged in to a greater extent than ever. The amount and value of the opium produced in the neighbourhood of Amoy has increased largely during the last year, and seems likely to do so. It is produced from the seeds of the Indian poppy, and although somewhat similar in appearance to the Bengal drug, is inferior in smell and for smoking purposes. —*Pharm. Journal.*

### Carriage of Compressed Gases.

The railway companies generally have given notice that in future cylinders containing compressed gases will not be received as ordinary luggage, but will only be accepted for transit under special conditions. The cylinders must be made of wrought iron or of mild steel of the best quality, containing not more than $\frac{1}{4}$ per cent. of carbon, thoroughly annealed after manufacture, of sufficient strength, and efficiently tested. The cylinders must be protected by being encased in closely-plaited hemp, or by being fixed in an ordinary wooden box without lid, but with rope handle, or by being loose in a wooden box with a lid secured by a strap, or by being enclosed in closely-woven wicker-work. Persons tendering cylinders for transit are required to sign a special form of contract-note.—*Ironmonger.*

### Sulphur Mining in Japan.

The *Financial News* observes that in the industrial development of Japan, sulphur mining is likely to play an increasingly important part. In 1868, when Japanese statistics in relation to Customs made a beginning, the exportation of sulphur was only 131 tons; in 1890 this quantity had increased to 21,274 tons. There was a slight drop in 1891 and 1892; but in 1894 no less than 84 sulphur mines were being worked, and 13 of them produced upwards of 100 tons apiece in the course of the year.

### A New Cyanide Factory.

A new cyanide factory has been started in Selm, Lüdingshausen, Germany. It has been promoted by a Hamburg syndicate, with a capital of 2,000,000 marks. Potassium cyanide, ferrocyanides, and sulphocyanides will be the principal products.—*Chemist and Druggist.*

### The Austrian Quicksilver Industry.

A deposit of cinnabar-bearing limestone has been discovered at Gratwein, near Graz, in Austria. It is believed, judging from superficial indications, that the deposit has a width of about 60 feet, and that it is a very valuable one. An English syndicate has been formed to exploit the mine. —*Ibid.*

### Imports into France of Molasses for Spirit Manufacture.

*Zeits. Spiritus Ind.* 1895, **18**, 59.

The following table gives the official figures of imports of molasses :—

| Years. | From Germany. | From Belgium. | From other Countries. | Totals. |
|---|---|---|---|---|
| | Kilos. | Kilos. | Kilos. | Kilos. |
| 1886 | 42,206,000 | 25,718,000 | 51,326,000 | 119,250,000 |
| 1887 | 35,918,000 | 33,135,000 | 34,091,000 | 103,144,000 |
| 1888 | 65,202,000 | 30,700,000 | 29,351,000 | 125,256,000 |
| 1889 | 26,353,000 | 34,483,000 | 25,660,000 | 86,496,000 |
| 1890 | 21,731,000 | 20,695,000 | 13,454,000 | 55,880,000 |
| 1891 | 53,356,000 | 19,658,000 | 14,015,000 | 87,029,000 |
| 1892 | 72,975,201 | 14,046,989 | 27,666,252 | 114,688,442 |
| 1893 | 106,630,931 | 22,786,622 | 27,145,603 | 156,563,156 |
| 1894 | 52,925,329 | 21,086,350 | 22,299,183 | 96,310,867 |

The imports of molasses into France have still further declined this year owing, to the increase in the duty on foreign molasses.—L. T. E.

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Seven Months ending 31st July. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals.......................... | 1,452,151 | 1,765,051 |
| Chemicals and dyestuffs.......... | 451,820 | 533,417 |
| Oils............................. | 747,101 | 742,991 |
| Raw materials for non-textile industries. | 4,063,668 | 4,829,385 |
| Total value of all imports .... | 31,835,553 | 35,128,142 |

### SUMMARY OF EXPORTS.

| Articles. | Seven Months ending 31st July. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) .... | 2,429,516 | 2,565,418 |
| Chemicals and medicines .......... | 657,024 | 703,682 |
| Miscellaneous articles............ | 2,141,427 | 2,684,215 |
| Total value of all exports..... | 18,398,536 | 20,559,486 |

### IMPORTS OF METALS FOR SEVEN MONTHS ENDING 31ST JULY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper:— | | | | |
| Ore.............. Tons | 9,759 | 8,504 | 46,287 | 67,371 |
| Regulus ........ „ | 5,044 | 10,559 | 100,298 | 257,821 |
| Unwrought .... „ | 5,666 | 3,010 | 226,843 | 130,324 |
| Iron:— | | | | |
| Ore.............. „ | 432,807 | 440,133 | 294,661 | 292,870 |
| Bolt, bar, &c.... „ | 3,957 | 7,897 | 87,074 | 63,267 |
| Steel, unwrought.. „ | 603 | 981 | 5,050 | 8,336 |
| Lead, pig and sheet „ | 11,601 | 14,935 | 105,641 | 149,392 |
| Pyrites ........... „ | 50,119 | 57,660 | 85,032 | 106,644 |
| Quicksilver....... Lb. | 37,925 | 68,260 | 3,155 | 6,636 |
| Silver ore....... Value £ | .. | .. | 166,995 | 169,771 |
| Tin ............... Cwt. | 48,786 | 71,984 | 169,715 | 228,867 |
| Zinc .............. Tons | 4,159 | 5,925 | 69,198 | 85,723 |
| Other articlos ...Value £ | .. | .. | 142,202 | 198,029 |
| Total value of metals | .. | .. | | |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR SEVEN MONTHS ENDING 31ST JULY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 12,221 | 11,931 | 10,682 | 10,816 |
| Bark (tanners', &c.) „ | 34,069 | 41,791 | 14,671 | 19,747 |
| Brimstone ........ „ | 21,769 | 24,320 | 5,062 | 4,917 |
| Chemicals...... Value £ | .. | .. | 104,411 | 121,680 |
| Cochineal ........ Cwt. | 241 | 341 | 1,451 | 2,126 |
| Cutch and gambier Tons | 2,550 | 4,372 | 54,600 | 95,695 |
| Dyes:— | | | | |
| Aniline and other Value £ | .. | .. | 42,923 | 36,138 |
| Alizarin ...... „ | .. | .. | 18,528 | 24,991 |
| Indigo ........... Cwt. | 1,634 | 2,495 | 23,587 | 29,787 |
| Nitrate of potash . „ | 25,342 | 16,713 | 22,478 | 16,171 |
| Valonia .......... Tons | 2,812 | 4,314 | 35,178 | 47,919 |
| Other articles... Value £ | .. | .. | 118,249 | 123,430 |
| Total value of chemicals | .. | .. | 451,820 | 533,417 |

### IMPORTS OF OILS FOR SEVEN MONTHS ENDING 31ST JULY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut......... Cwt. | 34,581 | 1,297 | 41,075 | 1,496 |
| Olive ............. Tuns | 2,964 | 1,714 | 99,257 | 62,556 |
| Palm .............. Cwt. | 108,400 | 133,306 | 114,203 | 139,545 |
| Petroleum ........ Gall. | 13,888,220 | 13,002,126 | 245,605 | 248,450 |
| Seed .............. Tons | 2,187 | 3,906 | 45,861 | 71,050 |
| Train, &c. ......... Tuns | 3,426 | 4,424 | 56,040 | 72,343 |
| Turpentine ....... Cwt. | 62,191 | 83,822 | 68,643 | 87,909 |
| Other articles .. Value £ | .. | .. | 76,417 | 59,642 |
| Total value of oils ... | .. | .. | 747,101 | 742,991 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR SEVEN MONTHS ENDING 31ST JULY.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 4,639 | 799 | 7,721 | 1,097 |
| Bristles.......... Lb. | 356,063 | 427,657 | 51,687 | 58,836 |
| Caoutchouc...... Cwt. | 19,254 | 18,553 | 177,908 | 172,954 |
| Gum:— | | | | |
| Arabic......... „ | 2,521 | 7,480 | 7,642 | 19,652 |
| Lac, &c. ....... „ | 6,726 | 10,458 | 33,965 | 59,044 |
| Gutta-percha .... „ | 4,105 | 4,051 | 34,698 | 19,937 |
| Hides, raw:— | | | | |
| Dry............ „ | 38,143 | 53,100 | 87,693 | 126,453 |
| Wet ........... „ | 43,298 | 77,086 | 88,684 | 176,730 |
| Ivory ............ „ | 899 | 1,197 | 36,346 | 54,258 |
| Manure:— | | | | |
| Guano ......... Tons | 451 | 6,758 | 1,917 | 58,411 |
| Bones.......... „ | 2,442 | 3,404 | 11,298 | 14,454 |
| Nitrate of soda... „ | 6,506 | 7,622 | 57,705 | 60,658 |
| Phosphate of lime „ | 35,360 | 39,646 | 67,967 | 67,535 |
| Paraffin.......... Cwt. | 20,835 | 47,667 | 22,194 | 49,555 |
| Linen rags....... Tons | 1,122 | 2,299 | 11,403 | 23,104 |
| Esparto.......... „ | 11,626 | 16,600 | 51,843 | 68,142 |
| Pulp of wood .... „ | 23,806 | 25,764 | 119,454 | 129,558 |
| Rosin............ Cwt. | 121,512 | 161,002 | 29,894 | 39,891 |
| Tallow and stearin „ | 157,240 | 172,280 | 191,787 | 205,256 |
| Tar ..............Barrels | 12,538 | 8,815 | 6,631 | 5,922 |
| Wood:— | | | | |
| Hewn ......... Loads | 248,814 | 280,903 | 465,774 | 564,762 |
| Sawn .......... „ | 787,225 | 870,498 | 1,699,489 | 1,843,155 |
| Staves ......... „ | 8,947 | 16,402 | 29,378 | 42,682 |
| Mahogany ..... Tons | 3,334 | 2,840 | 26,662 | 20,092 |
| Other articles....Value £ | .. | .. | 743,928 | 947,247 |
| Total value ....... | .. | .. | 4,063,668 | 4,829,385 |

### Exports of Metals (other than Machinery) for Seven Months ending 31st July.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............. Cwt. | 10,170 | 9,290 | 36,993 | 37,392 |
| Copper:— | | | | |
| Unwrought ..... „ | 29,086 | 45,209 | 62,453 | 101,121 |
| Wrought......... „ | 22,224 | 20,541 | 58,786 | 55,549 |
| Mixed metal .... „ | 16,327 | 16,295 | 34,425 | 34,753 |
| Hardware ..... Value £ | .. | .. | 143,464 | 155,295 |
| Implements....... „ | .. | .. | 93,494 | 108,186 |
| Iron and steel..... Tons | 228,478 | 280,762 | 1,526,448 | 1,814,818 |
| Lead ............. „ | 5,061 | 3,925 | 50,348 | 44,020 |
| Plated wares... Value £ | .. | .. | 21,833 | 28,104 |
| Telegraph wires „ | .. | .. | 303,483 | 82,421 |
| Tin ................ Cwt. | 9,680 | 10,400 | 35,110 | 35,245 |
| Zinc ............... „ | 14,816 | 14,266 | 9,869 | 10,279 |
| Other articles .. Value £ | .. | .. | 52,810 | 58,235 |
| Total value ......... | .. | .. | 2,429,516 | 2,565,418 |

### Exports of Drugs and Chemicals for Seven Months ending 31st July.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 444,000 | 501,591 | 121,393 | 120,881 |
| Bleaching materials „ | 99,750 | 127,351 | 38,686 | 42,621 |
| Chemical manures. Tons | 41,929 | 34,077 | 211,769 | 152,857 |
| Medicines....... Value £ | .. | .. | 69,922 | 84,678 |
| Other articles .. „ | .. | .. | 215,254 | 302,645 |
| Total value .......... | .. | .. | 657,024 | 703,682 |

### Exports of Miscellaneous Articles for Seven Months ending 31st July.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 733,400 | 890,800 | 14,971 | 17,143 |
| Military stores.. Value £ | .. | .. | 74,126 | 149,383 |
| Candles.......... Lb. | 1,546,200 | 1,983,900 | 26,630 | 33,789 |
| Caoutchouc ..... Value £ | .. | .. | 107,359 | 100,995 |
| Cement.......... Tons | 35,964 | 40,621 | 61,128 | 65,533 |
| Products of coal Value £ | .. | .. | 77,904 | 110,603 |
| Earthenware ... „ | .. | .. | 131,668 | 171,408 |
| Stoneware ...... „ | .. | .. | 13,829 | 15,793 |
| Glass:— | | | | |
| Plate........... Sq. Ft. | 85,548 | 161,909 | 5,140 | 8,710 |
| Flint........... Cwt. | 6,430 | 7,403 | 14,843 | 15,872 |
| Bottles......... „ | 42,986 | 55,078 | 21,697 | 25,867 |
| Other kinds.... „ | 13,237 | 19,403 | 10,505 | 13,971 |
| Leather:— | | | | |
| Unwrought .... „ | 10,627 | 13,836 | 98,435 | 124,312 |
| Wrought ..... Value £ | .. | .. | 18,544 | 28,910 |
| Seed oil.......... Tons | 3,238 | 3,573 | 71,208 | 74,868 |
| Floorcloth ..... Sq. Yds. | 1,569,600 | 2,042,200 | 57,089 | 85,082 |
| Painters' materials Val. £ | .. | .. | 106,606 | 145,632 |
| Paper ........... Cwt. | 71,591 | 78,186 | 105,941 | 119,103 |
| Rags.............. Tons | 3,937 | 4,256 | 21,963 | 21,984 |
| Soap.............. Cwt. | 45,853 | 50,500 | 49,233 | 52,949 |
| Total value .......... | .. | .. | 2,141,421 | 2,684,215 |

Besides the above, drugs to the value of 66,184*l*. were imported, as against 48,597*l*. in July 1894.

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, and MACHINERY.

### Applications.

13,622. G. C. Dymond.—From T. B. Myers. Improvements in or relating to spraying apparatus. Complete Specification. July 16.

13,867. Sir W. Arrol and W. Foulis. Improvements in apparatus for charging gas and other retorts. July 20.

13,896. F. Bormann-Zix. Improvements in the method of and apparatus for the production of superheated steam. July 20.

13,960. E. Petreano. Improvements in carburettors. July 22.

14,026. A. Sweetser. Improvements in saturators or vaporisers. July 23.

14,434. T. Atkins and T. A. Harris. A new or improved apparatus for filtering waste oils or other fluids. July 30.

14,456. H. R. Chubb. Improvements in machinery applicable for filtering, condensing, and absorbing air, smoke, fumes, and other gases. July 30.

14,652. A. Wastall. Improvements in distilling apparatus. August 2.

14,852. E. Theisen. Improvements in apparatus for evaporating or distilling liquids. August 6.

14,971. F. Willis. An improvement in the construction of gas furnaces for enamelling, assaying, milling, &c. August 8.

15,103. E. A. Pellet. Improvements in the manufacture of refractory substance and apparatus therefor. August 10.

15,197. T. Scott. Improvements in or relating to evaporators for obtaining common salt and for analogous purposes. Complete Specification. August 13.

15,211. J. M. Davidson. Improvements in and relating to filters. Complete Specification. August 13.

15,382. F. H. Tyacke and R. S. Brownlow. Improvements in apparatus for heating, softening, and purifying and condensing, applicable as a feed-water heater, feed-water heater softener and purifier, evaporator, or condenser. August 15.

### Complete Specifications Accepted.*

1894.

14,554. A. Lawrence and Bennett, Sons, and Shears. Apparatus for heating and cooling liquids. July 31.

15,249. C. J. Bagley, L. Roberts, and the Moor Steel and Iron Company, Limited. Apparatus for utilising the waste heat of furnaces of the open-hearth type. August 14.

15,463. A. Bassett. *See* Class XVII.

16,728. F. W. Crossley and J. Atkinson. Apparatus for transferring heat or refrigerating. August 14.

17,593. T. T. Best, S. A. Hollingsworth, and J. Brock. Apparatus for raising or pumping corrosive or other liquids. July 31.

18,462. T. W. F. Cherry. Improvements in taps for use with chemical and other fluids. August 14.

18,591. T. Hewitt. Cooling and freezing machines. August 7.

18,727. G. Krell. *See* Class VII.

18,828. E. Theisen. Apparatus for condensing, evaporating, or refrigerating fluids. August 7.

19,175. A. Gray. Apparatus for manufacturing paper, linen, or other fabrics coated or impregnated with celluloid or varnish, or the like. August 14.

19,293. J. L. Mitton and T. J. L. Mitton. Retort mouthpieces, and self-sealing lids for same. August 14.

20,414. R. Fegan. Manufacture of briquettes for fuel. August 14.

1895.

3595. J. N. Carey. Filters. August 14.

11,813. S. T. Wellman and C. H. Wellman. Melting-furnaces. July 24.

13,075. M. A. Champion. Apparatus for distilling water. August 14.

Patents Void through Non-Payment.

6798. A. J. Boult.—From L. Falasconi. Improvements in kilns for furnaces. July 31.

6887. J. Peake. Improvements in or relating to kilns for various purposes. August 7.

7205. The Gaseous and Liquid Fuel Supply Co., Lim., and B. H. Thwaite. Apparatus for inducing the flow of, and injecting and spraying gaseous and liquid fluids. August 7.

7464. A. Hof. Carburating or carbonising apparatus. August 14.

7636. T. A. A. Pile and W. A. Pile. Machines for moulding and pressing clay or other plastic materials.

## II.—FUEL, GAS, and LIGHT.

### Applications.

12,332a. G. A. Cannot. Improvements in the manufacture of briquettes for fuel from peat. Filed July 18. Date claimed June 25, 1895.

13,570. S. Chandler, jun. Improvements in apparatus for washing, purifying, and scrubbing gas. July 15.

13,574. F. Clark and the Southend Gas Co. Improvements in and apparatus for the manufacture of gas. July 15.

13,612. C. J. Yarnold and W. Elworthy. Improvements in and connected with the manufacture of gases, and apparatus therefor. July 16.

13,671. R. Middleton. An improved mode of procedure in or connected with the manufacture of artificial fuel and the like. July 17.

13,750. T. L. Willson. Improvements in the manufacture of illuminating gas. Filed July 18. Date applied for, December 19, 1894, being date of application in United States.

13,764. A. J. Boult.—From C. Dellwick. Improved process and apparatus for producing water-gas. July 18.

13,766. T. L. Willson. Improvements in the production of illuminating gas. Filed July 18. Dated applied for, December 19, 1894, being date of application in United States.

13,831. J. B. Torres. Improvements in and connected with the manufacture of oxygen and rich oxygen compounds for the working of metallurgical furnaces, gas-producers, and regenerators, ovens, heating-apparatus, and the like. July 19.

13,863. R. Stone. Improvements in the manufacture of a fuel for burning and heating purposes, and machinery in connection therewith. July 20.

13,959. H. L. A. Lapointe. Improvements in and connected with the manufacture of oxygen. Complete Specification. Filed July 22. Date applied for, March 26, 1895, being date of application in France.

14,200. R. G. Bennett. Improvements in mixing air and gas for incandescent lighting and heating. July 25.

14,208. C. E. Bichel and E. Schulte. Improvements in producing inexplosive acetylene gas. July 25.

14,336. A. H. C. Burrow. An improved candle. July 27.

14,460. H. Howell. Improvements in apparatus for the production of combustible gas. July 30.

14,609. R. Donovan. *See* Class XII.

14,682. J. Bowing. Improvements in coking processes. August 2.

14,685. H. Kühne. Ascertaining the heating power of solid combustibles and apparatus therefor. August 2.

14,759. M. G. Sykes. Improvements in the production of fuel. August 3.

14,855. A. K. Huntington. *See* Class VII.

14,883. G. Bacher. Improvements in the treatment of coal slime and apparatus therefor. Complete Specification. August 6.

14,974. C. Jacobsohn. Improvements in night-lights. August 8.

15,048. W. Foulis. Improvements in and apparatus for the manufacture of gas. August 9.

15,168. W. Foulis and P. F. Holmes. Improvements in apparatus for obtaining cyanides from gases. August 12.

15,228. A. V. Newton.—From A. Nobel. An improved mode of raising the temperature and illuminating power of flames. August 13.

15,268. F. W. H. Hempel and M. Gumpel. Improvements in incandescent gas lamps. Complete Specification. August 14.

15,295. E. J. Constam and L. Gaster. Improvements in the manufacture of illuminating bodies for use in electric lighting. August 14.

15,366. T. G. McEwen. Improvements in the manufacture of gas. August 15.

15,402. J. H. Exley. Improvements in apparatus for generating acetylene gas. August 16.

15,469. R. T. Glover and J. G. Glover. Improvements in or relating to means or appliances for increasing the heating power of atmospheric burner (gas), also for increasing the luminosity of incandescent mantles, canopies, or like bodies. August 16.

15,488. R. F. Strong. Improvements in the treatment of peat in the manufacture of fuel and for the production of artificial marble, stone, wood, and similar substances. August 17.

### Complete Specifications Accepted.

1894.

8974. T. G. McEwen. Manufacture of gas. August 14.

14,196. A. D. Shrewsbury. Coke ovens. July 31.

14,885. W. A. Fourness. Apparatus for generating and carburetting water-gas. July 31.

16,202. J. H. Crosby and M. McInerney. Improvements in fire-lighters and apparatus therefor. July 24.

17,555. H. R. Dinsmore. Apparatus for making gas from coal. July 24.

18,078. P. Dvorkovitz. Apparatus for enriching gases by liquid hydrocarbons. July 31.

18,440. S. Hersey and Kirkham, Hulett, and Chandler, Lim. Apparatus for washing or scrubbing gas. July 31.

18,441. Kirkham, Hulett, and Chandler, Lim. Apparatus for condensing and washing gas. July 31.

18,443. S. H. Terry. Use of liquid fuel and apparatus therefor. July 31.

18,510. W. Kemp. Apparatus for enriching gas. August 7.

Patents Void through Non-Payment.

7092. A. A. Lister. Apparatus for extracting tar and ammonia from gas. August 7.

7648. E. Stauber. Process and appliances for producing peat coke cakes. August 14.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Application.

14,617. C. H. McEuen.—From J. C. Alexander and R. C. Beveridge. Improvements in the treatment of kerosine shale for the production of hydrocarbons and other products therefrom. Complete Specification. August 1.

## IV.—COLOURING MATTERS AND DYES.

### APPLICATIONS.

13,626. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. July 16.

13,822. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of azo colouring matters. July 19.

13,947. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of direct-dyeing azo colouring matters. July 22.

13,949. C. D. Abel.—From A. Fischesser and Co. Manufacture of phthaleines by the action of mixed anhydrides. July 22.

14,135. J. Y. Johnson.—From the Badische Anilin and Soda Fabrik. The manufacture and production from phtalonic acid of new dyes related to the rhodamine series. July 24.

14,276. G. W. Johnson.—From F. von Heyden, Nachfolger. A process for the manufacture of aromatic nitro-sulpho-chlorides. July 26.

14,331. G. W. Johnson.—From F. von Heyden, Nachfolger. The manufacture or production of para-phenetidin-succinic acid and of para-phenetidin-dioxy-succinic acid. Complete Specification. July 27.

14,382. O. Imray. — From The Farbwerke vormals Meister, Lucius and Brüning. Manufacture of meta-nitranilin-sulpho acid and its analogues. July 29.

14,483. O. Imray. — From The Society of Chemical Industry in Basle. Manufacture of new "coupled tetrazo compounds" and of complex polyazo colouring matters resulting therefrom. July 30.

14,488. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of chemical compounds and dyestuffs derived from phenolic bodies. July 30.

14,194. O. Imray. — From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of azo colouring matters. July 30.

14,633. H. H. Lake.—From K. Oehler. New brown azo dyestuffs and method of producing the same. August 1.

14,686. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of anthraquinone derivatives. August 2.

14,687. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The production of dyestuffs. August 2.

15,242. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. The manufacture and production of black colouring matters of the anthraquinone series suitable for directly dyeing cotton in the cold bath. August 13.

15,457. O. Imray.—From The Society of Chemical Industry in Basle. Manufacture of black-blue to black diazo colouring matters for wool. August 16.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

14,601. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. A process for the production of fast azo-colours upon the fibre. August 7.

18,129. A. Feer. Improvements relating to the preparation of diazo salts, and to the use of the same for dyeing and printing. July 31.

18,516. A. M. Clark.—From A. Edinger and A. Muller. The manufacture of sulphocyanides of the quarternary ammonium compounds of quinoline pyridine, anti-pyrine, and iso-quinoline and their derivatives. August 7.

18,578. H. E. Newton. — From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. July 31.

19,187. J. Y. Johnson.—From C. F. Boehringer and Soehne. Manufacture of the alkyl-ethers of acylised $p$-amidophenols. August 14.

19,188. J. Y. Johnson.—From C. F. Boehringer and Soehne. An improved process for the manufacture of lactyl-$p$-phenetidine. August 14.

19,420. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of a colouring matter to dye cotton without mordant. August 14.

19,885. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters of the induline series. August 14.

19,970. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of direct-dyeing colouring matter. August 14.

19,971. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of direct-dyeing colouring matter. August 14.

19,972. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of direct-dyeing colouring matter. August 14.

1895.

13,291. J. Weller and W. Brauns. Manufacture of colouring matters. August 14.

## V.—TEXTILES, COTTON, WOOL, SILK, ETC.

### APPLICATIONS.

13,656. J. E. Bedford and C. S. Bedford. A process for printing inlaid patterns upon linoleum and like fabrics. July 17.

14,052. W. Mather. Improvements in the manufacture of mosaic floorcloth, and in apparatus for that purpose. July 23.

14,453. G. C. Dymond.—From La Soc. Leblois, Piceni, and Co. An improved process for the treatment of textile and other materials, and apparatus therefor. July 30.

14,781. G. Loppens and H. Deswarte. Improvements in and connected with retting or steeping flax and hemp. August 3.

15,152. C. Ris-Kummer. An improvement in raw silk. Complete Specification. August 12.

15,171. O. Duckworth and E. M. Tucke. Improvements in method of and apparatus for drying and oxidising stockings. Complete Specification. August 12.

15,392. J. A. Wade. An improved method of drying cotton. August 16.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

16,541. J. M. Webster. Improvements in machinery or apparatus for the manufacture of wood-wool. August 7.

16,618. J. Foulkes, J. E. Park, and G. N. Peake. Machines for scutching the leaves and stems of fibrous plants. July 31.

16,785. G. Jacober and A. Rabourdin. Manufacture of filamentous products from cellulose. July 17.

22,785. J. B. Fearnley and J. S. Fearnley. Waterproofing textile fabrics, and apparatus therefor. July 31.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, AND BLEACHING.

### APPLICATIONS.

14,339. J. Reixach and F. Bamford. Improvements in dyeing pile fabrics. July 27.

14,415. D. Stewart. Improvements in apparatus for oxidising indigo-dyed fabrics. Complete Specification. July 30.

14,514. W. Grimshaw. Improvements in the production of certain coloured or black printed designs upon textile fabrics. July 31.

14,704. E. Cabiati. A process for saving dyestuff in dyeing with indigo blue. Complete Specification. August 2.

### Complete Specifications Accepted.

1894.

20,308. W. E. Ray and the Thornliebank Co., Lim. Printing and mercerising cotton fabrics. August 14.

1895.

12,746. N. Browne.—From A. Roebig. Method and apparatus for applying colour or staining material to paper and the like. August 7.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

13,645. C. A. Faure and D. A. Casalonga. Improvements in and in apparatus for the manufacture of ammonia and ammonia salts. July 16.

13,826. C. Dreyfus. Improvements in the manufacture or production of nitric acid and apparatus therefor. July 19.

13,827. C. Dreyfus. Improvements in and apparatus for the manufacture or production of hydrochloric acid. July 19.

14,050. O. Imray.—From D. H. Chambers. Improvement in method of refining kaolin and other earths. Complete Specification. July 23.

14,113. A. R. Davis. Improvements in the electrolysis of alkaline chlorides. July 24.

14,122. L. Blackwell. Improved means for treating sodium chloride for the production of bleach and other products July 24.

14,221. R. Wilson. Improvements in apparatus employed for concentrating sulphuric and other acids. July 26.

14,504. J. Plummer. Process to obtain ammonia, chlorine, and hydrochloric acid from ammonia chloride. July 31.

14,618. H. R. Lewis. The manufacture of ammonium carbonate and acid ammonium carbonate from certain waste or by-products, and apparatus for use in such manufacture. August 1.

14,855. A. K. Huntington. Manufacture of cyanogen. August 6.

14,912. A. J. Holt and G. Millard. Improvements in the manufacture of bisulphide of carbon and apparatus therefor. August 7.

15,004. M. N. d'Andria. Improvements in and connected with the manufacture and purification of acetates and acetic acid. August 9.

15,040. W. Schulte and F. A. Sapp. Improvements in the production of cyanide of potassium, and in furnaces for producing cyanide of ammonium. Complete Specification. August 9.

15,066. A. Frank and N. Caro. Improvements relating to the production of cyanogen compounds and to the preparation of materials for use therein. August 10.

15,116. J. Pfleger. A process for the manufacture of cyanides. August 10.

15,326. A. Wolf and W. S. Blythe. Improvements in the treatment of galvanisers' flux skimmings. August 15.

15,360. T. L. Willson. Improvements in the production of calcium carbide. Filed August 15. Date applied for January 16, 1895, being date of application in United States.

15,429. R. W. Barker.—From M. Sommer. Improvements in salt. Complete Specification. August 16.

### Complete Specifications Accepted.

1894.

18,519. J. Pfleger. Improvements relating to the manufacture of cyanides and to apparatus therefor. August 7.

18,727. G. Krell. Apparatus for concentrating and distilling sulphuric acid and other liquids of high boiling point. August 7.

18,940. W. Whitehead and C. Gelstharp. Separation of arsenic, antimony, bismuth, and other metals from spirit of salt (hydrochloric acid), oil of vitriol, or sulphuric acid and other acid solutions, and to apparatus therefor. August 14.

18,998. J. J. Crosfield and K. E. Markel. Process of evaporating silicate of soda solutions. August 7.

19,189. T. T. Best and J. Brock. Manufacture of chlorate of soda. August 14.

21,529. E. Andreoli. Production of vinegar by means of ozone. August 14.

1895.

11,786. B. von Schenk. Manufacture and production of polysulphides of potassium and sodium. August 7.

12,953. The Chloride Electrical Storage Syndicate, Lim., and J. G. A. Rhodin. Manufacture of chloride of lead. August 14.

13,171. J. D. Darling. Manufacture of sulphuric acid and by-products, and apparatus therefor. August 14.

### Patent Void through Non-Payment.

7437. E. Fleischer. Manufacture of alkali aluminates. August 14.

## VIII.—GLASS, POTTERY, and ENAMELS.

### Applications.

14,454. H. Sturm. Improvements in or connected with apparatus for moulding and drawing ceramic articles. July 30.

14,612. W. Craft and F. S. Mash. An improvement in the manufacture of stained glass, or an improved method of glass decoration. August 1.

14,803. H. Cartlidge. Improved construction of potters' kilns. August 6.

14,816. C. Collinson. Improved devices for supporting tiles or other articles whilst being fired. August 6.

15,139. J. E. Brindley. Improvement in the manufacture of ceramic tiles. August 12.

### Complete Specifications Accepted.

1894.

18,397. The Worcester Royal Porcelain Co., Lim., W. M. Binns, and G. H. Hancock. Manufacture of decorated fictile ware. August 7.

1895.

13,151. F. G. Schluder and W. G. Verstandig. Process and means for producing clear plate-glass in cuvette furnaces. August 14.

### Patents Void through Non-Payment.

7040. W. A. Kerr. *See* Class IX.

7047. J. Morton. Kilns for burning retorts, pipes, quarries, and other refractory substances. August 14.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

### Applications.

13,761. E. F. Badgley, A. R. Green, and A. Crockett. Improvements in or appertaining to apparatus for, and the art of treating, working, and handling bituminous or similar compounds and articles made therefrom. Complete Specification. July 18.

14,187. A. Hirsch. Manufacture of vitreous artificial stone. July 25.

14,365. F. Heuber. An improved artificial stone. Complete Specification. July 29.

14,479. L. Clement. The non-slipping Kentish ragstone and bitumen road paving and flooring. July 30.

14,790. P. Stuart. Improved blocks for paving, flooring, landings, platforms, and the like. August 3.

14,976. A. van Berkel and H. Tipping. Improvements relating to the manufacture of artificial wood and stone for building and other purposes. August 8.

15,058. C. F. A. E. H. von Forell. Improvements in the manufacture of Portland cement. August 9.

15,264. H. H. Hodkin. Improvements in the manufacture of concrete paving slabs, and in the machinery therefor. August 14.

15,283. J. H. Lester and T. E. Thomlinson. Improvements in treating certain waste materials to produce valuable products, such as plaster or stiffening, weighting, and whitening materials therefrom. August 14.

15,488. R. F. Strong. *See* Class II.

15,517. C. W. Jefferson. Improvements in means for paving streets, roads, pathways, &c., and in the manufacture of the same. Complete Specification. August 17.

### Complete Specifications Accepted.

1894.

15,834. H. Wood. Manufacture of bricks. July 24.

17,868. C. Musker and A. Musker. Machinery for making paving or building slabs or blocks and other pressed articles. August 7.

17,947. J. Ryder and Sons, Lim., and J. Ryder. Manufacture of red bricks, terra cotta, tiles, and similar goods. July 24.

1895.

11,930. H. Sadin. Employment of schist in the manufacture of bricks for building purposes. July 31.

13,154. M. B. Church. Manufacture of an improved compound for coating and decorating walls and other surfaces, and for the production of casts or mouldings and for analogous purposes. July 24.

### Patent Void through Non-Payment.

7040. W. A. Kerr. An improved composition or compound designed to serve as a substitute for wood, and also applicable for the manufacture of bricks and crucibles, retorts, and other articles of earthenware. August 7.

## X.—METALLURGY, MINING, Etc.

### Applications.

13,701. C. F. Hohenberg. An improved coating for the interior of metal vessels. July 17.

13,770. W. Ramsay. Improvements in the separation of arsenic (and other volatile metals) from natural ores. July 18.

13,771. W. P. Routh and S. O. Cowper-Coles. Improvements in and apparatus for the recovery of gold from solutions containing it. July 18.

13,858. A. J. Boult.—From T. Prioux, C. Prioux, and C. Hugot. Improvements in or relating to soldering metals. July 20.

14,032. A. H. Bogle. Improvements in casting or moulding metals. July 23.

14,162. E. G. Appleby.—From L. F. Gowans. Improvements in the treatment of ores and the like by the cyanide process, and in appliances therefor. July 25.

14,166. A. C. J. Charlier. Improvements in the process for the volatilisation of galena into white compounds of lead, and of zinc into white compounds of zinc, the making of litharge, and the smelting of metals from their ores or slags. July 25.

14,229. M. F. Armstrong and R. J. Wallis-Jones. Brazing or welding of high-carbon or otherwise refractory steel or other metals. July 26.

14,266. J. B. Torres. Improvements in and connected with the dephosphorisation and desulphuration of iron, steel, and other metals and alloys, and the manufacture of basic and neutral materials for this purpose. July 26.

14,286. C. W. Kitto and W. Kitto. Improvements in apparatus and in the continuous treatment of ores for effecting the more economical and perfect extraction of gold. July 26.

14,388. J. C. Butterfield. Improvements in the treatment of auriferous, antimonial, and similar complex ores. July 29.

14,402. A. von Siemens. An improved method or process for the extraction of precious metals from their ores. Complete Specification. July 29.

14,437. J. Pain. *See* Class XXII.

14,553. C. A. Allison.—From T. Pilkington. Improvements in apparatus for extracting gold, commonly called amalgamating. July 31.

14,607. A. Gauchet. Improvements in and relating to converters for decarburising metals, and for the manufacture of steel. August 1.

14,783. E. A. Ashcroft. An improved process for the treatment of metalliferous ores and products. August 3.

15,088. J. Ruffle. An improved method for coating iron in a solid state, or steel in a solid state, with lead. August 10.

15,089. J. Ruffle. An improving method for coating iron in a solid state, or steel in a solid state, with alloys of lead and zinc, with alloys of lead and tin, or with alloys of lead and antimony. August 10.

15,090. J. Ruffle. A process for protecting the surface of molten lead from the action of air when coating iron in a solid state, or steel in a solid state, with lead. August 10.

15,091. J. Ruffle. A process for protecting the surface of molten alloys of lead and zinc, the surface of molten alloys of lead and tin, the surface of molten alloys of lead and antimony, from the action of air when coating, with any of the said alloys, iron in a solid state or steel in a solid state. August 10.

15,144. A. Shedlock. Improvements in apparatus for separating and concentrating ores and other materials in the pulverised or granular state. August 12.

15,280. J. J. E. Mayall and F. O'Connor Prince. A new or improved process for extracting aluminium from its primary source, and recovery of by-products. August 14.

15,356. J. W. Butler. Improvements in apparatus for extracting gold by means of mercury. August 15.

15,386. H. Louis and W. C. Roberts-Austen. Desulphurisation and purification of cast iron, steel, and ingot iron. August 16.

15,426. S. Taylor. A new or improved manufacture of compound metallic plates, sheets, and strips for various purposes. August 16.

15,518. C. F. Claus, jun. Improvements in the treatment of complex ores for the separation of gold, silver, and lead therefrom. August 17.

### Complete Specifications Accepted.

1894.

13,868. H. C. Barker and R. Pearson. Improvements in the method of extracting gold from gold ores, quartz, and auriferous alluvials, and collecting and retaining float gold. July 24.

14,155. J. J. Hood. Extracting metals. July 31.

17,974. A. J. Boult.—From A. L. Grant and C. G. Richardson. Refining nickel and copper mattes. July 24.

21,245. R. Fegan. Smelting ores. August 14.

1895.

5789. W. H. Legate. Coating and plating aluminium or alloys thereof with other metals. August 7.

11,813. S. T. Wellman and C. H. Wellman. *See* Class I.

12,290. J. J. Crooke. Extraction of gold and silver from their ores.

12,291. J. J. Crooke. Extraction of silver from its ores. July 31.

PATENT VOID THROUGH NON-PAYMENT.

7585. H. L. Herrenschmidt. Processes for the treatment of silicated nickel ores and pyritic ores of nickel and copper, or nickel, copper, and cobalt. August 14.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### APPLICATIONS.

13,730. W. Rowbotham and H. Levetus. Improvements in and relating to primary batteries. July 18.

13,900. R. W. Gordon. Improvements in galvanic batteries. Complete Specification. Filed July 20. Date applied for January 31, 1895, being date of application in United States.

14,095. B. Doyle. Improvements in electric battery cells and in the method of applying same. July 24.

14,142. M. W. W. Mackie. Improvements in apparatus for the recovery of gold by electrolysis from the sea. July 25.

14,158. W. Rowbotham. Improvements in and relating to primary batteries. July 25.

14,342. J. Kolb and A. D. A. Lambert. An improved electrolysing apparatus. July 27.

14,393. D. G. Fitz-Gerald. Improvements in voltaic batteries. July 29.

14,801. C. Luckow. Improvements in the electrolytic production of oxides and salts which are insoluble, or practically insoluble, in the electrolyte. Complete Specification. August 6.

14,840. F. W. Durham, jun. Spray electrolysis. August 6.

14,902. G. Fabbro. Improvements in plates for secondary batteries. August 7.

15,024. E. Andreoli and G. Andreoli. Electrolytic production of amalgams, and their utilisation. Complete Specification. August 9.

15,119. L. A. G. E. R. Comboul. Improvements in electrolysing apparatus. August 10.

15,126. W. H. Willatt. An improvement in secondary batteries. August 12.

15,292. H. Tipping and J. B. Hamond. Improvements in galvanic batteries. August 14.

15,369. J. B. Torres. Improvements in secondary or storage batteries. August 15.

15,371. W. Rowbotham. Improvements in and connected with primary batteries. August 15.

15,432. D. Mathieu. Improvements in or relating to batteries. August 16.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

14,536. C. F. Parkinson and W. Gatwood. Apparatus for heating and welding by electricity. July 31.

14,858. J. Y. Johnson.—From E. Javaux, C. F. Gallois, and F. Dupont. Purification of saccharine juices by electrolysis. August 7.

16,162. M. Engel. Improvements in accumulators or secondary batteries. August 14.

18,809. F. King. Improvements in or connected with secondary or electric storage batteries. August 14.

21,330. G. Hübner. Galvanic batteries. June 19.

21,838. W. Bein. New or improved process for electrolysing chemical combinations and winning the products of decomposition formed by the electrolysis. July 31.

1895.

7458. C. Kellner. Electrolysis of metallic salts. August 7.

10,445. H. C. F. Störmer. Apparatus for electrolysis of alkali salts with quicksilver as cathode. August 7.

11,752. E. Andreoli. Electro-deposition of gold and silver. July 24.

12,312. A. G. Saunders. Stamp batteries. August 7.

12,420. C. H. Weise. Manufacture of plates for secondary electrical batteries. July 31.

12,954. The Chloride Electrical Storage Syndicate, Limited, and G. A. Grindle. Secondary voltaic batteries. August 14.

PATENT VOID THROUGH NON-PAYMENT.

7168. G. Wester. Voltaic cells. August 7.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### APPLICATIONS.

13,623. A. G. C. Dymond.—From Köber's Eisenwerke. Improvements in or appertaining to oil presses. July 16.

14,271. J. S. P. Stutley. Improvements in or relating to lubricants. July 26.

14,315. T. Hill-Jones. An improved dry soap or washing powder. July 27.

14,609. R. Donovan. An improved mode of treating oils in order to increase their luminosity and reduce smoke and smell. August 1.

14,680. W. J. A. Melhuish. Improvements in melting or rendering fat for the manufacture of soap, candles, and other products, and in the apparatus therefor. August 2.

14,978. F. N. Turney. Improvements in degreasing and cleansing wool, cotton waste, and like materials, and in apparatus therefor. August 8.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

17,860. J. R. Hill. Manufacture of soap and glycerin. July 24.

1895.

8798. R. Gartenmeister, O. Stommel, and F. Vorberg. Composition of matter for cleansing and removal of greasy matter, oil or paint spots from dresses and textile fabrics. July 24.

9503. E. Maertens. Refining and separating wool-fat into sundry constituent parts. July 31.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, ETC.

### APPLICATIONS.

13,648. W. W. Cabena. The manufacture of an improved waterproof elastic cement. July 16.

13,711. A. Gutensohn. Improvements in the manufacture of oxide of lead, and means used therefor. July 17.

13,924. R. Stone. Improvements in the manufacture of fireproof, waterproof, and non-corrosive paint. July 22.

13,973. S. B. Schryver. Improvements in the manufacture of paints and pigments. July 23.

14,022. S. W. Wilkinson and The Grove Co., Lim. An improved preservative composition for coating iron and other metals. July 23.

14,210. F. S. Dunk.—From S. R. Gaikwad. Improvements in the preparation of blue-black ink for writing and copying in dry sheets. July 25.

14,334. F. G. Kleinstenber. Process of manufacturing a substance or product as a substitute for vulcanite or for other purposes to which it may be applicable. Complete Specification. July 27.

14,461. L. Knoche. Improvements in the manufacture of lac, varnish, and the like. Complete Specification. July 30.

14,478. F. W. Golby.—From G. Tognola and R. Gunther. Process for the production of black printing, lithographic, and stamping inks. July 30.

14,839. A. Pulbrook. New or improved compound applicable for rendering articles waterproof or airtight, or as a cement or varnish, or for other similar purposes. August 6.

15,005. W. Ellis. The combination of india-rubber with other chemical substances, which impart to the product a quality useful in certain manufactures. August 9.

15,367. J. Armstrong. An improved compound for cleaning, polishing, and re-varnishing painted, varnished, and other surfaces, which compound is also adaptable for use as a varnish and stain. August 15.

#### Complete Specifications Accepted.

1894.

14,758. G. C. Dymond.—From L. Auerbach and Co. Manufacture of water colour paints. July 31.

15,914. A. V. Newton.—From A. Nobel. An improved manufacture of artificial india-rubber, gutta-percha, and leather suitable for conversion into varnish. July 31.

17,747. F. W. Oliver. Improvements in paint. August 7.

1895.

8095. J. Tennant, J. Tennant, and W. R. Tennant. Manufacture of gold paint for interior gilding and other purposes. July 24.

### XIV.—TANNING, LEATHER, GLUE, AND SIZE.

#### Applications.

13,698. S. Frohwein. Improvements relating to the production of albumen and raw materials for certain purposes, and in apparatus or appliances in connection therewith. Complete Specification. July 17.

14,936. E. Schmahl and F. Feller. An improved glue or size and process of manufacturing same. Complete Specification. August 7.

#### Complete Specifications Accepted.

1894.

19,427. R. Ergang. Apparatus for dyeing skins. July 31.

#### Patents Void through Non-Payment.

6852. E. Drew. Substitute for leather. August 7.

7106. A. Huillard. Process of decolorising and clarifying tanning liquors or tannic extracts. August 7.

### XV.—AGRICULTURE AND MANURES, ETC.

#### Application.

14,143. G. A. Macintire. The Corona odourless liquid manure. Complete Specification. July 25.

#### Complete Specification Accepted.

1895.

12,566. H. P. Peace. An improved hematite slag manure. August 7.

### XVI.—SUGARS, STARCHES, GUMS, ETC.

#### Applications.

13,851. W. R. Hutton. Improvements in alkaline saccharates. July 20.

13,977. F. Harrop. An improved combination starch. July 23.

14,227. W. Spakler. Improvements relating to the manufacture of sugar for the purpose of facilitating the packing of the same. July 26.

14,585. H. J. McCubbin and E. J. T. Digby. A new or improved method of clarifying or refining sugar and syrup. August 1.

14,925. G. Kassner. An improved process for the manufacture of sugar. Complete Specification. August 7.

#### Complete Specifications Accepted.

1894.

12,624. O. Bensterein. Manufacture of starch. August 7.

14,606. R. H. Hunstock. Method and apparatus for making syrups. August 7.

14,858. J. Y. Johnson.—From E. Javaux, C. F. Gallois, and F. Dupont. *See* Class XI. August 7.

### XVII.—BREWING, WINES, SPIRITS, ETC.

#### Applications.

14,173. F. W. Manegold. An improved liqueur. July 25.

14,482. V. Lapp. Method and apparatus for treating mash in brewing for obtaining the wort therefrom. July 30.

14,495. F. Stoddart. A new or improved method of extracting the sediment from beers, wines, and other liquids. August 8.

#### Complete Specifications Accepted.

1894.

15,463. A. Bassett. Method and apparatus for measuring or checking the production of alcoholic liquids or the flow of liquids. July 24.

1895.

7813. A. J. Boult. From G. R. Besser. Processes and apparatus for ageing fluids containing alcohol. July 24.

10,762. E. Simonsen. Process for the treatment of materials containing cellulose for the production of spirit. August 7.

11,154. T. D. Lichtenstein. The manufacture and production of caramelised materials especially intended for use in the manufacture or treatment of beers, spirits, vinegar, aërated water, and other liquids or beverages. July 24.

11,155. T. D. Lichtenstein. Manufacture or treatment of beers, spirits, vinegar, aërated waters, and other liquids or beverages. July 24.

12,823. C. L. A. F. Buttner and C. F. Meyer. Method and apparatus for drying malt. August 7.

#### Patent Void through Non-Payment.

7140. S. Mason, jun. Method and apparatus for purifying and refining alcoholic liquors and other fluids. August 7.

### XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

#### Applications.

*A.—Chemistry of Foods.*

14,250. O. Imray.—From C. Rach. Improvements in the manufacture of cocoa compounds. July 26.

14,561. S. G. Goodchild. Improved means for sterilising milk and other liquids. July 31.

14,581. S. Griffin. Improvements in means for preserving food. August 1.

15,165. H. L. de Caux. Improvements in preserving milk. August 12.

15,255. S. Griffin. Improvements in means for preserving food. August 14.

15,506. A. J. Boult.—From A. Delcroix. Improvements in or relating to coffee or coffee substitutes. Complete Specification. August 17.

*B.—Sanitary Chemistry.*

13,857. W. Birch. Improved apparatus for separating solid or semi-solid substances from sludge or other fluid or semi-fluid matters. July 20.

14,727. W. Y. Hardie. Hardie's high pressure blast furnace for destroying towns' refuse and the gases and fumes emitted therefrom, also for preparing and utilising the residuals and bye products for commercial purposes. August 3.

### *C.—Disinfectants.*

14,305. A. Pickles. Improved antiseptic and disinfecting compounds, applicable also for washing sheep and other animals and for other purposes. Complete Specification. July 27.

### Complete Specifications Accepted.

### *A.—Chemistry of Foods.*

1894.

14,179. G. Weddell. New and improved baking powder. July 31.

16,548. R. Haddan.—From Flathreiner's Malzkaffeefabriken mit beschrankter. An improved process for producing substitutes for coffee. July 31.

17,548. J. Gray. Treating and aërating milk. July 24.

19,064. E. Leslie. Milk sterilizers. August 7.

19,987. J. Escuyer. Improved alimentary product and process of manufacturing the same. July 17.

1895.

12,743. J. Y. Johnson.—From F. von Heyden, Nachfolger. Preserving and sweetening food and liquors. August 7.

### Patents Void through Non-Payment.

7335. W. P. Thompson.—From F. Lanhoff. Preparation and treatment of rice and other cereals. August 14.

7485. H. Warry. Food preservation. August 14.

### *B.—Sanitary Chemistry.*

1894.

14,760. H. L. Sulman. Treatment of sewage. August 7.

1895.

13,106. J. Y. Johnson.—From F. von Heyden. Disinfecting and preserving. August 14.

### *C.—Disinfectants.*

1894.

14,067. E. J. B. P. Jodelay and M. J. E. Laurans. Apparatus for mixing liquids designed for disinfecting and other purposes. July 31.

1895.

11,908. G. Dawson. Manufacture of disinfecting preparations. July 24.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

14,632. F. Nonenmacher. An improved process for the manufacture of extensible paper and apparatus therefor. Complete Specification. August 1.

15,321. J. A. London, B. Cawthorn, and D. N. Bertram. Improvements in machines for fibreising paper materials, bedding materials, and the like. August 15.

15,351. G. F. Smith and H. J. Cook. Improvements in the manufacture of paper, cardboard, or the like, for use in wrapping up provisions or for analogous purposes. August 15.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

13,949. C. D. Abel.—From A. Fischesser and Co. Manufacture of phthaleines by the action of mixed anhydrides. July 22.

14,606. E. S. Hermes. An improvement in the method of making pharmaceutical tinctures, extracts, and liquors. August 1.

14,631. A. M. Parker. Improvements in the manufacture of germ extract. August 1.

14,798. W. L. Wise.—From The Chemische Fabriken vormals Hofmann and Schoetensack. Manufacture or production of bromine-phenacetin. August 3.

14,886. W. L. Wise.—From The Chemische Fabriken vormals Hofmann and Schoetensack. Improvements in the manufacture or production of nitrile of mandelic acid and mandelic acid. August 6.

### Complete Specifications Accepted.

1895.

11,635. R. Haddan.—From A. H. Gouts and E. I. Marc. Process for extracting volatile matters, especially those of vegetable tar. July 24.

11,830. A. J. Boult.—From J. F. Theurer. Manufacture of a colouring and flavouring extract for liquids. July 24.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Applications.

13,562. H. de Grousilliers. A process and apparatus for recovering volatile solvents from collodion coatings of paper. Complete Specification. July 15.

15,093. A. Hill. Improved intensifier reducer and toner for photographic purposes. August 10.

### Complete Specifications Accepted.

1894.

17,362. C. D. Durnford. Effecting photographic exposures. August 14.

### Patents Void through Non-Payment.

7312. W. W. J. Nicol. Photographic printing purposes. August 14.

7635. E. Hackh. Magnesium lights for photographic and signalling purposes. August 14.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

13,813. W. Fairweather.—From J. T. Carrick and H. N. de Wilde. Improvements in the production of explosive nitro compounds. July 19.

14,182. F. Allen and F. Waldock. A storm or smouldering match for the use of smokers and others. July 25.

14,437. J. Pain. Means for preventing oxidation of metals, also for protecting pyrotechnic chemical compound substances from the injurious effects of air or moisture. July 30.

14,452. F. W. Bawden. Improvements in explosive compounds. July 30.

14,775. M. Wagner. Manufacture of a safety explosive. Complete Specification. August 3.

14,921. P. Fowler. Improvements in lucifer matches. August 7.

15,112. A. W. F. de Courcy Bower. Improvements in lucifer matches. August 10.

15,301. H. V. Keeson. Improvements in electric exploders. August 14.

### Complete Specifications Accepted.

1894.

17,994. H. S. Maxim. Smokeless emplosives. July 31.

1895.

9432. M. Bals, C. Noel, and G. Gerrersdorfer. Manufacture of matches, and apparatus therefor. August 17.

12,768. H. H. Lake.—From The International Powder Co. Smokeless powder. August 7.

13,161. J. Lux. Explosive cartridges more especially intended for use in mines. August 14.

### Patent Void through Non-Payment.

7193. J. Y. Johnson.—From J. A. C. de Latouche. Military and sporting ammunition. August 7.

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# THE JOURNAL

OF THE

# Society of Chemical Industry:

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Improvements in or relating to Means or Apparatus for Sifting, Grading, or Separating Cinders, Chemicals, and the like, also straining Liquids and Paint.* J. Squire, Ilkley, Yorks. Eng. Pat. 14,980, August 4, 1894.

The apparatus consists of a suitable receptacle, in the upper portion of which is an oscillating sieve, having a fixed agitator suspended within it, and at the bottom one or more compartments into which loose trays or drawers are fitted. Immediately below the sieve is a fixed hopper having a large orifice at the bottom; the sifted material, which falls through this orifice, is directed by means of a pivoted board into either of the trays, or into a spout which delivers it outside the box.—L. A.

*Improvements in Metal Casks, Barrels, Drums, and the like.* Regis Perron, Paris, and Felix Monmon, Vincennes, Dept. of the Seine, France. Eng. Pat. 16,079 (under International Convention), August 23, 1894.

The body of the barrel is formed of two truncated cones suitably fastened together. In one design, the large ends of the cones have helical convolutions formed upon them, which engage one in the other when the cones are screwed together, the end of the female cone engaging in a groove in a ring which is fixed to the male cone. The joint is made tight by caulking. Each cone also carries an angle-iron hoop or ring, and by bolting the two rings together, with a broad central band of sheet metal with flanged edges between them, the joint is stiffened and made secure. The smaller ends of the cones are folded over to engage cupped bottoms which are riveted thereto.—L. A.

*Improvements in Filtering Apparatus.* P. E. Hodgkin, London. Eng. Pat. 16,914, September 5, 1894.

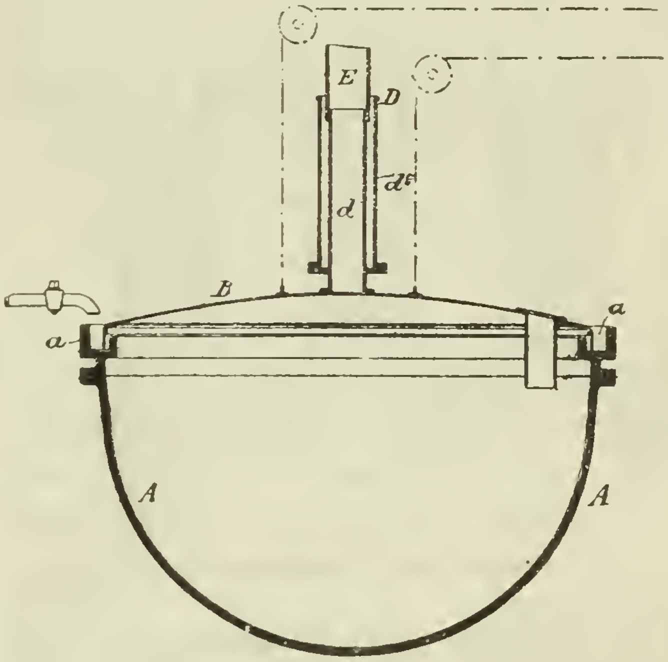
A vertical cylindrical vessel provided with suitable inlet and outlet valves, is furnished with a central perforated tube containing the filtering medium. The liquid to be filtered, such as waste oil or a mixture of oil and water, is led into the domed cover, and, gravitating through the filtering medium, finally escapes into the outer casing, from whence it is drawn off by a suitable cock. Any number of these elemental filters may be arranged in line and supplied from the same inlet main.—E. G. C.

*Improved Means for Hermetically Closing Bottles and the like.* F. H. Lenders, London. From A. Denayer, Brussels. Eng. Pat. 17,207, September 10, 1894.

The bottle is formed with a comparatively wide mouth, the upper surface of the rim being made or ground flat. The stopper, made of glass, porcelain, or other material which will not affect the contents of the bottle, fits loosely in the neck of the bottle and has a flange which is provided with a flattened under-surface. Between the two flat surfaces a rubber ring is placed. The bottle is then partially exhausted either by placing it in a vacuum chamber or in boiling water, after which the stopper is retained in its position by atmospheric pressure.—L. A.

*Improvements in or connected with Concentrating or Evaporating Vessels.* T. Glover and J. Brock, Liverpool. Eng. Pat. 17,212, September 10, 1894.

The vessel A, which may be of the ordinary shape, is furnished at its upper edge with a gutter *a*, forming a water seal or lute into which the flange of the cover, B, fits. The outlet D, through which the vapour escapes, is also made with a lute (formed by the two pipes $d$ and $d^2$) of a depth somewhat greater than the height to which it is desired to raise the cover B. The steam from the evaporating liquid may be collected and conveyed by the fixed pipe E to any place where it can be utilised for heating purposes, without in any way interfering with ready accessibility to the contents of the vessel. The liquid to be evaporated, may be fed into the vessel through the lute *a*, the flange of the lid being serrated, and thus the lute is preserved during the working of the vessel.—L. A.



Improved Evaporating Vessel.

*Improvements in Apparatus for Treating the Fire Gases evolved in Steam-Boiler and other Furnaces.* J. Patterson, Bridgeton, Glasgow. Eng. Pat. 18,163, September 25, 1894.

The object of the invention is to combine apparatus used in increasing the draught with separating the smoke, dust, &c., from the fire-gases of steam-boiler and other furnaces.

A fan or similar apparatus is arranged to draw the fire gases from the flue, uptake, funnel, or chimney into which they pass on leaving the furnace, and to discharge them through any suitable outlet. Whilst passing through the fan, water, introduced in jets, mingles as spray with the fire gases and separates smoke and dust from them, and absorbs any of the soluble gases.

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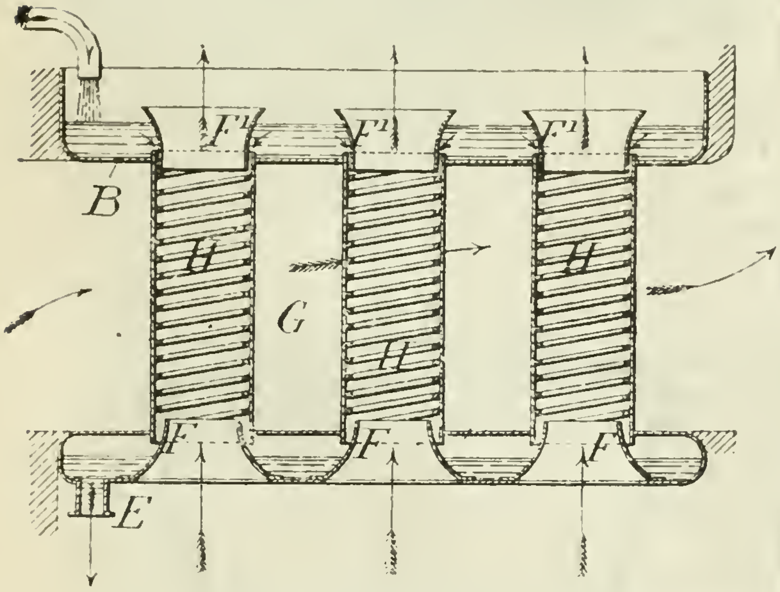
* Any of these specifications may be obtained by post by remitting 8d.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

*An Indicating Funnel or Tun-Dish.* G. F. Fitter and J. Buxley, both of Birmingham. Eng. Pat. 18,451, September 29, 1894.

The improved funnel or tun-dish consists of a bowl provided with a double pipe, the inner one of which is provided with a guide for a float and float stem. The liquid enters the receiving bottle or other vessel by means of the annular space between the pipes, and on arriving near the level of the neck of the receiver, it presses up the float to give a visible indication of the height of the liquid.—E. G. C.

*Improvements in Apparatus for Condensing, Evaporating, or Refrigerating Fluids.* E. Theisen, Baden-Baden, Germany. Eng. Pat. 18,828, October 4, 1894.

The liquid to be evaporated flows from the vessel B through the annular spaces between the nozzles $F^1$ and tubes H, down the inner surfaces of the tubes H in thin films, and through the annular spaces between the tubes H and nozzles F into the vessel E. With this arrangement, the hot air or gases which promote evaporation can pass up through the nozzles F and tubes H without having to traverse the falling liquid, and the loss of effect due to frictional resistance is prevented. In order to retard and make the flow of liquid down the tubes more uniform, coiled wires are inserted, causing the liquid to flow round the tubes in the channels formed between contiguous convolutions of the wires. In cases where the liquid is caused to flow down the outsides of the tubes, ropes or strands of hemp, asbestos, &c., coated or impregnated with paraffin, gutta-percha, and the like, are coiled round the outside of the tubes; or the tubes may be constructed with helical corrugations.

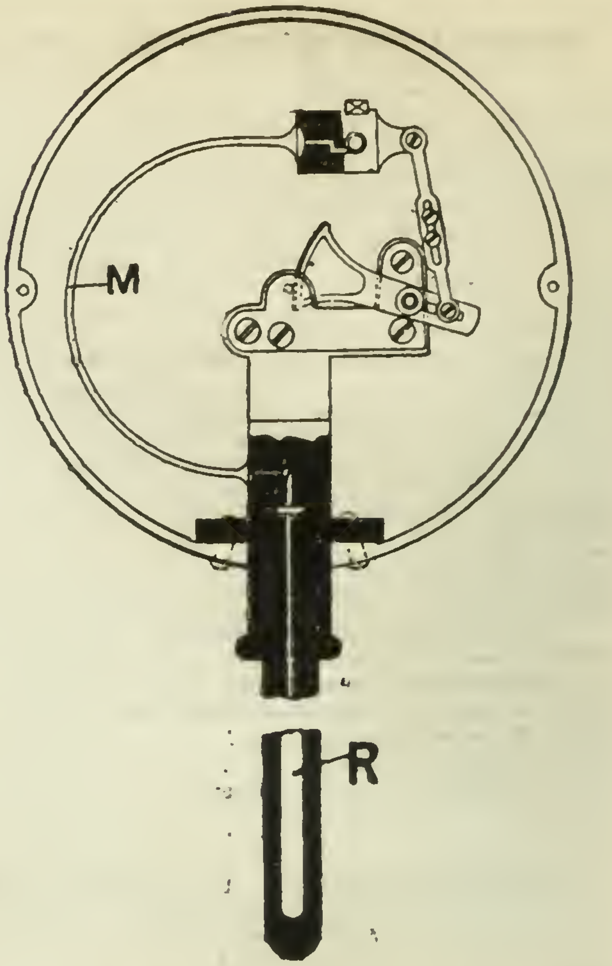


Apparatus for Evaporating Liquids, &c.

The apparatus may also be applied to the condensation of steam or the refrigeration of gases passing through the chamber G, by means of the cooling effect due to evaporation taking place within the tubes.—L. A.

*A New or Improved Pyrometer.* W. E. Heys, Manchester. From Schaffer and Budenberg, Buckau, in the German Empire.) Eng. Pat. 10,886, June 1, 1895.

The apparatus consists of a main tube R of wrought iron or steel, for resisting the effects of heat and pressure, communicating with a curved tube M, fixed at one end but connected at the outer end by a link to a sector engaging with a pinion on the axis of the pointer. The lower part of the tube R is filled with mercury, the remaining space being filled with an inert gas such as carbon dioxide or nitrogen, so that when the mercury expands under the action of heat, the gas is compressed and the tube M straightens out, thereby imparting motion to the index finger moving over a scale of degrees.—E. G. C.



*Improvements in Funnels.* J. J. Ebert and M. Loewenstein, both of New York, U.S.A. Eng. Pat. 12,327, June 25, 1895.

The object of the invention is to provide a funnel for filling bottles with liquids without loss or waste, especially when transfering the partially filled funnel from one bottle to another. The body and stem of the funnel are such that though the funnel fits the neck of the bottle closely, the liquid continues to flow readily, since the air displaced from the bottle escapes by a small central tube fixed in the larger funnel tube, which, passing upwards, communicates with the air above the point of contact with the neck of the bottle. Moreover, by a further device, when the funnel is to be lifted from a bottle just filled, and transferred to another, and the upper part or body is raised for this purpose, it slides upwards upon an inner tube which contains small holes through which the liquid passes. In sliding upwards, these holes are covered by the wider outer funnel tube, which immediately after, comes in contact with a stop, acting as a valve at the upper end of the inner tube. On setting the funnel upon the next bottle, the weight of the remaining liquid in the body causes the latter to slip down again upon its inner stem, thus once more uncovering the holes, and flow of liquid at once begins.

## II.—FUEL, GAS, AND LIGHT.

*Semet-Solvay Coke-Oven.* J. H. Darby. Trans. North of Eng. Inst. of Min. and Mech. Engs. 1895, **44**, 290—304.

The air used for the combustion of the return-gas in these ovens, is pre-heated by recuperative flues to 350°—400° C. The gases themselves, after scrubbing and prior to combustion, average the following percentage composition by volume:—$CO_2 = 3\cdot3$; $CO = 7\cdot9$; $O = 0\cdot2$; $H = 52\cdot8$; $N = 2\cdot0$; $CH_4 = 31\cdot2$; olefines 2·6 per cent. In coking rich coal, from two-fifths to one-half of the gas produced is surplus; and if all be burnt under boilers each pound of fuel coked should evaporate 1·25 lb. of water. The waste heat of the gases alone, suffices to evaporate 0·6 lb. of water per lb. of coal coked. But the waste gas, before the absorption of benzene, has a luminosity of 16 to 17 candle-power (with a good coal), and the yield amounts to 10,000 cub. ft. per ton; after absorption, the surplus gas, amounting to 4,000 cb. ft. per ton, may be used in steel furnaces or otherwise. The illuminating power of the gas is a criterion of the working of the oven, since high luminosity is incompatible with the introduction of air into the ovens. It is calculated that if these ovens were added to a combined blast furnace and open hearth steel plant, 2·8 tons of coke could be manufactured per ton of steel made, the waste gases from the ovens supplying all the heat required for the furnaces and for the re-heating and rolling of the steel, whilst on the supposition that 15 cwt. of pig-iron are required (*plus* scrap) per ton of steel, about 30 cwt. of excess pig-iron or 36 cwt. of coke could be sold for every ton of steel made. In such a case the coke ovens would be heated by producer gas, consuming $2\frac{1}{2}$ cwt. of small coal per ton of coke made, and the whole of the oven gas would be utilised outside. The yield of by-products from the Semet-Solvay ovens with fairly rich coal is about 5 per cent. of tar, 1·3 per cent. of ammonium sulphate, and 3 gals. of light oil (sp. gr. 0·89) per ton of coal. Durham retort ovens, treating coal containing 24 per cent. of volatile matter, have given 3·25 tons of coke per charge and required 60 hours for the work, whilst Semet-Solvay ovens, using the same coal, gave 3·3 tons per charge in 22 hours. The actual yield by the Semet-Solvay plant using slack coal may be as follows:—

| Coal. | Vol. Matter, excluding $H_2O$. | Yield of Dry Coke. | Ash in Coke. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Durham ........ | 23·32 | 80·50 | 7·50 |
| S. Yorkshire .... | 31·93 | 71·10 | 10·80 |
| S. Wales........ | 17·20 | 81·82 | 7·10 |
| N. Wales........ | 32·60 | 68·07 | 8·89 |

The increased yield in each case is attributed to deposited carbon. Instances are quoted in which economy of fuel in blast-furnace practice has followed the substitution of Semet-Solvay for beehive-oven coke.—W. G. M.

*Brunck Coke-Oven and System for the Recovery of By-Products.* R. Brunck. Trans. North of Eng. Inst. of Min. and Mech. Engs. 1895, **44**, 283—289.

The Brunck oven is 32·8 ft. long, by 6·56 ft. high, by 15 to 21·5 ins. wide—according to the quality of the coal. (This Journal, 1894, 379). The weight of the roof is borne by a solid wall separating each pair of ovens, and on either side of this partition are built the thin walls containing vertical heating flues, like those of the Coppée-Otto ovens. In this way each oven has its own heating system, which minimises the waste of heat from the adjoining chambers; whilst the massive construction of the partition-wall not only provides a magazine for the retention of heat when neighbouring ovens are being emptied, but by its greater strength allows each vault to have greater height, and therefore to be proportionately narrow for any given capacity. Beneath the oven are flues, divided into three sections by transverse walls, into which is passed a part of the gas for combustion, and air previously heated by traversing channels beneath the chambers. The remainder of the gas is introduced into the upper horizontal flues. After heating the ovens, the waste gases, which should contain less than 0·5 per cent. of free oxygen, are utilised under boilers. The gases mingled in the two end sections of the system, burn, and the products of combustion pass through the central section into a horizontal flue running beneath the whole battery of ovens. At the Kaiserstuhl Colliery, near Dortmund, where the system has been tried on an experimental scale, the temperature of the air used for combustion was 420° C., and that of the waste gases leaving the flues 1,050° C. The freedom with which the gases can flow through the vertical flues enables a lower pressure to be employed, so that the pressures in them and in the oven are equalised; and there is less leakage, either of oven-gases outwards or of air inwards, than there would otherwise be, and hence, there is less loss or deterioration of by-products. Repairs too, are easily effected in one oven, without interfering with the working of the others. The practical results at Kaiserstuhl have shown that in each oven 7·2 tons of coal (containing 14 per cent. of water), can be coked in $34\frac{1}{2}$ hours, including the time required for loading and discharging, whilst the annual yield of coke per oven is 1,250 tons, from a coal containing 20·5 per cent. of volatile matter; a Coppée-Otto oven under similar conditions giving only 925 tons. The yield of tar produced is stated to be 13·4 per cent. greater, and of ammonium sulphate 9·5 per cent. greater than that afforded by the Coppée-Otto system. The daily steam production by the waste gases is equal to 820 gallons of water per oven. In a larger plant it is estimated that the surplus evaporation, after deducting the amount of steam required for the condensing plant, would be 784 gallons per oven per diem. The inventor guarantees a yield of by-products 15 per cent. higher than an estimate based upon the results obtained by the Coppée-Otto ovens.—W. G. M.

## PATENTS.

*Improvements in Apparatus for Manufacturing and Carburetting Hydrogen Gas, and Producing Metal Sulphates as By-Products.* H. Hawkins and S. H. Hawkins, Portsmouth. Eng. Pat. 9197, May 9, 1894.

The improved apparatus consists of a tank or chest made of sheet copper or other metal capable of withstanding sulphuric acid, and divided, by a median horizontal partition, into an upper and a lower chamber. The upper chamber is divided, in its turn, by a vertical partition, into a larger and a smaller chamber.

The lower chamber, which contains also a false bottom of perforated copper plate, is charged with scrap iron or zinc; the larger upper chamber with dilute sulphuric acid ($1\frac{1}{2}$ to 4); the smaller upper chamber with a carburetting material, such as benzoline.

Through a suitably arranged pipe, the sulphuric acid is conducted under the false bottom, rises amongst the iron, and generates hydrogen. The gas then passes into the carburetting chamber and thence to the holder.

A pipe, leading from under the false bottom of the lower chamber to the bottom of the acid chamber, allows the acid to regurgitate to the latter chamber if the hydrogen is being generated too fast.

To enable the carburetting material to be fed in whilst the apparatus is at work, a portion of the carburetting chamber is partitioned off, and can, at will, be put in communication with the exterior, or with the rest of the apparatus, by a double set of connections.

If it be desired to give an addditional carburation to the hydrogen, benzoline is allowed to slowly drip on to the metal scrap while it is being acted upon by the acid.

—E. R. B.

*Improvements in and connected with Gas-carburetting Apparatus.* J. Ormerod, Manchester. Eng. Pat. 11,256, June 11, 1894.

This inventor claims a new form of carburettor and a new liquid to be used therewith, the principal objects of his improvements being to prevent the condensation from the carburetted gas of carburetting liquid in the service pipes, and to use a liquid with a flashing point higher than the minimum prescribed by the Petroleum Act.

The liquid is a mixture of 2 parts of petroleum naphtha (sp. gr. 0·720—0·750) with 1 part of rosin spirit (sp. gr. about 0·800).—E. R. B.

*Improvements in Apparatus for Mixing and Burning Inflammable and Explosive Gases and Vapours.* A. H. Tyler and J. S. E. De Vesian, both of London. Eng. Pat. 12,820, July 3, 1894.

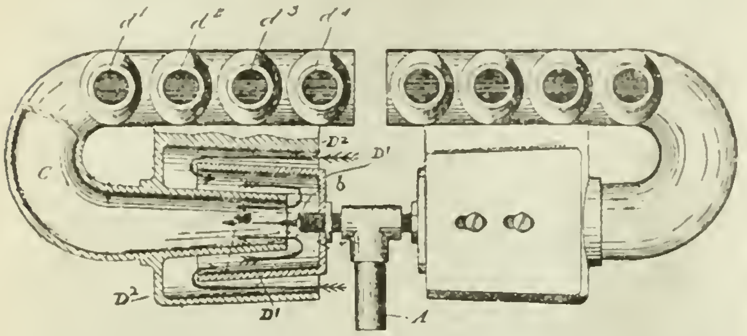
This apparatus is applicable to pipes or other passages traversed by inflammable gases, and consists of a chamber with inlet and exit pipes, and filled with finely divided metallic particles (such as shot, &c.), said particles being kept in position by end-plates, which may be perforated metal plates or wire gauze.

The object of the invention is to prevent explosions by the passage of flame along such pipes or passages.

—E. R. B.

*Certain Improvements in Atmospheric Gas Burners.* G. E. Wright, Birmingham. Eng. Pat. 13,243, July 9, 1894.

To minimise the risk of "lighting back" at the gas-inlet nozzles, of gas fires of various sorts, when the gas is being burnt at low pressures, or when a draught is acting on the burner, this inventor proposes the apparatus shown in part sectional plan, in the accompanying figure, where A is the gas-supply pipe; *b* the inlet nozzle; C the mixing chamber for the gas and air; $d^1$, $d^2$, $d^3$, $d^4$, the burners; $D^1$ a bell affixed to the inlet nozzle; and $D^2$ a second bell, larger than the foregoing and enclosing it.



The air supply, normally, is sucked in between the walls of the two bells, travelling in the direction of the arrows.

If flame should flash back from the burners, through C, it will fail to light the gas at *b*, for the explosion "will force the mixed air and gas back towards $D^1$, $D^1$, where the various turns, shown by the arrows, will so baffle the mixed air and gas as to form an air-buffer, the elasticity of which will force the flame forward again, and thus prevent the gas lighting at *b*."—E. R. B.

*An Improved Construction of Incandescence Gas Burner.* H. M. H. Comte Delamarre, Paris. Eng. Pat. 13,365, July 10, 1894.

The aim is to produce a very perfect mixture of gas and air before combustion, and to evenly distribute the gaseous mixture at the burner, in order to obtain the greatest perfection of combustion and the highest degree of incandescence. Moreover, the arrangement of the burner is such that its proper action is uninfluenced by strong currents of air.

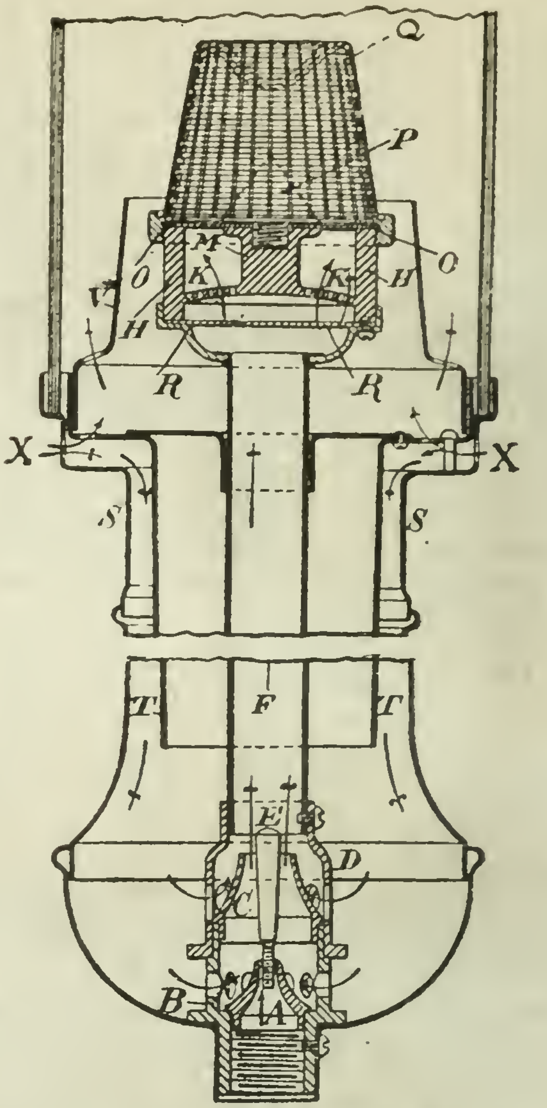
The apparatus, which is shown in vertical section by the figure, consists essentially of three parts: the mixer A, B, C, D, the burner H, K, M, O, P, R (each of which is separately claimed), and the connecting tube F. Gas entering the cone A escapes by perforations near its apex into the chamber B, and owing to the injector action, produced by the initial pressure of the gas, air is sucked into B through the apertures in the wall of B. The gaseous mixture now passes through the second cone C, into D, and by a similar action to that just described, a further supply of air enters through the apertures in the wall of D. E is a conical stem which screws into the top of A and permits of the regulation of the area of the annular opening of C.

The burner consists of a metal cylinder H, closed at the bottom by a perforated disc K. The boss M, of K, causes the gaseous current to pass mainly against the sides of H, and thence through wire gauze O O. A cone, P, of suitable refractory material, such as an alloy of iron and nickel, directs the burning gases against the hood so as to heat this structure to incandescence.

The "incandescence cage or cap" Q "may be constructed in any known manner, but by preference . . . of interlaced filaments composed of a mixture of magnesia, zirconia, and other earthy oxides." (This structure is not claimed.)

To still further guard against the effects of strong external air currents, the lower parts are enclosed in the casing S, the cylinder T acting as a baffle.

All the air enters by a ring of apertures X X, part of it descends between S and T to supply the mixer, whilst the remainder enters the space between the burner and an air cone V, situate a short distance from it. Of this air, part passes up between the cone and the burner, constituting a further air-supply to the flame, whilst part traverses apertures in the base of the air cone, and passes upward on the outside of the cone, its current assisting in keeping steady and uniform the action of the burner. The wire-gauze diaphragm R is to prevent any accidental lighting of the gaseous mixture inside the burner.



This burner may be used with or without a chimney, and it is suitable also for lighthouses and for beacons on account of its regularity in the presence of air currents.
—E. R. B.

*An Improved Process for Generating Combustible Gas, and in Apparatus therefor.* B. H. Thwaite, London, Eng. Pat. 13,385, July 11, 1894.

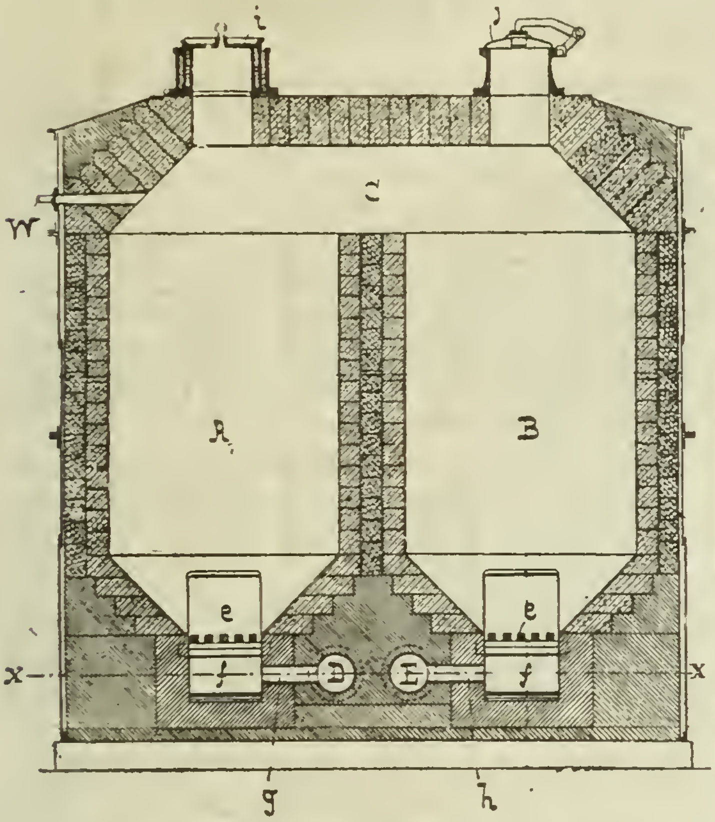
The patentee describes a method of gas production in which the combustible gases and the products of partial combustion of the fuel in one generator, are made to descend (or ascend) through incandescent fuel in a second generator, the final gaseous products being hydrogen and carbon monoxide.—E. R. B.

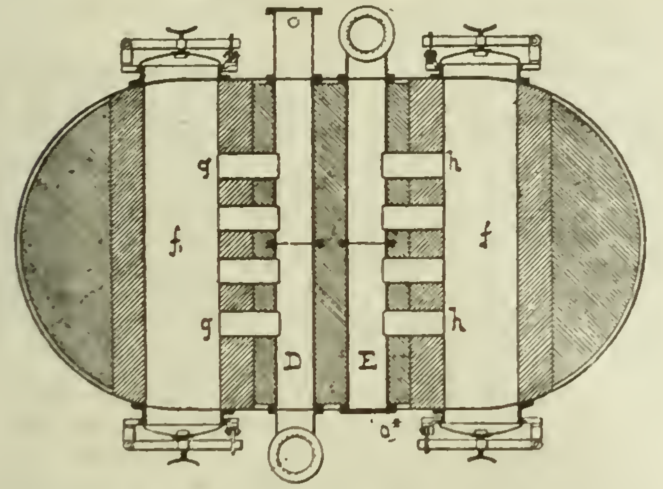
*Improvements in Apparatus for Manufacturing Gas.* F. Mayer, Baltimore, Maryland, U.S.A. Eng. Pat. 13,758, July 17, 1894.

This patent relates to that class of gas generator in which the crude gas manufactured in one generator, is made to pass through the cooler but still highly heated fuel in a second generator, arrangements being provided for reversing the gaseous current from time to time.

A and B are two generators of ordinary structure, connected by C, with grates *e e*, and closed ash-pits *f f* (see Fig. 2, which shows a horizontal section along X X of Fig. 1). From the ash-pits several flues, *h h*, and, *g g*, respectively, lead into D and E, which latter, by means of a valve, may be put into communication either with the hydraulic main or with the air-blast main.

In working, after charging the generators with coke, anthracite, "or other carbonaceous material," $i$ and $j$ being still open, the air-blast is admitted under both grates and the fuel in both generators brought to incandescence. The air-blast is then cut off, $i$ and $j$ closed, and steam admitted to A, through D, $g$, $f$, and $e$; the crude water-gas so manufactured passes through C, down B, and through $e$, $f$, $h$, and E to the hydraulic main. As soon as the fuel in A has somewhat cooled, the steam current is reversed, and the water-gas current now passes from B, through C, to A, and so finds exit by D, which is now in communication with the hydraulic main. When the fuel in B has also become too cold for effectual working, the gas exits are closed, $j$ opened, and the residual gas in the generator blown out; the steam supply is next cut off and any further residual gas blown out by a steam-jet W. Air is now admitted, $i$ opened, the fuel in both generators raised to incandescence, and the cycle of operations recommenced.





Much of the apparatus described, especially that relating to the reversal of the gas currents, is of an elaborate nature, and for its appreciation, the specification and its plates must be consulted.—E. R. B.

*Improvements in Coke Ovens.* A. D. Shrewsbury, Charleston, Kanawha Co., West Virginia, U.S.A. Eng. Pat. 11,196, July 24, 1894.

The dome of the oven is provided with a perforated false top, so that there is a second small chamber above the coking space, which is divided into two compartments. The air undergoes a preliminary heating before it has access to the coking chamber, having to pass through the perforations of the false top. As a variation, one half of the false top may be omitted and the air allowed direct admission into the coking space. Steam is admitted into the bottom of the coking chamber, for the better elimination of sulphur, whilst "electro-positive and electro-negative elements connected with suitable circuit wires" are arranged within the oven; "galvanic action" is thereby secured and the amount of ammonia increased. The main object of the invention is the even and uniform distribution of the air over the surface of the coal and the preliminary heating of the air before its introduction on to the surface of the coal.—A. G. B.

*Improvements in and relating to Apparatus for Conveying, Storing, and Utilising Petroleum and other Liquid Hydrocarbons.* T. G. B. de Ferrari, Genoa, Italy. Eng. Pat. 14,390, July 26, 1894.

In reservoirs for storing or transporting petroleum, the patentee provides double walls, the intervening space being filled with water. For greater convenience in withdrawing the petroleum, water is admitted under slight pressure to the bottom of the reservoir, the petroleum being raised by the layer of water, upon which it floats. In the specification the arrangement is particularly described in connection with the storage of liquid fuel in sea-going vessels, either for mere transport or for use as fuel in propelling the vessel. Sea-water is to be used in this case, and diagrams are given showing how it may best be admitted into the hold of the ship for the purpose.—A. G. B.

*Improvements in the Manufacture of Retorts of Refractory Material.* N. Teissier and G. L. A. Nègre, both of Uzès, France. Eng. Pat. 14,553, July 28, 1894.

These inventors state that a thickness of 6—7 centimetres or more, of walls ordinarily allowed for retorts constructed of refractory materials, has been found to be necessary by practical experience. They propose to corrugate the walls (either longitudinally or transversely) and to reduce this thickness, greater heating surface and conducting power being thereby obtained. The inventors state that with retorts constructed according to this method there are fewer fractures due to inequality of heating, because the corrugations permit the walls to yield proportionally to such irregularities of heating.—E, R. B.

*A Method and Means for Preventing and Localising the Explosion of Inflammatory Gas or Dust in Coal Mines or elsewhere.* C. Gautsch, Munich, Germany. Eng. Pat. 15,771, August 18, 1894.

An atmospheric screen is proposed, of such nature that the gas or matter of which it is composed shall offer no impediment to the passage of solid objects and shall not be deleterious to animals, but shall be capable of arresting flame. The screen proposed, consists of fine particles of such substances as powdered bicarbonate of soda and boric acid diffused in the air of the locality to be protected, by means of an atomiser or spraying device.—A. G. B.

*Improvements in Apparatus for Burning Liquid Fuel.* J. L. Osborn, Plymouth, Devon. From C. Neuhaus, Vienna, Austria. Eng. Pat. 15,773, August 18, 1894.

The steam for the atomising injector, is drawn from a chamber which is supplied from the boiler through a reducing valve which keeps the steam at constant pressure in the said chamber. The chamber also serves to separate water from the steam before it reaches the injector; this condensed water is used to heat the oil before it is injected. —A. G. B.

*An Improved Apparatus for Carburetting Air.* J. F. Coutts, Woolwich. Eng. Pat. 16,923, September 5, 1894.

A chamber is filled with animal or vegetable fibre, charged with "spirits" of mineral oils, and air is then forced through under pressure. Part of the mixed air and "spirit" vapour is used to heat the air entering, and so assist the carburetting process.—R. B. P.

*Gas Washer.* G. Pettigrew, Middlesbrough. Eng. Pat. 17,395, September 13, 1894.

This apparatus consists of a vertical tower, divided into a series of compartments by horizontal plates. On the upper surface of the plates are a number of short tubes arranged spirally, which allow the gas to pass from one compartment to the next. Over these is placed a spiral hood of inverted U-section, the lower edges of which are serrated. These hoods form spiral channels on the top surface of the plates. The washing water is fed on to the centre of the top plate, and flows along between the walls of the spiral channel to the side of the tower. Thence it falls through a connecting tube on to the next plate, and flows back towards the centre along the spiral channel on this plate, then down through another tube on to the centre of the next plate, and so on.

The connecting tubes project above the top surface of the plates, so that a layer of the washing water remains on the latter, and seals the serrated edges of the spiral hoods.

The gas to be washed, enters the tower at the bottom, passes up through the connecting tubes into the lowest spiral hood, bubbles out under the serrated edges of it through the washing liquid, and then passes up through the next plate, and so on. The gas finally leaves the washer through an exit pipe on the top.—R. B. P.

*Improvements in Carburetting Gas.* H. T. Blake, Ross, Hereford. Eng. Pat. 17,873, September 20, 1894.

The gas to be carburetted, is caused to flow through a long passage, formed by a number of cylindrical baffle plates in a cylindrical chamber. On one side, these baffles are covered with flannel, or some similar material, saturated with the carburetting medium. The gas then passes to the outer part of an upper chamber, which consists of two concentric tubes, the inner one being perforated with a number of holes. The outer part, into which the gas passes, is filled with an absorbent material, such as cotton- or slag-wool, sponge, &c., which is kept soaked with the carburetting medium, fed on to it from a reservoir on top through a regulating tap. The carburetting medium drops from the top part into the lower one, where it is absorbed, through capillary action, by the flannel. The carburetted gas, after passing through the hydrocarbon-soaked material in the upper part of the apparatus, passes inwards through the perforated tube and out through an exit pipe on top.
—R. B. P.

*Improvements in and Apparatus for Enriching Gases by Liquid Hydrocarbons.* P. Dvorkovitz, London. Eng. Pat. 18,078, September 22, 1894.

The apparatus consists of a vertical casing or tower, in which a series of perforated plates are placed, one above the other. The perforations are surrounded by a tubular projection on the top side of the plates, over which a cap or thimble is placed. Alternately, on opposite sides of the plates, are overflow pipes, projecting slightly above the top surface, and passing down nearly to the next plate. The projecting rim ensures a layer of liquid remaining on the plates, which seals the thimbles covering the holes, and also the lower end of the overflow pipes.

The gas to be enriched enters the tower beneath the lowest plate, and bubbles up successively through the liquid layer on each plate, past the lower edges of the thimbles. The hydrocarbon for enriching is fed in on top, and flows down from plate to plate successively, through the overflow pipes.

In the lowest part of the tower there is a steam coil, or other arrangement, for heating the incoming gas.
—R. B. P.

*Improvements relating to the Use of Liquid Fuel, and Apparatus for that Purpose.* S. H. Terry, London. Eng. Pat. 18,443, September 28, 1894.

The use of steam injectors for spraying oil as well as supplying air for furnaces, is objectionable when liquid fuel is to be employed for marine boilers, since the steam thus applied is both largely expended and is not subsequently condensed, a fact which involves the loss of fresh water. The volume of steam sacrificed in this way will frequently amount to from 5 to 10 per cent. of that generated by the boiler. To avoid this loss, and at the same time to reduce the roar of the furnace, the patentee supplies oil without air by an arrangement of jets, and air through separate and independently controlled air-jets, by means of a fan or blower, which is capable of being worked by an engine, the exhaust steam of which is condensed. The portion of steam which is used for the oil injectors may be saved by substituting an injector worked by oil vapour. The vapour for this purpose is generated in the oil-feed tank, which is heated either by an internal steam-coil or by means of some independent source of heat; the conduit pipe for the vapour leads from the top of this tank, whilst the oil is drawn off from the bottom.—A. G. B.

*Improvements in Apparatus for Enriching Gas.* W. Kemp, Kingston-on-Thames. Eng. Pat. 18,510, September 29, 1894.

The apparatus consists of a tube-coil, surrounding a nest of parallel tubes; both are situated in a cylinder forming a steam jacket round them. The nest of straight tubes communicates with a chamber at each end. The enriching hydrocarbon is fed into the tube-coil, and in passing along it, is vaporised. The vapour issues into a chamber, where it meets the gas, and the two together pass along the nest of straight tubes to the second chamber, where they are thoroughly mixed by being caused to pass through several perforated baffle plates.—R. B. P.

*An Improved Process of and Apparatus for Producing and Liquefying Acetylene Gas.* Haseltine, Lake, and Co., London. From E. N. Dickerson, New York, U.S.A., and J. J. Suckert, Ridgewood, New Jersey, U.S.A. Eng. Pat. 5730, March 19, 1895.

These inventors prepare acetylene gas by acting upon the carbides of alkaline or of alkaline earth metals with water: the apparatus employed being such, that the gas produced, is liquefied by its own pressure, at the temperatures at which the apparatus is maintained.—E. R. B.

*Improvements in or relating to the Manufacture of Gas from Oil and Air.* W. P. Thompson, London. From G. D. Bayaud and G. F. Perrenoud, both of New York, U.S.A., and G. H. Harvey, Pittsburg, Penn., U.S.A. Eng. Pat. 5732, March 19, 1895.

These inventors describe a new process for the manufacture of gas, and suitable arrangements of apparatus for the purpose. Their process consists in mixing air and oil, under pressure, in a carburetting vessel, which is kept warm by means of a steam coil disposed within it. The carburetted air and the residual oil, both still under pressure, are conducted off by separate systems of pipes, to two injectors or other suitable atomising arrangements, where the carburetted air atomises the residual oil by one injector into a retort, and by the other underneath this retort. The spray of the latter is lit and the retort thus heated; while, inside the retort, the manufacture of gas is completed from the remainder of the carburetted air and residual oil. The gas so manufactured may be used for heating purposes direct, or may be passed through coolers, to a gas-holder. In an alternative modification of the process, coal-gas or coal-gas and air may replace the air, which ordinarily, is pumped into the carburetting vessel.

The individual parts of the plant described are of a usual character, but a noticeable feature of the apparatus is that the pressure under which the carburetted air exists, is caused to regulate by lever-valves, (1) the supply of steam to the pump which forces air into the carburetting vessel, and (2) the supply of residual oil to the atomisers, the apparatus therefore becoming automatic in great measure.
—E. R. B.

*Improvements in or relating to Retorts for the Distillation of Shale and other Bituminous Substances, or for the Calcining of Ironstone, Lime, or other Substances, also applicable to Gas Producers.* J. Bryson, Pumpherston, J. Jones, Dalmeny, and W. Fraser, Glasgow. Eng. Pat. 7113, April 6, 1895.

These improvements upon the patentees' former patent, 8371 of 1894, relate to the lower end of the retorts referred to, and provide means whereby, without interfering with the continuous supply of steam to the retort, the downward motion of the charge is ensured, and fluxing and clinkering obviated; the lower part of the charge being kept moving, and a small portion of the ash being allowed to escape continuously, or almost continuously, into the closed hopper which encloses the end of the retort.

In the simplest arrangement described, the charge is supported upon a flat plate, which takes the place of the grate, and which extends from side to side of the furnace, but does not quite reach to the back and front walls of the latter. Above this plate is another one—the scraper or push plate—which is capable of a to-and-fro motion. At each movement, some of the ash is forced over the front or back edge of the bed-plate into the hopper chamber beneath.

The same principle is applied in a second modification, where, however, the bed-plate carries a dome-like upward extension, which partly supports the charge.

The nozzles which admit steam—superheated or otherwise—to the retort, open into the hopper chamber, the steam finding its way into the retort by the passages which serve, as seen above, for the exit of ash.

In producers where the section of the retort or furnace is circular, the "bed-plate" is made circular and the "scraper plate" is attached at right angles to a shaft which penetrates the centre of the bed-plate, and which is capable of rotation.—E. R. B.

*A New or Improved Apparatus for the Production of Gas from Oil.* M. Merichenski and J. D. Moffat, both of London. Eng. Pat. 8120, April 24, 1895.

A flat cylindrical vessel with a spiral division plate, which forms a spiral channel inside it, is filled with pith, sponge, or some similar material capable of absorbing a quantity of hydrocarbon oil. The material is saturated with such oil, air is caused to flow through the spiral channel and thus becomes saturated with oil vapour. Two or more vessels can be superposed and the air may be caused to flow through them in series.—R. B. P.

*Improvements in Gas Retorts.* A Guéguen, Paris, France. Eng. Pat. 10,145, May 22, 1895.

This inventor proposes to decrease the thickness of wall in earthenware retorts, thus improving the transmission of heat to the contents, while the requisite strength is afforded to the wall by strengthening ribs or wings on the outside, or on the outside and on the inside. These wings or ribs may be moulded with the wall or formed by cutting it away, and they may be of any size and arranged in any suitable manner, but preferably obliquely, so as to form helicoidal ribs upon the curved portions, thus forming strengthening supports, in the direction in which the retorts have most chance of breaking.—E. R. B.

*An Improved Manufacture of Incandescence Mantles and the like for Gas and other Burners.* O. Knöfler, Charlottenburg, Germany. Eng. Pat. 11,038, June 4, 1895.

Cotton threads are at present solely employed for the organic basis of incandescent mantles, and are composed of short filaments twisted together.

The patentee has succeeded in making from collodion, endless impregnated threads, by charging the material with salts of incandescing oxides, and operating according to the method by which Chardonnet's "artificial silk" is prepared. The collodion solution is mixed with an alcoholic solution of the salts to be employed, or with the solid oxides if salts soluble in alcohol be not obtainable; any suitable organic material, such as sugar or camphor, may be added. This mixture is now forced through a series of capillary tubes and the resulting threads are fixed by passage through a solvent which will dissolve the alcohol and ether of the collodion, without attacking the inorganic salts evenly distributed throughout the threads. Water is the simplest and cheapest fixing agent, and if it be rendered alkaline, a coating of hydroxide will be immediately formed on the thread, which will be thus protected from the solvent action of the water. Since the burning of such threads when they have been woven into fabrics is too energetic, they must be denitrated before being burnt. The denitration is effected by dissolving some reducing agent in the solvent used for fixing the threads; such agents are formaldehyde, hydroxylamine, ammonium sulphide, and the like. Alkali sulphides dissolved in dilute alcohol are undoubtedly the best denitrating agents, but these solutions are open to the objection that water so easily extracts the inorganic salts.

Besides the fact that mantles woven from such impregnated collodion threads are much more durable than those woven from cotton threads and subsequently impregnated, an advantage accrues from the smaller percentage of ash in collodion than in cotton threads. Even after a washing with hydrochloric acid, cotton mantles retain 0·5 per cent. of ash; this is very deleterious to the light-emissive power of the finished mantle.—A. G. B.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Petroleum Soaps and their Solubility in Petroleum.* Zeits. ang. Chem. 1895, 225.

*See under* XII., *page* 810.

*Estimation of Paraffin in Crude Anthracene.* F. Heusler and J. Herde. Zeits. ang. Chem. 1895, 254.

*See under* XXIII., *page* 828.

*Estimation of Sulphur in Petroleum.* F. Heusler. Zeits. ang. Chem. 1895, [10], 285.

*See under* XXIII., *page* 828.

### PATENT.

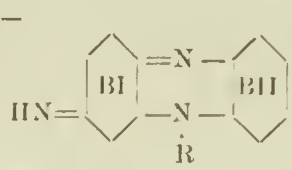
*An Improved Process for Extracting Volatile Matters, and especially those of Vegetable Tar.* R. Haddan, London. From A. H. Gouts and E. J. Marc, Paris, France. Eng. Pat. 11,635, June 14, 1895.

The claims are for the apparatus figured and for "extracting volatile matter . . . by heat derived from superheated steam without the aid of pressure, the said steam being produced by raising the boiling point of the water employed by means of salts (for instance, chloride of sodium) dissolved therein."—A. G. B.

## IV.—COLOURING MATTERS AND DYES.

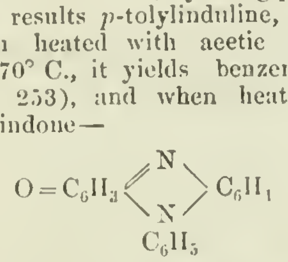
*The Induline Series. V.* O. Fischer and E. Hepp. Annalen, **286**, 187—247.

The authors, in continuation of their work on the indulines (Annalen, **272**, 306; this Journal, 1893, 669), make use of the following scheme for the nomenclature of those of the benzene series:—



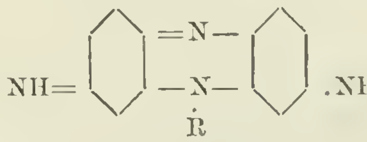
R being an alcohol radicle (methyl, ethyl, phenyl, &c.), and if this substituent be designated by the prefix *meso*, all possible indulines can be systematically named, according to the method already given. Meso-methylinduline has not yet been prepared, the lowest substituted induline being *ms*-phenylinduline, $C_{18}H_{13}N_3$. This, which is also produced as a by-product in the amido-azobenzene melt, can now be produced in any quantity by the molecular transformation of aposafranine (Ber. **21**, 1590; this Journal, 1888, 497: also Ber. **26**, 1655; this Journal, 1894, 30). This latter is easily prepared by the action of sodium nitrite on phenosafranine dissolved in alcohol in presence of hydrochloric acid. The colouring matter, after distilling off most of the alcohol, is salted out and recrystallised from dilute alcohol. The green colour with which it dissolves in concentrated sulphuric acid is characteristic, whilst in fuming sulphuric acid it dissolves with a brownish-red colour

When boiled in a benzene solution it undergoes a complete change, forming an indifferent, sparingly-soluble powder, from which aposafranine could not be regenerated. By heating aposafranine hydrochloride with two or three times its weight of aniline on the water-bath, the colour with which the melt dissolves in concentrated sulphuric acid gradually becomes reddish-violet, and there results the induline, $C_{18}H_{13}N_3$. A small quantity of phenylinduline, $C_{18}H_{12}N_3C_6H_5$, melting at 231° C., is formed simultaneously. The induline, $C_{18}H_{13}N_3$, melts at 203°—204° C., and the melting-point, 215° C., given in an earlier paper as that of the same base isolated from the amido-azobenzene melt, is ascribed to the presence of a bluer colouring matter, which melts higher. On heating the hydrochloride further with aniline to 130° C., it can be converted into phenyl-*ms*-phenylinduline, and higher homologues can be produced by this method; for instance, by using *p*-toluidine in place of aniline, there results *p*-tolylinduline, melting at 227°—228° C. When heated with acetic and hydrochloric acid to 160°—170° C., it yields benzene-indone hydrate (Annalen, **266**, 253), and when heated with alcoholic baryta, benzene-indone—

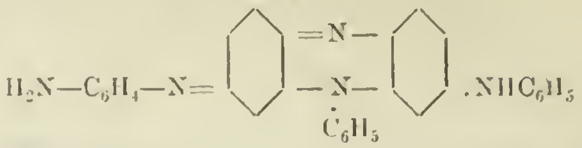


which can be converted into phenazine. Thus, the mother-substance of safranine has, for the first time, been obtained by converting phenosafranine into aposafranine and this into benzene-indone and phenazine. A further constituent of the amido-azobenzene melt is the phenyl-*ms*-amidophenyl induline, which has already been described (Annalen, **262**, 256; this Journal, 1891, 457). It is of great technical value, since its sulphonic acids dye wool evenly, similarly to the rosinduline sulphonic acids, which is not the case with other induline sulphonic acids, more especially those of the amido-azobenzene melt. The compound is an oxidation product of *p*-phenylene diamine in presence of aniline or its salts, and when azophenine, *p*-phenylene diamine, aniline, and alcohol are heated together for 12 hours to 140° C., the first-named substance acts as an oxidiser, amidophenylinduline, $C_{24}H_{18}N_4$, melting at 150° C., being produced. The same compound is obtained by the action of three molecules of quinone dianil, $C_6H_5N{:}C_6H_4{:}NC_6H_5$ (v. Bandrowski, Monatsh. Chem. **9**, 414; this Journal, 1888, 562), on one molecule of *p*-phenylene diamine, and the authors discuss various formulæ for the resulting compound. Though no decision as to the position of the primary amido-group could be arrived at, yet the existence of the latter is beyond doubt, as the base can be diazotised, and gives reactions characteristic of a primary amine.

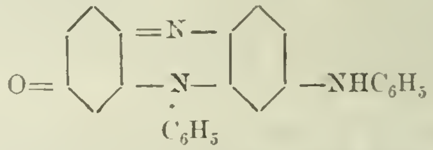
In addition to the indulines of the amido-azobenzene melt, like amidophenylinduline, which possess an unsymmetrical constitution, there exists an isomeric series which the authors term symmetrical indulines. These stand in the same relation to the safranines as the induline $C_{18}H_{13}N_3$ does to aposafranine. They are all derivatives of the following general formula:—



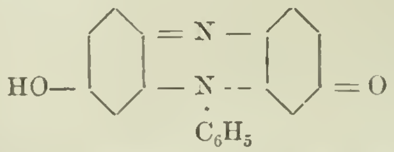
The colouring matters mauveïne and indazine belong to this series. The simplest derivative, *ms*-methyl-*s*-induline, is unknown, as is also the *ms*-phenyl derivative. On the other hand, phenyl-*ms*-phenyl-*s*-induline, $C_{24}H_{18}N_4$ (phenomauveïne), is well known, and is obtained by oxidising pure aniline, or from nitroso-aniline or-diphenylamine and aniline (Ber. **26**, 1194; this Journal, 1893, 671), or else by the action of nitroso-aniline on diphenyl-*m*-phenylene diamine (Annalen, **272**, 314; this Journal, 1893, 669). The authors have found that in all cases a second colouring matter is obtained, the formation of which depends upon the presence of the quinone-imide group. For instance, by the action of nitroso-aniline on diphenyl-*m*-phenylene diamine, there is formed not only phenomauveïne, but also a second colouring matter, which has now been identified as an amidophenylphenomauveïne, having the formula—



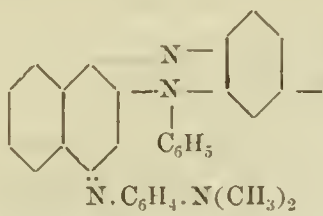
In the same way, the action of nitrosodimethylaniline on diphenyl-*m*-phenylene diamine yields not only indazine, $C_{26}H_{22}N_4$, melting at 218°—220° C., but also the base $C_{28}H_{27}N_5$, melting at 210°—212° C., which is more easily soluble in benzene, and dissolves in concentrated sulphuric acid with a blue colour, whilst indazine dissolves with a green colour, which, on diluting the solution with water, turns blue and then bluish-violet. These colorations with sulphuric acid are characteristic of the two colouring matters formed in this reaction; the simpler always dissolves with a green, whilst the more complicated one dissolves with a blue or violet colour. A similar result is obtained by using nitrosodiphenylamine in place of nitrosodimethylaniline, the two bases obtained having the formulæ $C_{30}H_{22}N_4$ and $C_{36}H_{27}N_5$, the former being phenylmauveïne, melting at 256°—257° C., and dissolving in concentrated sulphuric acid with a grass-green colour, whilst the latter is phenylamidophenylmauveïne, which melts at 202° C., and dissolves with a blue colour in concentrated sulphuric acid. Both these compounds are blue colouring matters. It has been found that the conversion of indulines into indones by heating with acids, which takes place very easily in the naphthalene series, does not give good results when applied to the benzene indulines, and it is preferable to employ alcoholic potash or baryta. Certain of the indones can be obtained by using nitrosophenol, which, when condensed with diphenyl-*m*-phenylene diamine, yields mauvindone, having the constitution—



When decomposed by heating with alkalis it forms *s*-oxybenzene-indone, although in small quantity. This compound, which has the formula—



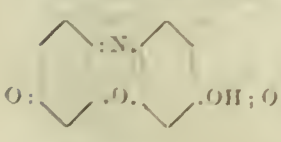
is more easily produced from phenylmauveïne. Further investigation proved its identity with the safranol Nietzki and Otto (this Journal, 1888, 498) obtained as a decomposition product of phenosafranine, and the authors have now separated as an intermediate product amidobenzene-indone. Since the safranines are symmetrical and are converted by heating with bases (*e.g.*, alcoholic potash) into the corresponding *s*-indulines, the course of the reaction can be explained, since the phenosafranine is first converted into the corresponding induline, $C_{18}H_{14}N_4$, which then yields amidobenzene-indone and subsequently oxybenzene-indone. Continuing their investigations on the rosindulines the authors describe a nitrophenylrosinduline, melting at 270° C., and further a trinitro derivative. Both these compounds, when decomposed by heating with hydrochloric acid, yield rosindone and a nitrated aniline. The former compound can also be nitrated to nitroso-indone, which, on reduction, forms a very oxidisable amidorosindone. The colour base so produced forms two series of salts, one of which is blue, the other reddish-yellow. The sulphonic acids of rosinduline and of rosindone, when heated with 10 per cent. soda-lye under pressure to 222° C., are hydrolysed, forming the corresponding oxyrosindone. Since these latter compounds possess characteristic properties, they are of use in identifying colouring matters of the induline series. To the symmetrical rosindulines belongs the blue-violet colouring matter obtained by the inter action of nitrosodimethylaniline, α-naphthylamine hydrochloride, and aniline. The constitution already assigned to the compound is incorrect, and inasmuch as it gives, amongst other products, $B_2$4-hydroxyrosindone when heated with hydrochloric acid to 180° C., it has the constitutional formula—



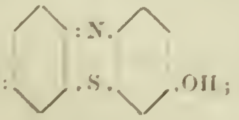
and can also be prepared by the action of nitrosodimethylaniline on phenyl-β-naphthylamine. The action of phenyl-α-naphthylamine on nitrosodimethylaniline gives a bluish-black base, which dissolves with a green colour in concentrated sulphuric acid, gives a more soluble nitrate than the β-compound, and does not fluoresce either as base or salts, reactions by which the two isomers can be readily distinguished.

*Naphthindulines.*—In their previous paper (Annalen, **272**, 339; this Journal, 1893, 669) the authors have described several compounds belonging to this series, more especially Naphthyl red and Magdala red. The former is one of the products obtained by heating benzene-azo-α-naphthylamine with phenol to about 130° C., the second product being rosinduline, $C_{22}H_{15}N_3$. The two substances are separated by the lesser solubility in alcohol of the Naphthyl red hydrochloride.

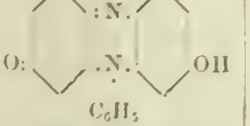
*Magdala Red.*—The technical product contains two different colouring matters, the bases having the composition $C_{30}H_{19}N_3$ and $C_{30}H_{20}N_4$, the latter preponderating in the present commercial article, which is a hydrochloride. In earlier preparations the proportion was reversed. The pure base, $C_{30}H_{19}N_3$, dissolves in concentrated sulphuric acid with a blue colour, which, on dilution, passes through greenish-brown to reddish-violet, whilst the base, $C_{30}H_{20}N_4$, dissolves with a yellowish-green colour, which, on addition of water, gives first of all a brownish-pink coloration, and this, on further dilution, gives a red solution. The former dissolves easily in ether, benzene and methylal, whilst the latter is sparingly soluble. By heating the base $C_{30}H_{19}N_3$ with hydrochloric acid in acetic acid solution, it yields *ms*-naphthylnaphthindone, which, on distillation with zinc dust gives *s*-α-β-naphthazine. The base $C_{30}H_{20}N_4$, which is the true Magdala red, can be isolated by means of its sulphate (Julius, this Journal, 1886, 480) and decomposition with pure caustic soda, crystallises from ether in small greenish prismatic crystals. The base itself does not fluoresce in aqueous or alcoholic solution, but only the salts. When heated with concentrated hydrochloric acid in acetic acid for 20 hours to 210° C., amido-*ms*-naphthylnaphthindone is formed, which is insoluble in alkalis. There is simultaneously produced the further decomposition product $C_{30}H_{19}N_2O_2$, which is hydroxy-*ms*-naphthylnaphthindone. The authors have also succeeded in removing the amido group from the base $C_{30}H_{20}N_4$, and have obtained the base $C_{30}H_{19}N_3$ by boiling the diazo compound with alcohol. A table is appended at the conclusion of the paper giving qualitative tests for the various indones to which the induline colouring matters can be referred. Attention is also called to the similarity in constitution between the indulines, methylene-blue colouring matters, and oxazines, and the complete analogy existing between the symmetrical oxindones, resorufin and thionol—



Resorufin.



Thionol
(Hydroxythiazone).



Hydroxybenzene-indone.

Very few derivatives corresponding to the rosindulines, rosindones, and naphthindulines have been prepared in the Methylene blue and Oxazine series, but it is to be expected that methods for the synthetical preparation of these substances will gradually be devised.—T. A. L.

*Oxidation of Anthraquinone.* C. Zurcher. Bull. Soc. Ind. Mulhouse, 1895, 170.

Anthraquinone dissolved in sulphuric acid at 66° B., or mixed with acid at 60° B., is easily oxidised by the addition of ammonium persulphate and gentle heating. A small quantity of the persulphate causes the formation of monohydroxyanthraquinone, a larger amount and more vigorous heating, results in the production of alizarin similar to commercial "alizarin, blue shade."

In ammonium persulphate the oxygen or part of it is present in a state different to that in which it is generally found in oxidising agents, for in the presence of concentrated sulphuric acid it converts chromic acid to chromic oxide, with copious evolution of oxygen.—R. B. B.

*Constitution of Iodine Green.* L. Lefèvre. Bull. Soc. Chim. 1895, [3], **13**, 247—252.

The author shows that Hofmann and Girard's Iodine green is a methiodide of tetramethyltriamidodiphenylcresylcarbinol, not of hexamethyltriamidodiphenylcresylcarbinol as has been generally accepted, in spite of the analyses of the discoverers.

When heated under ordinary pressures, the green loses methyliodide and yields a violet derivative of tetramethyltriamidodiphenylcresylcarbinol; when the heating is conducted under increased pressure, the liberated methyliodide reacts with a molecule of the violet, yielding a sparingly soluble blue-violet dihydriodide of hexamethyldiphenylcresylcarbinol. Excess of methyliodide brings about reduction to the hydriodide of leucaniline dimethiodide.
—A. G. B.

*Chrome Ink and its Preparation.* Prof. Knapp. Dingler's Polyt. J. **296**, 188—189.

This ink is easily prepared, has a good covering power, and is inexpensive, costing less than 4½*d.* per gall. for materials. It has, however, the disadvantage of occasionally gelatinising. This is due to two causes: the relative solubility of logwood extract in hot and cold water, and the properties of the chromium lake itself. Commercial logwood extract dissolves slowly and sparingly in cold, but readily and quickly in hot water. A small quantity, about 2 per cent., of charcoal always remains undissolved, and the filtered solution on standing deposits a red precipitate. With 30 times its weight of water, about 20—30 per cent. separates out. A well-prepared black ink contains only 3—4 per cent. of solid matter, but is perfectly opaque even in layers only a few millimetres thick. It passes through a filter as quickly as water, and without leaving any residue. It is, however, very easily salted out, and even the presence of a small excess of potassium bichromate is sufficient to produce gelatinisation after a shorter or longer period. Another point which also bears on the precipitation of the ink, is the action of the metallic nib. If, as is the case at the present time, coppered nibs be used, it is noticed that with an ink having a tendency to deposit, the coppered portion is soon attacked and becomes covered with a gelatinous coat, whilst the bright steel portions are uncoated or but very slightly attacked. In order to obtain a satisfactory ink, a logwood extract is prepared by boiling and allowed to stand until thoroughly cold. A solution, after cooling and filtering, should contain 4 per cent. of dry extract. The chromate solution should be prepared cold and contain 8—9 per cent. of potassium bichromate. It is advisable not to add the chromate at once, but in small quantities, testing the ink, after cooling, from time to time. As a guide to the amount it may be mentioned that 100 grms. of one extract required 3·13, 3·33, and 3·26 grms. of crystallised potassium bichromate, whilst another extract required from 4·43 to 4·47 grms. It must be remembered that the ink is paler cold than hot, and the tests must therefore be taken with cooled samples. A small addition of alkali has the effect of causing the ink to flow freely.—T. A. L.

## PATENTS.

*Improvements in the Manufacture or Production of Ortho- and Para-oxy-orthotoluic Acids and Metacresol.* G.

W. Johnson, London. From Kalle and Co., Biebrich-on-the-Rhine, Germany. Eng. Pat. 16,559, August 30, 1894.

The compounds referred to are obtained by the action of caustic soda at a high temperature on 1.3-naphthalene disulphonic acid and certain of its derivatives. As an intermediate product, 1.3-dihydroxynaphthalene is produced, which, on further heating with alkalis, splits up into *o*-toluic acid and acetic acid or one of its decomposition products. In place of the 1.3-naphthalene disulphonic acid, a corresponding naphthol or naphthylamine sulphonic acid may be employed, and it is immaterial whether the sulphonic acid group is in the α- or β-position. By employing a naphthalene trisulphonic acid in which two of the sulphonic acid groups are in the 1.3-position, different products are obtained according to the position of the third sulphonic acid group. For instance, *o*-hydroxy-*o*-toluic acid—

$$C_6H_3.OH.CH_3.CO_2H[1:2:3]$$

is obtained from 1.3.4′-naphthalene trisulphonic acid or from 2.4.1′-naphthylamine disulphonic acid. By employing 1.3.2′-naphthalene trisulphonic acid, 1.3.2′-naphthylamine disulphonic acid, or 1.3.2′-amidonaphthol sulphonic acid there results *p*-hydroxy-*o*-toluic acid—

$$1.4.6.C_6H_3.CH_3.OH.CO_2H.$$

If a 1.3.3′-derivative be used either as a naphthalene trisulphonic acid, naphthol, or naphthylamine disulphonic acid, the resulting product is *m*-cresol. The following working details are given for the manufacture of *o*-hydroxy-*o*-toluic acid:—By treating 1.5-naphthalene disulphonic acid with fuming sulphuric acid at a low temperature it is converted into 1.3.1′-naphthalene trisulphonic acid. 60 kilos. of this acid, together with 120 kilos. of caustic soda and 90 litres of water, are heated for five hours to 280° C. The melt is then poured into water, acidulated, boiled to expel sulphurous acid, and filtered. The *o*-hydroxy-*o*-toluic acid crystallises out on cooling, and melts at 143° C. Its acetyl derivative crystallises in shining long needles, melting at 144° C. For the preparation of *m*-cresol the 1.3.3′-naphthalene trisulphonic acid is used, the same quantities being taken as above. After acidulating the melt, the *m*-cresol produced is separated from a small quantity of *o*-toluic acid simultaneously produced, by distillation with steam in presence of soda.—T. A. L.

*Manufacture of a Yellow Basic Colouring Matter.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat, 17,048, September 7, 1894.

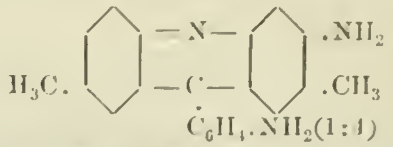
By heating *m*-nitrophenol or its ethers with *p*-toluidine and *p*-toluidine hydrochloride in presence of a metallic chloride, a yellow basic dyestuff is produced. This has the composition $C_{20}H_{17}N_3$ and is a homologue of diamidodiphenylacridine (phosphine), and like the latter, gives a characteristic sparingly soluble nitrate. It is obtained by heating together 100 kilos. of *p*-toluidine hydrochloride, 30 kilos. of *p*-toluidine, and 10 kilos. of ferrous chloride to 200°—220° C. in a vessel provided with an agitator. 30 kilos. of *m*-nitro-phenol are then gradually added, and after the reaction is complete, the melt is repeatedly extracted with hot water, the red dyestuff being precipitated with salt from the filtered solutions. The dyestuff is then re-dissolved, fractionally precipitated with an alkali, and finally converted into the nitrate, which crystallises well. The base, which melts at 230° C., is slightly soluble in water, readily in alcohol, ether, and benzene, forming yellow solutions with a green fluorescence. The new colouring matter dyes yellow shades on tannin-mordanted wool and cotton.—T. A. L.

*Manufacture of Yellow Basic Dyestuffs.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 17,049, September 7, 1894.

When *m*-nitro-amines are heated with aniline and aniline hydrochloride, there result blue basic dyestuffs of the induline series, but if *p*-toluidine be substituted for the aniline, the reaction takes a different course and homologues of diamido diphenylacridine (chrysaniline) are produced. For instance, by heating together one of the nitrotoluidines—

$$CH_3:NO_2:NH_2 = 1:2:4 \text{ or } 1:4:2,$$

with *p*-toluidine and *p*-toluidine hydrochloride in presence of ferrous chloride, a base is obtained having the formula $C_{21}H_{19}N_3$ and the following constitution:—



The product is obtained by heating together in a vessel provided with an agitator, 100 kilos. of *p*-toluidine hydrochloride, 30 kilos. of *p*-toluidine, and 10 kilos. of ferrous chloride to 200°—220° C., and 30 kilos. of one of the above nitrotoluidines is slowly stirred in at this temperature. When the reaction is complete, the melt is extracted with boiling water and the dyestuff precipitated with salt. It is then re-dissolved in water, fractionally precipitated with an alkali, and converted into the sparingly soluble nitrate. The base melts at 212° C., is slightly soluble in water, but easily in alcohol, ether, and benzene, giving yellow solutions with a green fluorescence. The colouring matter dyes silk, wool, and cotton mordanted with tannin, yellow. In place of the nitrotoluidines mentioned, their mono- and dimethyl derivatives may also be employed, and in addition, the *m*-nitro-derivatives of mono- and di-methyl- and -ethylaniline, yellow to reddish-yellow and orange colouring matters resulting in all cases.—T. A. L.

*Improvements in the Manufacture of Hydrazo Compounds from Aromatic Nitro Hydrocarbons.* E. Straub, Berlin, Germany. Eng. Pat. 17,133, September 8, 1894.

In the formation of hydrazo compounds by alkaline reduction from nitro compounds, owing to the production and separation of azo and azoxy derivatives as intermediate products, good yields have not hitherto been obtained by electrolytic reduction methods. According to the patentee, it is essential that the initial and intermediate products shall remain in solution during the whole operation, and he also states that caustic potash is to be preferred to caustic soda. The current employed is 17—18 ampères per sq. c., with a tension of 4—5 volts, the temperature of the reduction cell being 60°—80° C. The anode and cathode are separated by a porous diaphragm, the anode of metal dipping into 10—20 per cent. caustic potash lye, whilst the cathode of carbon or metal is in the solution of the nitro body. For the preparation of hydrazobenzene by this method, 75 kilos. of nitrobenzene are dissolved in 460 litres of 96 per cent. alcohol and 80 litres of caustic potash lye ($KOH : H_2O = 2 : 1$) and submitted to the action of the above current until the liquor has become light yellow. The alcohol is then distilled off and the residue collected on a filter. The yield is 85 to 90 per cent. of the theoretical. The hydrazo-benzene so obtained may be converted in the well-known manner into benzidine.

—T. A. L.

*Improvements relating to the Preparation of Diazo Salts, and to the Use of the same for Dyeing and Printing.* A. Feer, Mülhausen, Alsace, Germany. Eng. Pat. 18,429, September 28, 1894.

Stable diazo salts are obtained according to this invention by combining certain diazo compounds with the carboxylic, sulphonic, and disulphonic acids of aromatic hydrocarbons and their derivatives, and with methylsulphuric acid, phenylsulphuric acid, and their homologues. The diazo solution obtained from 27·6 kilos. of *p*-nitraniline, 28 kilos. of sulphuric acid, and 14 kilos. of sodium nitrite, is run into a concentrated solution of 72·4 kilos. of α-naphthalene sodium sulphonate. The precipitate is filtered off and dried at about 30° C. The dye-bath is prepared by dissolving the salt in water and adding sodium acetate, whilst for printing, the salt is simply mixed with the thickening.—T. A. L.

*The Manufacture or Production of Colouring Matters.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 18,578, October 1, 1894.

This is a further extension of the following Eng. Pats. :— 18,519 of 1889, 3397 of 1890, 13,443 of 1890, and 5984 of 1891 (this Journal, 1890, 1032; 1892, 999; 1891, 760; and 1892, 345). These specifications relate to the production of azo dyestuffs for wool, obtained by combining the diazo derivatives of amines or substituted amines with the sulphonic acids of 1'1'-dihydroxynaphthalene. Under the present patent the combination of certain other amines is claimed, such as the diazo compounds of the ethereal salts, amides, or anilides of aromatic amidocarboxylic acids or of amido ketones. The combination is carried out in the usual manner, of which the following is an example. The diazo compound from 16·5 kilos. of the ethyl ether of *p*-amidobenzoic acid, hydrochloric acid, and 7 kilos. of sodium nitrite is run into an aqueous solution containing 36·4 kilos. of the sodium salt of 1.1'.4.2-dihydroxynaphthalene disulphonic acid and 40 kilos. of sodium acetate. When the formation of the dyestuff is complete, the whole is made alkaline, and the colouring matter, after salting out, is filter-pressed and dried. It has the following constitution :—

$$C_2H_5O_2C.C_6H_4.N = N.C_{10}H_3(OH)_2(SO_3Na)_2$$

and dyes wool magenta-red shades from an acid bath.

—T. A. L.

*Manufacture of New Condensation Products and Colouring Matters derived therefrom.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 18,588, October 1, 1894.

By condensing the nitroso derivatives of secondary and tertiary amines or their sulphonic acids with 1·2-amidonaphthol or its sulphonic acids, compounds are obtained which dye chrome-mordanted wool grey, but by subsequent treatment with sulphur and fuming sulphuric acid, these products yield blue colouring matters dyeing fast blue shades on metallic mordants. A solution of 24 kilos. of 1·2-amidonaphthol sulphonic acid and 6 kilos. of sodium carbonate in 500 litres of water is mixed with 18·6 kilos. of nitrosodimethylaniline hydrochloride. A blue-black precipitate separates out, which dissolves in soda-lye with a dull red-violet colour, changing to yellow on the addition of hydrochloric acid, whilst the solution in concentrated sulphuric acid is reddish-yellow. In order to convert it into the blue dyestuff, 10 kilos. of the condensation product and 2 kilos. of flowers of sulphur are dissolved in 100 kilos. of fuming sulphuric acid containing 23 per cent. of $SO_3$ and heated to 40°—60° C. for 5—6 hours. The melt is then poured into water, filtered off, the precipitate dissolved in dilute soda solution, and after filtration the colouring matter is salted out. It forms a blue crystalline powder, easily soluble in hot and moderately soluble in cold water, and dyes chrome-mordanted wool a blue shade.

—T. A. L.

*Manufacture of Basic Orange-Yellow Colouring Matters.* O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 18,589, October 1, 1894.

The yellow colouring matters of the acridine series, such as acridine yellow and benzoflavine, may, according to this invention, be easily alkylated, yielding orange-yellow to orange-red dyestuffs suitable for leather-dyeing and for fibres mordanted with tannin. A mixture of 10 kilos. of acridine yellow, 20 kilos. of methyl alcohol, and 5 kilos. of hydrochloric acid, is heated for 3—4 hours in an enamelled autoclave to 180°—190° C. After cooling, the excess of alcohol is distilled off and the residue dissolved in water and filtered. The dyestuff can be separated as zinc chloride double salt by adding zinc chloride to the solution. The hydrochloride is a brownish-red powder which differs from acridine yellow in being easily soluble. It gives orange-yellow shades on leather and on cotton mordanted with tannin and tartar emetic. By using ethyl in place of methyl alcohol, more yellowish shades are obtained. Of course, in place of hydrochloric acid and methyl alcohol, other alkylating agents may be employed, such as methyl chloride or bromide, or methyl alcohol and sulphuric acid, with the same results.—T. A. L.

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## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

### PATENTS.

*Improvements in or in connection with Retting Flax, Jute, or other similar Fibrous Materials, and Eliminating the Gummy or other Matter therefrom.* H. S. Close, Yorkshire, and W. O. Roff, Leicester. Eng. Pat. 14,363, July 26, 1894.

The fibrous materials, placed in wire-work receptacles, are immersed from 1 to 3 hours in hot water to which is added liquid ammonia of from 0·928 or 0·910 or, if desired, 0·880 sp. gr., in the proportion of about ¼ to ½ oz. to every lb. of the fibrous materials. Instead of ammonia, ammoniacal salts of equivalent strength may be used. Then the materials are passed through squeezing rollers, and immersed in hot soft water, and finally from 1 to 4 hours in hot water to which is added soft soap, or cotton-seed oil, or olive oil, in the proportion of about 1 to 2 oz. to every 14 lb. of the fibrous materials. The drying is effected in a chamber in which cold air is caused to circulate freely amongst the fibrous materials.—H. S.

*Improvements in Apparatus for Impregnating Textile Fabrics with Liquor.* J. Smith, Heywood. Eng. Pat. 14,873, August 3, 1894.

Pieces of the fabrics to be treated, are led into a vessel provided with a system of rollers over which the fabrics are passed up and down. The rollers are so arranged that only a small quantity of liquid will be needed to fill the vessel. The material, in passing between the immersed rollers, is nipped and pressed. The apparatus is provided with a conveyor for the treatment of large pieces of fabrics.

—H. S.

*Improvements relating to the Treatment of Textile Materials and Products for the Manufacture therefrom of Artificial Hair, and for other Purposes.* G. Jacober and A. Rabourdin, Ivry-Port, France. Eng. Pat. 16,785, September 3, 1894.

The cellulose of cotton, ramie, and other vegetable fibres, is first cleansed, to remove impurities, by treatment with alkaline or other suitable solutions, with subsequent washing. It is then treated from ¼ to 1 hour at the ordinary temperature with a mixture containing 100 parts of chemically pure monohydrated sulphuric acid, 12 to 40 parts of pure glycerin, and 15 parts of distilled water. Stearine, paraffin, oleine, dextrin, or other suitable substances may be used instead of glycerin. This operation is followed by washing, neutralising the acid, and drying.

—H. S.

*Improvements in the Treatment of Wool and other Textile Materials with Liquids, and in Apparatus therefor.* A. Dicktus, Verviers, Belgium. Eng. Pat. 17,205. September 10, 1894.

The principal object of this invention is to improve the action of washing or scouring liquids upon wool or other textile substances, whilst maintaining the fibres in their natural state. The process consists in causing the fibrous materials, by means of the liquids used, to be carried along either continuously or intermittently in a series of chutes open to the air, which are provided with bucket wheels, dams, or other suitable mechanical arrangements, and are interrupted by falls. The patentee declares that by this process of aëration, soaking, and agitation, the materials under treatment are effectively cleansed without injury to the fibres.—H. S.

*Improvements in the Waterproofing of Textile Fabrics, and in Apparatus therefor.* J. B. Fearnley and J. S. Fearnley, Bradford. Eng. Pat. 22,785, November 24, 1894.

The patentees have found that by adding a small quantity of solvent to the waterproofing agents, the melting point

of the latter is reduced. They therefore mix suitable waterproofing agents, such as paraffin wax, Japanese wax, beeswax, borax, glue, &c., &c., with a small quantity of solvent, not sufficient to dissolve the waterproofing substances, but so far as to reduce the melting point so that the mixture can easily be liquefied. This mixture is then applied to the fabric by means of three rollers, each laid horizontally, but arranged one above the other. The lowest of them dips into the liquefied substance and transfers it to the second roller, which is covered with an absorbent material upon which the liquefied substance is evenly deposited. The fabric is then passed between this roller and the top roller, the waterproofing substance being hereby deposited on the fabric in such a state as to require no further melting. The fabric is then passed through a drying machine. The patentees declare that by this process, the fabric is rendered waterproof without interfering with the porosity of the fabric, and that all risk from fire and explosion is avoided.
—H. S.

*An Improved Process of Retting Flax, Hemp, and other Plants.* J. Hennig, Courtrai, Belgium. Eng. Pat. 8243, April 25, 1895.

The patentee adds to the retting water, a certain quantity of yeast, accompanied or not by an organic acid, such as citric, tartaric, or acetic acid. The proportion of 200 grms. of yeast to 1 hectolitre of water and 10 grms. of any of the above-mentioned acids, is stated to give good results. The temperature must be maintained at about 30° C., so as not to interrupt the fermentation. Care should be taken to keep the fibrous substances to be treated, fully in the liquid. From the moment when the fermentation changes from the vinous into the putrescent state, the material under treatment must be carefully watched, and taken out of the bath so soon as the fibres freely detach themselves from the woody substance. The fibres are then washed, preferably in a continuous current of water.—H. S.

*A Process for Washing Crude Wool.* F. Raschig, Ludwigshafen, Germany. Eng. Pat. 10,918, June 1, 1895.

The washing is done by using simultaneously soda soap and cresylic acid, the latter being partly, fully, or not at all saturated with caustic soda. The patentee states that the addition of the cresylic acid to the soda soap greatly increases the solubility of the latter, a mixture of 20 parts of soda soap and 5 parts of cresylic acid dissolved in 100 parts of water at 40° C. possessing great detergent power.
—H. S.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Glucina as a Mordant.* M. Prud'homme. Bull. Soc. Ind. Mulhouse, 1895, 166—169.

The valency of glucinum has long been a disputed point. The author sought to solve the problem by ascertaining the properties of its oxide as a mordant for alizarin and similar oxyketonic colouring matters. The hydrates of sesquioxides, such as $Al_2O_3$, $Cr_2O_3$, $Fe_2O_3$, do not alone form useful soap-resisting lakes with alizarin, but an addition to the dyebath of 1 mol. lime for 1 mol. alizarin is necessary. But the hydrates of protoxides of diatomic metals, *e.g.*, NiO, CoO, and also SnO act differently; the addition of lime salts to the dye-bath causing no change in the shade, or at most a slight diminution in intensity.

To fix glucinum hydrate on cotton, a solution of the sulphate was precipitated with ammonia and ammonium carbonate, and the carbonate formed was dissolved in acetic acid. The cotton was padded in this solution, dried, aged, and passed through ammonia. One portion was dyed with alizarin in distilled water, another equal portion with alizarin and calcium acetate (equal mols.). After dyeing, the patterns were wrung out and soaped at the boil. They differ little in intensity, the first being slightly deeper. The author concludes that, as a mordant, glucina acts as a protoxide. Further dyeing trials yielded these results on cotton Nitro-alizarin, red; Alizarin blue, greenish-blue; Anthrapurpurin, red-violet; Alizarin Cyanine G, violet-blue. To prepare a mordant for wool, the hydrate is precipitated by ammonia and dissolved in tartaric acid. This mordant gives useful shades with Alizarin, Alizarin Blue, Coerulein, and Alizarin Bordeaux B.—R. B. B.

*New Method for the Dyeing of Furs.* Erdmann. Zeits. ang. Chem. 1895, [14], 424—429.

The older methods of dyeing furs are kept secret. Although dyes for wool are equally applicable to hair, only those which can be applied cold are available for fur, as hot liquids would attack the hide and loosen the hairs. Chrysoidine, β-Naphthol green, and Methyl violet may be employed merely warm; but the furrier usually requires shades of brown and black. The author therefore employs oxidation colours, produced by exposing such organic bases as β-phenylenediamine, $C_6H_4(NH_2)_2[1:4]$, and para-amidophenol, to the action of oxidising agents. For the latter, ferric chloride, or potassium bichromate or permanganate, may be used; but hydrogen peroxide is better, because it leaves no salt to be washed out subsequently. Angora hair dipped in a cold mixture of equal volumes of 3 per cent. β-phenylenediamine and 3 per cent. hydrogen peroxide solutions, and exposed freely to air, becomes black after a quarter of an hour, and in a few hours the colour is so fast that it resists even boiling soap solution, whilst the microscope shows the section of any hair to be equally and evenly dyed in all parts. Para-amidophenol, $C_6H_4NH_2.OH[1:4]$, mixed with an equivalent quantity of alkali, gives similar oxidation colours, but of a lighter brown shade. Since warm mixed solutions of β-phenylenediamine and quinone give a deep brown precipitate, in which the molecules are combined in equal proportionns, and since there is a distinct smell of quinone during the dyeing process, the action of the dye is ascribed to the formation of the latter substance. The brown precipitate above mentioned is insoluble in water and but slightly soluble in alcohol, whilst it dissolves readily in glacial acetic acid. Almost insoluble in sodium carbonate solution, it is freely taken up by dilute soda-lye, whence it is re-precipitated by carbon dioxide or other acids. The above oxidising reaction is probably accompanied by others more complex, and the shades of colour produced upon the fur are correspondingly varied at different times. "Metol" and "Amidol" (diamidophenol), toluylenediamine, amidodimethylaniline, and β-phenylenediamine sulphonic acid, dye hair dark brown; but those containing the sulpho group give more soluble and therefore less fast colours. The presence of a carboxyl group also renders the dye less fast, otherwise amidoparaoxybenzoic acid could be used to give a yellowish-red, para-amidosalicylic acid a bright reddish-brown, and 1 : 3 : 4-diamidobenzoic acid a brown colour. The bases recommended are now in the market under the name *Ursol*. On different furs different shades of brown are developed, and the tint may be varied by altering either the base or oxidising agent. The fur may be wholly immersed in the bath, or the dye may be painted on; or, again, the skin may be dipped into a light-coloured bath, and then the hairs may be painted with a darker dye.

For dyeing human hair, para-amidophenol is recommended because it is non-poisonous, and gives a good colour, free from the violet, red, or yellow tint commonly resulting from the use of dyes. β-phenylenediamine should not be used, as it is poisonous, and leads to inflammation of the skin and eczema.—W. G. M.

*Dyeing and Colouring Paper.* A. M. Villon. Bull. J. des Fab. de Papier, 1895, [15], 2, and [16], 4—5.

*Varnishing with Metallic Soaps.* — Metallic soaps form excellent varnishes for paper because they are very adhesive, impermeable, and flexible. As a base for these varnishes, palmitate of alumina may be taken as a type. An aqueous solution of palm soap is treated with sulphate of alumina. 10 kilos. of soap are dissolved in 100 kilos. of boiling water. 30 kilos. of sulphate of alumina are dissolved in 200 litres of boiling water to which is gradually added the soap solution, whilst agitating. A white gelatinous precipitate of palmitate of alumina is formed, which solidifies during the 12 hours the liquor is allowed to cool. This precipitate is placed upon a cloth to drain, pulverised, washed in cold water, and dried. The agglomerated pieces are again reduced to powder. Palmitate of alumina is insoluble in cold water, but soluble in benzene, essence of turpentine, and petroleum spirit. A solution of alumina soap of 25, 40, and 80 grms. per litre of petroleum spirit constitute an excellent varnish for paper, which may also be employed like gum-lake, than which it is much cheaper, and is also absolutely transparent. Another method of preparing this soap consists in dissolving 1 kilo. of soap in 10 litres of water, and gradually adding 15 litres of petroleum spirit, with constant stirring. The liquid finally separates into two layers, the lower being an aqueous solution of soda, and the upper a solution of alumina soap in petroleum spirit, which is decanted off and allowed to rest a week, until clear and free from water.

The colouring of varnish is a delicate operation owing to the difficulty of preventing the destruction of the transparency. The colouring matter must be quite soluble in the vehicle employed. Until recent years there were only alcohol varnishes that were suitable for the production of coloured varnishes, whereas these are now prepared from coloured soaps, coloured resins, waxes, &c.

Resins, dragon's blood, and gamboge give the yellow and red varnishes; the gold alcohol varnishes are also prepared as described. The following are a few examples of gold varnish:—

1. Gum-lac, 500; cachou, 4; dragon's blood, 60; and alcohol 90°, 500 grms.

2. Gum-lac, 250; gamboge, 125; saffron, 10; and alcohol, 1,000 grms.

3. Gum-lac, 250; sandarac, 125; mastic drops, 70; Venice turpentine, 60; gamboge, 60; aloes, 15; and alcohol 96°, 1,500 grms.

4. Gum-lac, 180; sandarac, 45; Venice turpentine, 43; dragon's blood, 125; and alcohol 96°, 1,500 grms.

Varnishes coloured with extracts of colouring matters are prepared by simply dissolving the colouring matter and then the resin in alcohol. Cochineal, indigo (indigo carmine), quercitron, orchanet, and orchil can also be employed. For this class of varnish vegetable colouring matters have been gradually replaced by artificial colours, which give brighter, clearer, and "shot" colours.

*Varnishes tinted with Aniline Colours.*—The ordinary varnishes are simply prepared by adding to the white transparent varnish an aqueous solution of aniline colour in alcohol. This forms a beautiful varnish, but very fugitive in the light. The colours may be mixed to obtain any desired shade.

To produce fine solid colours for a firm varnish, it is not desirable to use soap, resin, or wax colours. The basic colours only should be used. Insoluble or slightly soluble colours should be dissolved in alcohol, but if soluble in water, use that vehicle. Dissolve 30 grms. of Marseilles soap in 2 litres of water, then add the colour, which is immediately precipitated as an insoluble soap. With Methylene blue, the separation is instantaneous. With Light blue the soap colour remains partly in solution and partly in suspension in the water. In this case, facilitate precipitation of the colour by addition of a little hydrochloric acid. The colour is collected on the filter, washed with water, dried at a low heat, and spread on a porcelain plate.

To avoid filtration, agitate the liquid containing the precipitated colour with some petroleum spirit or benzene. To produce the resin and wax colours, operate in the same manner, but in the place of Marseilles soap use the soap obtained by boiling resin or wax with a solution of caustic soda. These aniline colours are soluble in alcohol, petroleum spirit, benzene, essence of terebenthine, and carbon bisulphide. Such colours may be employed for alcohol varnishes and also varnishes of palmitate of alumina, the colours obtained being very beautiful.

*Varnishes coloured with Mineral Substances.*—The alcohol varnishes can also be coloured with Prussian blue (prussiate of iron free from alumina) and acetate of copper. The employment of successive layers of Prussian blue with gamboge or turmeric gives a wide range of shades. Blue with carmine varnish, with dragon's blood varnish, gives a range of violet shades.

The soaps of the metals, in a solution of petroleum spirit or benzene, also give the solid shades, but unfortunately they are a little dull and short of lustre, which might, however, be avoided by using aniline colours.

The following are the colours of the different soaps:—

| | |
|---|---|
| Soap of iron | Brown-orange. |
| ,, chromium | Violet shade of green. |
| ,, copper | Malachite green. |
| ,, nickel | Emerald green. |
| ,, cobalt | Lilac. |
| ,, uranium | Light yellow. |
| ,, manganese | Rose. |

These soaps are to be employed with palmitate of alumina.

Coloured gelatin varnishes, varnishing with lakes, and the making of spangled paper, are next briefly described.

A description of the preparation of lacquered paper is next given.—S. P. E.

*Processes for Staining Wood Black.* Badische Gewerbezeitung, February 1895.

A PROCESS that is much employed for the above purpose, consists in painting the wood consecutively with copper sulphate solution (1 per cent.) and alcoholic aniline acetate (equal parts of alcohol and acetate). A very durable black—and the nearest approach to real ebony—is readily obtained by moistening the surface of the wood with dilute sulphuric acid (1:20), and subsequently applying heat. A temperature of 60°—90° C. suffices in a very few minutes to produce the desired result. An excellent black was obtained in this way on beech, bass, and box-wood; whilst a second treatment with acid was necessary in the case of cherry, walnut, and birch. With oak and ash the results were not so good; and apple, and different varieties of pine, were still less amenable to the process, pine especially being unevenly stained. In order to afterwards remove the acid from the wood, it might be well to thoroughly wash the latter with dilute soda solution, followed by clean water. It is unlikely that this method can be applied to any but small articles, because of the risk of possible fractures during the necessary heating of the wood.

—H. T. P.

### PATENT.

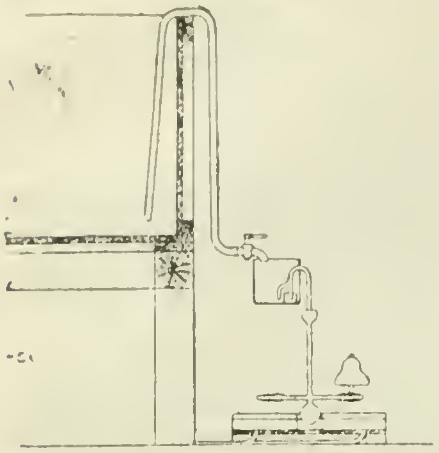
*Process for the Production of Red Tints by Combining on the Fibre Paranitraniline with Mixtures of Betanaphthol and its Sulphonic Acids.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Hoechst-on-the-Maine, Germany. Eng. Pat. 16,987, September 6, 1894.

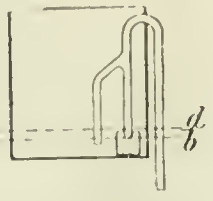
IN order to obtain bluer shades of paranitraniline-red, the patentees propose to add small quantities of the sodium salt of 2.2′-naphthol sulphonic acid to the solution of sodium naphtholate used for developing. With an addition of 5 per cent., a distinctly bluish-red is obtained which is as fast to soap as the ordinary red. The following quantities are given for a developing solution:—28·5 grms. of $\beta$-naphthol, 50 c.c. of a 22° B. caustic soda solution, 120 grms. of 80 per cent. Turkey-red oil, and about 2·7 grms. of 90 per cent. 2·2′-naphthol sodium sulphonate are made up to 1 litre, the development with the diazotised $p$-nitraniline being carried out in the usual way.—T. A. L.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Water Meter for Hydrochloric Acid Condensers.* Georg Schüler. Zeits. ang. Chem. 1895, [13], 373—374.

LUNGE has described an apparatus invented by Rawlin in 1882, for feeding condensers with water, which, however, in many respects proved unreliable, one great fault being that, instead of emptying itself completely by means of a siphon, it frequently happened that a stream of water mixed with air continued to flow. However, by a slight modification, G. Schüler succeeded in overcoming these difficulties, as shown in the accompanying sketch. The siphon consists of a forked tube, one limb of which dips into a little trough, the other having free access to the water in the vessel to be emptied. When the water has fallen to the line *c d*, the level of the water will sink more rapidly in the little trough than in the large vessel, until reaching *a b*, the vessel empties itself without any emulsion of air with water. The diameter of the siphon should be about 13 mm.; should, however, only 1,600 kilos. of salt be decomposed, then 7 mm. would be sufficient. The time taken for the vessel to fill of course depends on the feed-water; for simplicity' sake, all vessels are made of such a size that they are filled in 80 seconds. The siphon is with advantage connected with a water distributor and Seybel's bell arrangement, whereby it may be controlled from below, without there being any necessity for ascending the tower.





—J. R.

*Condensation of Hydrochloric Acid by means of the Lunge-Rohrmann Tower.* George Lasche. Zeits. ang. Chem. 1895, [13], 374—376.

In Zeits. ang. Chem. **20**, 1894, page 610, a Lunge tower was described containing perforated plates, the holes being 12, 7, and 6 mm. diameter. In the present case, only those plates with 7 and 6 mm. holes were utilised, 30 of each kind being placed in the tower, those of 6 mm. at the top, the interstices between the plates being filled with flints. The diameter of the perforated plates was about 808 mm., and the distance between about 19 mm. When at work a good deal of hydrochloric acid passed through uncondensed; however, a yield of 169·3 per cent. of hydrochloric acid on the salt used, was obtained of 19·9° B. at 18°, or 20·1° B. at 15°. As it was not the intention to increase the perforated plates to obtain better yields, a column of coke was substituted at the top of the tower, eight plates being removed for this purpose. The yield consequently improved to about 183—184 per cent. of hydrochloric acid at 20° B. on the salt used, with a daily decomposition of 4,250 kilos. salt.

The writer is of opinion that the tower described is capable of condensing all the hydrochloric acid—in fact, that its capabilities can hardly be called into question, only it becomes necessary to insert the coke column when there is a strong draught. It is possible that by using a plus pressure salt-cake furnace it might be possible to do away with the coke column without affecting the yield. An effective condensation might even be obtained without the coke column on account of the absence of the hollow space between the plates, which in this case is filled with flint.

—J. R.

*Cost of Working an Electrolytic Plant for Manufacturing Alkali and Chlorine.* C. Häussermann. Dinglers' Polyt. J. **296**, 189—191.

The various items of the expense of working an electrolytic caustic soda plant (this Journal, 1892, 963) are in many cases incomplete, and the author is of opinion that the following details may be of interest, although it must be observed that the figures given in the paper are not the results of actual factory workings, most of the information being taken from Lunge's "*Handbuch der Soda Industrie*" and from other publications. It is supposed that a daily output of 5,000 kilos. of 96 per cent. caustic soda, and the corresponding amount of bleach, is required to be produced by electrolysing brine. No allowance is made for the hydrogen, and if, as is believed to be the case at the present time, potassium chloride is electrolysed, the yield of potash to that of soda is greater in the proportion of 5:7. The motive power being steam, the factory is supposed to run continuously for a year of 350 days. The various expenses are classed under the following headings:—1. Power. 2. Salt. 3. Coal. 4. Lime. 5. Packing. 6. Labour. 7. Repairs. 8. Depreciation. 1. *Power.*—One ampère, of which 80 per cent. is available, gives 1·19 grm. of caustic soda and 1·05 grm. of chlorine in 1 hour, or 28·56 grms. of caustic soda and 25·2 grms. of chlorine in 24 hours. Hence, in order to produce 1 kilo. of caustic soda in 24 hours, a current of 35 ampères must be employed. The resistance in the cells requires a difference of potential of 3·5 volts, and the total current required is 3·5 × 35 = 122·5 V.A. Thus, for the production of 5,000 kilos. of caustic soda, $5{,}000 \times 122{\cdot}5 = 612{\cdot}5$ kilo-watt-days $= \frac{612{,}500}{736} = 832$ electrical horse-power are required every 24 hours. Neglecting a small proportion of chlorate formed, the amount of chlorine produced is 0·0252 × 35 × 5,000 = 4,410 kilos., which, allowing for losses, gives about 125,000 kilos. of 33 per cent. bleaching powder. Assuming 1 electrical horse-power = 1·1 mechanical horse-power, the power required is 915 horse-power, to which another 85 horse-power must be added for other machinery, such as water, vacuum, and brine pumps, cranes, centrifugal machines, and lighting. Thus the necessary power for a 24 hours' run amounts to 1,000 horse-power (24 horse-power-hours give 5 kilos. of caustic soda). Since a steam engine of modern type requires 0·8 kilo. of coal per horse-power-hour, the coal consumed is 0·8 × 24 × 1,000 = 19,200 kilos., which at M. 1·20 per 100 kilos. amounts to M. 230·4. Calculating that the expense of converting mechanical into electrical energy is equal to the cost of the coal consumed, the total sum charged to power is 230·4 + 230·4 = M. 460·8. No estimate is made as to how much of this item might be saved by using water power. 2. *Salt.*—Theoretically 100 kilos. of caustic soda require 146·2 kilos. of salt or allowing 10 per cent. for unconverted sodium chloride and insoluble matter, &c. 160 kilos., *i.e.*, 5,000 kilos. would require 8,000 kilos. of salt, which at M. 1·50 per 100 kilos. amounts to M. 120. 3. *Coal.*—The figures relating to the coal required for evaporating and fusing the soda are taken from Lunge's work, vacuum pans being employed for concentrating the lye to a sp. gr. of 1·45. The lye coming from the cells contains about 80 grms. of caustic soda per litre and as 1 kilo. of coal will evaporate 20 kilos. of water, the 50 cub. m. which have to be boiled off will require 2,500 kilos. of coal costing M. 30. Each ton of caustic soda requires for fusing, 1 ton of coal and 5,000 kilos. require 5,000 kilos. of coal at a cost of M. 60. 4. *Lime.*—100 kilos. of bleach require 60 kilos. of lime or 12,500 kilos. require 7,500 kilos. which at M. 1·50 per 100 kilos. would cost M. 112·5. 5. *Packing.*—According to Lunge, the packing of 1,000 kilos. of caustic soda in iron drums costs M. 16, but this sum can be reduced to M. 12, especially if the drums be made on the factory. Hence the daily expenditure under this item is M. 60. The packing for 1,000 kilos. of bleach costs M. 17 (Lunge, page 831) and hence M. 212·50 for 12,500 kilos. 6. *Labour.*—The labour on 100 kilos. of caustic soda from ammonia soda amounts to M. 0·90. With this assumption, the labour for evaporating, fusing and packing the day's production, amounts to M. 45. The labour on the bleach is reckoned at M. 0·50 per 100 kilos. and equals M. 62·50. It is also assumed that an additional 25 men, including foremen, will be required at an average wage of M. 3·75. 7. *Repairs.*—This item, including renewals of the anodes and diaphragms is taken at M. 1 per 100 kilos. of manufactured material amounting in this case to M. 175. 8. *Depreciation.*—The factory buildings excluding dwelling houses consist of offices, boiler, and engine house with shaft, sheds for the electrolytic cells, concentrating and fusing sheds, bleach house, stores, smith's shop, workmen's baths, and well, &c. Assuming that the buildings cover a space of 12,000 sq. m., and that the cost of building is on an average M. 30 per sq. m., the whole cost amounts to M. 360,000, in addition to which M. 40,000 must be added for well, chimney shaft, and boundary wall. A 5 per cent. depreciation on M. 400,000 amounts to M. 20,000 a year or M. 57·15 per day. The machinery having already been credited with a 10 per cent. depreciation it only remains to consider that on the rest of the plant. Little being known as to the construction and wear and tear of the apparatus, the author assumes that M. 600,000 represents its value. The 10 per cent. depreciation on this sum amounts to M. 60,000 a year or M. 171·42 per day, and hence the total amount under this item is M. 228·57. Adding all these sums together, the cost of producing daily 5,000 kilos. of caustic soda and 12,500 kilos. of bleach amounts to :—(1) Power = 460·80 ; (2) Salt = 120·00 ; (3) Coal = 90·00 ; (4) Lime = 112·50 ; (5) Packing = 272·50 ; (6) Labour = 201·25 ; (7) Repairs = 175·00 ; (8) Depreciation = 228·57 = Total, 1660·62. In addition to this are the general expenses, reserve fund, carriage, insurance, sick fund, rates and taxes, &c., which ought to be taken at 25 per cent. or more of the cost of production.—T. A. L.

*Estimation of Fuming Sulphuric Acid.* G. Lunge. Zeits. ang. Chem. 1895, 221.

*See under* XXIII., *page* 821.

## PATENTS.

*Improvement in the Manufacture of Soda Crystals or Washing Soda.* C. P. Peak, J. Peak, and H. Peak, Pemberton, and A. G. Haddock, Wigan. Eng. Pat. 14,894, August 3, 1894.

Washing soda crystals of blue or other colour are formed by adding a suitable colouring agent to the alkaline liquor before crystals begin to form. Methylene blue B, in the proportion of about one part to 4,000 parts of the soda liquor, is preferably used to impart a blue colour to the crystals, this coloration serving to neutralise the natural or acquired yellow tinge of linen or other fabrics.—E. S.

*Method of Producing Solid Persulphate of Sodium.* R. Loewenherz, Amsterdam. Eng. Pat. 16,014, August 22, 1894.

Solid ammonium persulphate is added to a concentrated solution of sodium hydroxide, when sodium persulphate is formed and ammonia evolved, according to the following equation :—

$$(NH_4)_2S_2O_8 + 2HNaO = Na_2S_2O_8 + 2NH_3 + 2H_2O.$$

The salt may be caused to crystallise, either by adding alcohol, or by evaporation at a rather low temperature, or by exposure in a vacuum.

The sodium persulphate may also be formed by placing sodium sulphate solution in a porous pot, set in a vessel containing sulphuric acid, and connecting the latter to the negative pole of a source of electricity, and the former to the positive pole. Any excess of sulphuric acid passing into the inner vessel is neutralised by addition of solid sodium carbonate.

Sodium persulphate is recommended to be used for bleaching and titrating purposes, and also as an antiseptic and in medicine. The salt is decomposed by water as follows : $Na_2S_2O_8 + H_2O = Na_2SO_4 + H_2SO_4 + O$ (in nascent state).—E. S.

*Process and Apparatus for Obtaining Magnesium Manganite and Hydrochloric Acid from the Double Chloride of Manganese and Magnesium, or for Utilising Certain Residual Liquors Produced in the Manufacture of Chlorine.* E. Buckse, St. Petersburg, Russia. Eng. Pat. 16,320, August 27, 1894.

The acid manganese liquors obtained in the manufacture of chlorine from manganese peroxide and hydrochloric acid, are neutralised with magnesia in such manner that there may be about 0·8 equivalent of $MgCl_2$ to 1 equivalent of $MnCl_2$. The neutralised liquor is concentrated until hydrochloric acid begins to be evolved, in lead or iron pans, and the mass is further dehydrated in a reverberatory furnace or in muffles. The porous lumps formed, still retain 25 to 30 per cent of water. These lumps are charged into a set of vertical shafts, built of fireproof bricks, kept at a red heat by fire-gases led through side-flues, and supplied with air and superheated steam at the top, the steam generator being set near the top between four shafts. Exit for the hydrochloric acid gas is provided at the bottom, whence it is taken to ordinary condensing plant, and is stated to give an average strength of 18° B. The $MnO_2MgO$ remaining after the oxidation is discharged from the base of the shafts in lumps, which crumble easily, and dissolve readily in hydrochloric acid without leaving any residue. The decomposition of the $MnCl_2MgCl_2$ is effected according to the equation,—

$$MnCl_2MgCl_2 + 2H_2O + O = MnO_2MgO + 4HCl.$$

The compound of manganese and magnesium oxides is either placed in the chlorine generators dry, and the acid added, no extraneous heat being needed ; or it is made into a mud with the generator liquid (as in the Weldon process) and filled into generators previously charged with the acid. After production of chlorine, the liquors obtained of $MnCl_2MgCl_2$ are again treated as described, so that the process is continuous.—E. S.

*A New or Improved Method for Oxidising the Protosalts of Iron to the Persalts.* N. McCulloch, Glasgow. Eng. Pat. 17,112, September 8, 1894.

An acid solution of the ferrous salt to be oxidised, is placed together with nitric oxide, or its equivalent in nitrogen peroxide, in the proportion of about two and one-third parts per one hundred parts of iron to be oxidised, in a cylindrical wooden vessel, closed at both ends with wooden lids, and provided with a revolving agitator with wooden vanes. As the oxidation is effected by the oxygen of the air, for which the nitrogen oxide acts as a carrier, as it successively yields up oxygen to the ferrous salt and is itself re-oxidised by the air, it is necessary to supply a sufficiency of air to the apparatus. For this purpose, air holes in the ends and sides of the cylinder are provided, which are opened as required. When the solution changes in colour from a dark chocolate to a reddish yellow, the oxidation of the iron is considered complete.—E. S.

*Improvements relating to the Manufacture of Cyanides and to Apparatus therefor.* J. Pfleger, Kaiserslautern, Germany. Eng. Pat. 18,519, September 29, 1894.

In the manufacture of cyanides from carbon, alkali, and atmospheric nitrogen, the reacting material is spread in thin layers on flat-bottomed covered chambers, heated exteriorly from below, and with such space between the material and the cover of the chamber as to admit only so much air as is required for local combustion in the reaction material. By "alkali" is understood oxides or carbonates of potassium, sodium, calcium, or barium, separately or mixed. An oxidising agent, such as sodium or potassium nitrate, may be added to the reaction material. The interiors of the chambers are lined with magnesia, moulded into suitable form and burnt. The present process is stated to differ essentially from previous processes of like nature, in respect to intermingling air intimately with the reacting material whilst ignited, instead of heating the material in air more or less deprived of oxygen ; and it is further stated that about three hours suffice for formation of the cyanide, as against 8 to 10 hours, when the heating is conducted in a current of nitrogen free from oxygen, whilst the temperature required for the reaction by the present process is lower. The yield is described as being 95 to 98 per cent. of the theoretical amount.—E. S.

*Improved Apparatus for Concentrating and Distilling Sulphuric Acid and other Liquids of High Boiling Point.* G. Krell, Hüsten, Germany. Eng. Pat. 18,727, October 3, 1894.

The concentrating and distilling apparatus consists of a tube, closed at both ends to half its diameter, set horizontally in a bath of molten lead. Sulphuric acid is run from a reservoir set on the cover, to the bath (being thus warmed) by a siphon and inlet funnel, at such a rate as to keep the tube half-full, as provided for by the end partitions. A pipe, entering horizontally at the end of the tube opposite the inlet, and bent downwards at its extremity, takes off the concentrated acid. Condensing apparatus is connected, one to the inlet and the other to the exit end of the tube, to collect respectively the very weak and the stronger acid distilled. The tube may be made of "platinum, gold, cast-iron, or even wrought-iron lined with platinum or gold."

The tube may be of any suitable shape, corrugated, sinuous or the like, but should be such that the rear and front may be easily reversed, to secure an even wearing away of the metal. The invention applies to the concentration or fractionation of other liquids of high boiling point besides sulphuric acid.—E. S.

*Improvements in the Process of Evaporating Silicate of Soda Solutions.* J. J. Crosfield and K. E. Markel, Warrington. Eng. Pat. 18,998, October 6, 1894.

Alkaline and neutral sodium silicates, having respectively the approximate formula, $Na_2Si_2O_5$ and $Na_2Si_3O_7$, when their solutions are boiled in open vessels, are found to form a surface skin, hindering further concentration, when a strength of about 100° Tw. in the case of the alkaline silicate, and of about 145° Tw. for the neutral silicate, is attained. The inventors evaporate the solution in a vacuum instead of in open vessels, whereby, according to one of the claims, a solution may be obtained of 170°—180° Tw., or so as to become solid on cooling. Also, owing to the lower temperature at which the evaporation is conducted in a vacuum, the formation of dehydrated silica, giving a cloudy appearance to the finished material, is prevented.—E. S.

*Improvements in or relating to the Manufacture of Sulphuric Acid.* N. P. Pratt, Atlanta, U.S.A. Eng. Pat. 4856, March 7, 1895.

The apparatus includes ordinary sulphuric acid plant, as furnaces for generating sulphurous acid, a nitre-oven, Gay-Lussac and Glover towers, and acid- and cooling-chambers, and there are added contrivances to accelerate draught, to produce to-and-fro currents, to utilise all nitro-sulphuric acid, and to promote the necessary reactions.

The acid chamber is provided at its front end with a casing in which a fan or blower is mounted, and two pipes lead from the fan-casing to the upper part of condensers, which have flues or pipes near the bottom, opening into the chamber. The condensers are packed with acid-resisting material, affording spaces for draught and condensation, and are sprayed by a suitable device at the top, either with water or with dilute sulphuric acid from the cooling chamber, near which, and thus at the rear end of the acid chamber, they are placed. An escape pipe allows passage of the condensed sulphuric acid to the chamber-pan. Two condensers are shown; but any convenient number may be employed. A flue passes from the top of the Glover tower into the acid chamber at a point above the fan, and one or more steam jets supply the water for hydration. A flue connects the farther side of the cooling chamber to the Glover tower to establish circulation, there being a valved opening near the top of the inner side of the chamber into the acid chamber. Below the acid chamber are two tanks, each connected to an acid egg, and these to an air compressor. One of these tanks receives the nitrous vitriol running from the pan of the Gay-Lussac tower, whence it passes into its connected acid egg, and is forced thence to the Glover tower to be showered down there. From this tower the acid passes into the second tank and acid egg, to be forced to the tank over the Gay-Lussac tower, circulation through the two towers being thus maintained. The acid chamber may be provided with a number of comminuting and condensing columns, for additional mixing of the acid-producing materials. A steam injector may replace the draught-producing fan, and two or more fans or injectors may be used.—E. S.

*Improvements in the Manufacture and Production of Polysulphides of Potassium and Sodium.* B. von Schenk, Heidelberg, Germany. Eng. Pat. 11,786, June 17, 1895.

Potassium or sodium polysulphide, free from monosulphide, is obtained by mixing solutions of calcium polysulphide and an alkali metal sulphate or carbonate, the reaction being expressed by one or other of the following equations:—

$$CaS_5 + Na_2SO_4 = CaSO_4 + Na_2S_5$$

$$CaS_5 + Na_2CO_3 = CaCO_3 + Na_2S_5.$$

Calcium polysulphide is obtained by boiling an intimate and finely-sifted mixture of three parts sulphur and two parts of calcium hydroxide with a prescribed proportion of water, diluting the lye obtained, and decanting after a certain time. The cleared lye is then stirred with the proper proportion of the required alkali salt, and the decanted liquid is evaporated to dryness. The product is termed "polysulphine," and is applicable to washing and scouring purposes.—E. S.

## VIII.—GLASS, POTTERY, ENAMELS.

*The Bottle Manufacture, a Subsidiary Industry in connection with Iron Works.* E. Jensch. Zeits. ang. Chem. 1895, 222.

Attention is drawn to the immense quantity of material and the large amount of heat lost with the slag of the blast furnace, and it is pointed out that this slag consists of various silicates of calcium, together with the other constituents usually present in molten bottle-glass. A means is thus indicated not only of using up a large quantity of the slag, but also of realising the greater part of its contained heat, and of minimising the cost of the fuel, which, in the glass industry, bears such a disproportionate ratio to that of the raw materials.

Where possible, it is recommended that the still molten slag should be run directly into the glass furnace, or, where this cannot be done, it should be emptied immediately from the slag wagons into the furnace, and there melted with sand and alkali to form glass.

The following considerations show the advisability of combining the two industries:—G. Westmann has shown that to obtain 1 kilo. of glass from its constituents, sand, calcium carbonate, and sodium sulphate, 611 heat units are necessary, whilst Akermann, from an investigation of 78 slags, has found that 1 kilo. of slag, at the moment it leaves the furnace, contains 400 heat units. 1 kilo. of this slag will yield, on admixture with the necessary sand and alkali, 1·34 kilo. glass, a quantity which in the ordinary way requires for its formation 819 calories (611 × 1·34). Assuming the slag goes into the glass furnace at its maximum temperature, it will provide, from its contained heat, 400 of these units, thus reducing the heat value to be derived from the fuel external to the furnace to 419 units. This means a saving in the fuel alone of 48 per cent. $\left(\frac{400 \times 100}{819}\right)$, or 5,000 tons of coal in a works producing eight million bottles per annum. The above values represent the heat necessary to induce chemical action; the heat necessary to compensate for loss by radiation and to maintain the furnace at the temperature of reaction, is neglected in the calculations, but it has been assumed to have the same value whether the glass is formed from slag or in the ordinary manner.

The author further points out that the formation of slag heaps will be avoided, and the purchase of limestone will no longer be necessary. The sand dust, more or less coloured, settling out in the flues of the blast furnace, will serve in part for the silica necessary in the manufacture of glass, whilst, in addition to this, the slag itself forms the cheapest possible source of the required alkali. It contains on the average 1 per cent. of potash and soda, sometimes as much as 3 per cent., whilst that present in most bottle glasses ranges from 4 to 6 per cent.; a saving of 11 to 18 per cent. is thus effected in the dearest constituent of the glass. The author points out various considerations arising from the varying composition of slags, and the modes of making and adapting these to the requirements of glass-making.—J. T. C.

### PATENT.

*Improvements in the Manufacture of Decorated Fictile Ware.* The Worcester Royal Porcelain Co., Ltd., W. M. Binns, and G. H. Hancock, Worcester. Eng. Pat. 18,397, September 28, 1894.

The ware is given a preliminary firing, and the metallic substance chosen for the production of a given colour is then applied in the form of a solution of one of its salts; the ware is dried and re-heated to develop the desired colour. The essential difference from the ordinary process consists in the use of the metal in the form of a solution of one of its salts instead of as a solid pigment.—B. B.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### PATENTS.

*Improvements relating to the Manufacture of Artificial Stone and the like.* A. Muirhead and G. Hackford, London. Eng. Pat. 14,934, August 3, 1894.

Powdered sand, flint, or other siliceous material is mixed with silicate of soda, fired, mixed with more silicate of soda and silicate of alumina (kaolin). The mass is then moulded and fired to form a product which is more refractory the more alumina it contains. Powdered mica and other silicates may be substituted for the kaolin.—B. B.

*An Improved Composition, forming a Substitute for Stone, Marble, Plaster, and the like.* F. H. Lenders, London. From C. Bertin, Brussels, Belgium. Eng. Pat. 17,208, September 10, 1894.

Calcined magnesia is mixed with a solution (of about 40 per cent. strength) of magnesium chloride, containing about 2 per cent. of aluminium sulphate. Sand, powdered glass, white lead, barium sulphate, and other mineral substances, as well as colouring materials of various kinds, may be added. The composition is moulded to form artificial stone articles, and it may also be used to face wood or other structural materials.—B. B.

*Improvements in the Manufacture of Red Bricks, Terra-cotta Tiles, and similar Goods.* J. Ryder and Sons, Ltd., and J. Ryder, Manchester. Eng. Pat. 17,947, September 21, 1894.

Red clay goods are said to be produced from common clay by adding to 8 or 9 lb. of the raw material, about 1 oz. of barium carbonate and burning in the usual way.—B. B.

*An Improved Composition for Roads, Pavements, and Floors.* G. S. Cory, Swansea. Eng. Pat. 18,210, September 25, 1894.

Asphalte, cement, gravel, sand, stone chips, clinker, and the like, suitable for forming the body of a pavement, are mixed with 3 to 6 per cent. of waste india-rubber or gutta-percha in small pieces. The product may be spread as needed or moulded into blocks and slabs. Mixtures containing sawdust or waste fibrous matter may also be used. —B. B.

*Improved Asphalte for filling the Joints of Setts and Paving, so as to prevent it melting with the Heat of the Sun and not to be Brittle in Winter.* J. Wetherill, Batley. Eng. Pat. 9024, May 7, 1895.

One ton of pitch is melted and mixed with 20 gals. of creosote oil, or 40 gals. of coal-tar, and 4 cwt. of finely-sifted freshly-slaked lime are stirred in. The proportions may be varied.—B. B.

*Improvements in Apparatus for Treating Cement-making Materials.* J. F. de Navarro, New York, U.S.A. Eng. Pat. 10,741, May 30, 1895.

The apparatus consists of an inclined revolving cylinder set over a grate and closed at each end by caps terminating in stuffing-boxes. The material to be heated is fed in at the upper end of the cylinder through a hopper having an appropriate valve to control the feed, and passes out at the other by a shoot also fitted with a valve. The treated material is removed by means of a conveyer. The gases given off during the passage of the material through the cylinder, pass away through a hollow perforated shaft which forms the axis of the cylinder, being sucked out by a fan and forced through a purifier into a gas holder. To favour the even heating of the material in the cylinder, the latter is provided with internal longitudinal ribs so arranged as to turn over and move onwards systematically, the charge of material passing through the cylinder. The primary object of the apparatus in the case of cement-making, is the collection of the carbonic acid given off, the final calcination for the production of clinker being conducted in ordinary kilns. —B. B.

## X.—METALLURGY.

*Reactions of Lead Sulphide.* A. Lodin. Comptes rend. 1895, **120**, 1164—1167.

The author describes experiments with reference to the reactions involved in the metallurgy of lead. (See also this Journal, 1894, 639 and 812). The following are the conclusions at which he arrives :—

1. Sulphide of lead fuses only at 935°, but its vapour tension is considerable at temperatures much below this.

2. This last property is sufficient to explain the volatility attributed by Hannay to the hypothetical compound $PbS_2O_2$, and also the fact that lead sulphide reacts with lead oxide and with lead sulphate at temperatures below 935°.

3. The equations which have been long accepted in explanation of the reactions in question are found to be verified at these temperatures.—A. K. M.

*Metallic Alloys forming definite Compounds.* H. Le Chatelier. Comptes rend. 1895, **120**, 835—837.

The general method employed is to fuse together the two metals, using an excess of that metal which can afterwards most easily be dissolved out (*e.g.* by acids). The fused mass is then treated with a suitable reagent. The following alloys of copper are described :—(1.) *Tin-copper*, $SnCu_3$; white crystalline plates left after treating the fused mass with cold concentrated hydrochloric acid, which does not attack them. (2.) *Zinc-copper*, $Zn_2Cu$; white crystalline needles. (3.) *Aluminium-copper*, $AlCu$; white crystals. An alloy of chromium and zinc, containing 7 per cent. of metallic chromium is also described.

These metallic compounds, like the phosphides, sulphides and carbides, are hard, and do not exhibit any of the malleability of their constituent metals. This explains the hardness of the alloys which are obtained by the union of metals as soft as copper, with tin, zinc, and aluminium.—D. E. J.

*Copper and Azurite Mines near Wallerfangen in the District of Saarlouis.* E. Jensch. Zeits. ang. Chem. 1895, [10], 292.

The azurite (kupferlasur), the hydrated carbonate of copper, occurs in the Bunter Sandstein—a formation analogous to the Permian — as the cementing medium binding the sand together; sometimes also in aggregations or as the petrifactive material in numerous vegetable remains. From inscriptions on the rock and from actual workings discovered, it is evident that the ore was known to and worked by the Romans and their successors, and it is supposed the copper was extracted on the spot by smelting. It would also appear that copper ore was mined here during the Middle Ages. The "Vieille Montagne" Company obtained the mining rights in 1855, and at first shipped the ore to Linz, but as the percentage of copper, amounting to 19 per cent. at the outset, decreased, works were erected at the foot of the Limberg, wherein the finely-ground ore was extracted with hydrochloric acid and the copper precipitated from solution by scrap iron, but the diminishing richness of the ore, accompanied by an unusual increase in the cost of acid, led to the abandonment of the undertaking after a few years.—C. S.

*Action of Mineral Lubricating Oils on Metals.* S. Aisinman. Zeits. ang. Chem. 1895, [11], 313.

*See under* XII., *page* 811.

*Analysis of Tin-Plate.* G. Lunge and E. Marmier. Zeits. ang. Chem. 1895, 429.

*See under* XXIII., *page* 822.

*Method of Determining Sulphur in Burnt Sulphur Ores.* H. F. Keiler and P. Maas. J. Franklin Inst. 1895, **139**, 286.

*See under* XXIII., *page* 822.

*The Bottle Manufacture, a Subsidiary Industry in connection with Iron Works.* E. Jensch. Zeits. ang. Chem. 1895, 222.

*See under* VIII., *page* 806.

*Determination of Boiling and Fusing Points.* H. Le Chatelier. Comptes rend. **121**, 323.

*See under* XXIII., *page* 821.

## PATENTS.

*Improvements in Ore Roasters.* J. E. L. Barnes, Liverpool. From A. G. Davis, Middlesbrough, Kentucky, U.S.A. Eng. 12,637, June 29, 1894.

A rectangular brick furnace is divided into three longitudinal, narrow, and high compartments, the central one enlarged to form a hopper, to receive the ore above, and provided with an outlet below. The outer compartments are divided horizontally, so as to form two superposed chambers on each side of the central ore chamber, each compartment communicating with that in the centre by narrow ports. One of the upper side chambers is used as a combustion chamber, the products of combustion passing across and through the ore to the opposite side chamber, whence they pass away through a flue provided for the purpose. Into the lower side compartment, diagonally opposite to the combustion chamber, producer-gas is introduced, which filters through the lower portion of the ore, to the corresponding lower side chamber; and thence it may, if desired, be led into the combustion space above. The ore passes by gravity continuously through the central compartment. A furnace, of circular section, on the same principle, may be made by surrounding a central cylindrical cavity with two concentric annular compartments, of which the inner of the two is the re-roasting chamber.—W. G. M.

*Improvements in Extracting Metals.* J. J. Hood, London. Eng. Pat. 14,155, July 23, 1894.

Precious metals are dissolved from their ores by treatment with an alkaline solution of potassium or sodium cyanide, in which is dissolved the salt of a base metal, such as mercury or lead, that is capable, under such circumstances, of exchanging places with the gold. Mercury salts are preferred, an equivalent weight of metallic mercury being deposited for the gold dissolved. The solution may be made up by direct mixture of the ingredients in correct proportions, followed, or not, by evaporation and crystallisation; or by adding the solution of the base metal to the cyanide liquors actually in contact with the gold ore. For the extraction of the gold from the resulting solution, the use of the copper-zinc couple is recommended.—W. G. M.

*Improvements in the Refining of Nickel and Copper Mattes.* A. J. Boult, London. From A. L. Grant and C. G. Richardson, Toronto, Canada. Eng. Pat. 17,974, September 21, 1894.

The finely-crushed matte, having been dead-roasted, is completely reduced by treatment with a reducing gas, using a fairly high temperature towards the end of the operation, to guard against the production of excessively pyrophoric metal. It is then treated with just sufficient sulphuric acid to dissolve all the nickel and iron present; the solution is passed over a further quantity of the reduced powder to remove any trace of dissolved copper by exchange with nickel, and is peroxidised by the aid of chlorine. The cobalt and iron are finally removed by any known process, and the nickel solution then crystallised or otherwise treated for the recovery of the metal.—W. G. M.

*Improvements relating to the Coating or Plating of Aluminium or Alloys thereof with other Metals.* W. H. Legate, Hartford, U.S.A. Eng. Pat. 5789, March 19, 1895.

The aluminium, pure or alloyed, is first immersed for an hour in a pickle containing 3·5 oz. of oil of vitriol and 8 dwt. of boric acid per gallon, then rinsed in water, plunged momentarily into a solution of potash (12° density, by a Tagliabue's "actino - hydrometer") at 100° C., again rinsed in water, and dipped once or twice in a "dark dip," consisting of 4 lb. of sodium nitrate, 2 oz. of hydrochloric acid, and 3·5 dwt. of soot, mixed in a gallon of sulphuric acid, which should be kept at 38° C., and have a density of 50° B. Thus prepared, the metal, after further washing, is coated electrolytically with zinc, in a vat containing 1·5 gal. of *liquor ammoniæ*, 4 lb. of potassium cyanide, 3·5 lb. of zinc chloride, 5 oz. of potassium carbonate, and 8 dwt. of white arsenic to a gallon of water, the density of the bath being 10° actino-hydrometer, and the temperature 38° C. A little more ammonia must be added if the zinc coat be not uniform. A copper deposit is now obtained electrolytically from a solution of 1·5 gal. of *liquor ammoniæ*, 2 lb. of potassium cyanide, 12 oz. of sodium carbonate, 4 oz. of copper chloride, and 5 dwt. of white arsenic in 1 gal. of water; the density and temperature of this solution should be the same as those of the zinc bath. If the copper coating blisters, more cyanide must be used.—W. G. M.

*Improvements in Melting Furnaces.* S. T. and C. H. Wellman, Upland, Delaware, Pa., U.S.A. Eng. Pat. 11,813, June 18, 1895.

The furnace consists of a horizontal cylinder, braced together by hoops, and provided with a toothed segment on its under side (engaging with a horizontal rack), so that it may be rocked forward, and thus rotated about its axis, by means of hydraulic cylinders. In the foundations are regenerators, provided with slag pockets at the end nearest the furnace, the connection between the furnace ports and the flues being either at the base of the furnace, where those for gas and air are separated by an air space to prevent intermingling due to leakage, or at the ends of the cylinder, the upright flues in this case being fixed. The charging door is at one side of the hearth, which is formed in the usual way within the cylinder, and diametrically opposite to it is the tap-hole, which is therefore above the slag-line of the furnace, until the whole is tilted for tapping.—W. G. M.

*An Improved Hematite Slag Manure.* H. P. Pease, Middlesbrough. Eng. Pat. 12,566, June 29, 1895.

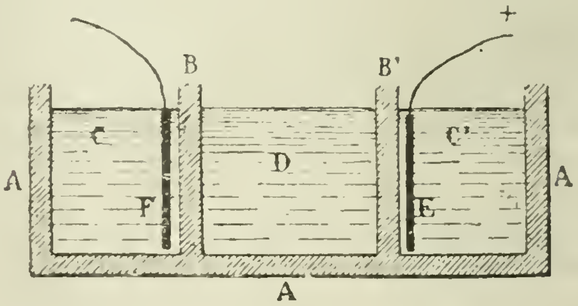
*See under* XV., *page* 815.

# XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

## (*A.*)—ELECTRO CHEMISTRY.

*Indirect Electrolysis.* E. Andréoli. Journ. Franklin Inst. **140** (1895), 153—155.

A chamber A is divided by two porous partitions B and B¹ into two lateral compartments C and C¹, and a central compartment D. All three compartments are filled with an electrolyte, and the lateral compartments C C¹ contain an anode E and a cathode F. Under these conditions electrolysis in C C¹ proceeds as if the central compartment were absent, the solution in this compartment remaining unaffected by the electrolysis. But if a metallic plate be placed in the central compartment, electrolytic action at once begins. The electrolyte need not be the same in the three compartments. Suppose that the lateral compartments C C¹ contain a solution of common salt and the middle one, D, a solution of gold cyanide. On passing a current, electrolytic decomposition takes place, chlorine is liberated at the positive electrode E, caustic soda produced at the negative electrode F, and the cyanide solution is not affected by the migration of the ions. But if a metal plate or, preferably, a number of them be immersed in D, gold will



be deposited upon the plates, although they are not connected with the battery or with the anode or cathode. When a lead plate is used in the central compartment it is found that the surface of the plate which faces the diaphragm of the negative compartment becomes completely peroxidised, while the other side becomes covered with a coating of gold. Such an operation is termed by the author "indirect electrolysis." One example of it, which may possibly find practical application, relates to the decomposition of bisulphite of sodium for the production of nascent hyposulphurous acid for bleaching purposes. By the ordinary electrolytic methods this is impracticable, but, according to the author, it is accomplished by the indirect method with ease and rapidity.—D. E. J.

*Cost of Working an Electrolytic Plant for Manufacturing Alkali and Chlorine.* C. Häussermann. Dingler's Polyt. J. **296**, 189.

*See under* VII., *page* 804.

## PATENTS.

*Improvements in the Purification of Saccharine Juices by Electrolysis.* J. Y. Johnson, London. From E. Javaux, C. F. Gallois, and F. Dupont, Paris, France. Eng. Pat. 14,858, August 2, 1894.

*See under* XVI., *page* 816.

*An Improvement in Secondary Voltaic Batteries.* L. Epstein, Twickenham, England. Eng. Pat. 17,369, September 12, 1894.

The negative plates, which are formed of discs of copper-wire gauze, and which have been amalgamated and coated with zinc electrolytically, are mounted and fixed upon a spindle, so that they can be revolved in order to obviate the unequal action which takes place on electrodes, owing to the difference of density of the electrolyte at different depths. The spindle passes through without touching, or is insulated from the positive plates, which may be of any known kind, preferably of that described in Eng. Pat. 350, 1890 (this Journal, 812, 1890). The positive plates are connected to conductors in the usual way, and the spindle serves as conductor for the negative discs.—G. H. R.

*Improvements in Electrodes, chiefly designed for Use in Electric Accumulators.* W. Schäfer and A. Heinemann, Berlin, Germany. Eng. Pat. 17,566, September 15, 1894.

This improvement consists in the use of plates composed of glycerate of lead, with or without a conducting support, which has been subjected to electrolysis in a bath containing a solution of sulphuric acid of about 16° B., to which has been added some of an alkaline permanganate, such as permanganate of potash or permanganate of soda. The amount of permanganate to be used, depends on the size of the bath, and care should be taken not to introduce too large quantities at once, the addition being made in several successive stages as soon as decoloration occurs. In this manner the glycerin is oxidised and the peroxide of manganese separated out, so that a strong uniform plate of peroxide of manganese is obtained. In the preparation of the glycerate of lead, which is to be employed for the construction of the positive plates, the use of crude glycerin, or of pure glycerin to which has been added butyric acid, hydracrylic acid, lactic acid, or other acids of the series, is recommended; whilst for the negative plates, pure glycerin with an admixture of butyric acid is preferred.—G. H. R.

*New or Improved Process for Electrolysing Chemical Combinations and Winning the Products of Decomposition formed by the Electrolysis.* W. Bein, Berlin, Germany. Eng. Pat. 21,838, November 12, 1894.

This process relates to the electrolysis of solutions, and the separation of the products formed about the electrodes by a non-porous partition or partitions extending through a part or parts of the section of the solution under treatment, the products being separated partly by the electric current and in part by difference of gravity. Various solutions are mentioned for treatment, including alkaline and other salts. —J. C. R.

*Improvements in the Purification of Saccharine Juices by Electrolytic Treatment, and Means employed for that Purpose.* O. Imray, London. From La Société Anonyme Raffinerie Say, Paris, France. Eng. Pat. 7108, April 6, 1895.

*See under* XVI., *page* 816.

*Improvements in the Electrolysis of Metallic Salts.* C. Kellner, Vienna, Austria. Eng. Pat. 7458, April 11, 1895.

The inventor proposes to decompose the amalgam formed when an alkali salt is decomposed with a mercury cathode by joining it up as an anode in a separate tank or tanks arranged in series, battery fashion. This series of cation-separating cells may have a separately-developed current passed through it from a dynamo to start the decomposition. The battery current may be used for external work. —J. C. R.

*Improvements in the Electrodes or Plates of Electric Storage Batteries.* G. Hübener, Gernsbach, Germany. Eng. Pat. 8011, April 23, 1895.

The improved method of constructing plates for electric storage batteries consists in fusing together dinitrobenzene, mononitrobenzene, or bromonitrotoluene, tar, or its derivatives mononitrocellulose, cellulose meal, and metallic oxide or oxides, and casting the fused mixture to the desired form, with or without conducting strips.

The proportions preferred are as follows:—

1 part by weight of crystallised dinitrobenzene;
$\frac{1}{4}$ part by weight, mononitrobenzene or bromonitrotoluene;
1 part by weight, tar or its derivatives;
$\frac{1}{2}$ part by weight, mononitrocellulose; and
$\frac{1}{2}$ part by weight of cellulose meal.

These are mixed together and heated in a steam- or water-bath to about 80°—85° C. until the mixture becomes fluid, when suitable metallic oxides, preferably lead oxide, in the proportion of 1·5 to 1·6 parts are added to 1 part of the mass, and this mixture is further heated until the added oxides have become fluid or dissolved. The melted mixture is cast in moulds of the required shape, wherein it sets to a porcelain-like mass in about 30 seconds after it has cooled to about 50° C.—G. H. R.

*Improvements in Diaphragms for Use in Electrolytical Apparatus.* R. Comboul, Paris, France. Eng. Pat. 9806, May 17, 1895.

The improvement consists in the use of a liquid partition arranged between two or more partitions formed of permeable membranes or sheets of material, such as textile fabrics, felt, vegetable parchment, wood, and the like, which are chosen of unequal degrees of porosity and permeability, so that the interposed layer of liquid is maintained practically constant in height by the combined actions of capillarity and endosmosis. In the case of the electrolysis of chloride solutions, the layer of liquid held between the two membranes consists of water charged with salts, and it is claimed that by this device the life of the membranes is greatly prolonged in spite of the corrosive actions of the chlorine and soda formed.—G. H. R.

*Improvements in Apparatus for Electrolysis of Alkali Salts with Quicksilver as Cathode.* H. C. F. Störmer, Christiania, Norway. Eng. Pat. 10,445, May 27, 1895. Under International Convention, November 26, 1894.

Apparatus is herein described for electrolysing solutions, such as sodium chloride, with a mercury cathode for obtaining amalgams. The mercury is contained in or on horizontal trays or shelves, "gutters," with the anodes between, and with pipe connections from one shelf to another, so that the mercury can be run off at the bottom. These shelves are shaken to keep up a circulation in the mercury, but not such as to break the surface "skin" of the mercury. The amalgam is decomposed in an outside vessel, and the mercury returned to the apparatus.—J. C. R.

*Apparatus for Marking Linen, Paper, and other Fabrics.* C. Beadle, London. Eng. Pat. 10,465, May 27, 1895.

In this Journal, 1894, 1191, a process is described for marking linen, paper, &c. by an electro-chemical method, the fabric being moistened and pressed between a metallic die connected to one terminal of a source of electricity and a metal plate or bolster connected to the other terminal. The object of the improvement is to effect a better marking, which, when the die is of silver, will take place when the direction of the current is changed so that it flows for a short time in one direction and then for a short time in the other direction. The means employed are a small voltaic battery and a reversing switch having its terminals electrically connected to a metal die and to a bolster respectively, the claim being for such a device as that just described.

*Improvements in Apparatus for Electrolysing Chloride Solutions.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 10,929, June 1, 1895.

An anode is claimed consisting of a plate (glass or ebonite, &c.) carrying a network of platinum wires, and an electrolysing cell consisting of a tube of zinc or a pair of zinc plates in combination with an anode as above (see following abstract).—J. C. R.

*Improvements in Apparatus for Electrolysing Chloride Solutions.* E. Hermite, E. J. Paterson, and C. F. Cooper, London. Eng. Pat. 10,930, June 1, 1895.

These improvements relate to developments of the inventors' process (Eng. Pat. 6197 of 1894; this Journal, 1895, 492) for electrolysing sea-water or chloride of sodium for disinfecting purposes. Their present object is the construction of apparatus of a simple and inexpensive kind and automatic regulation. The electrolytic cells are glass tubes. Within each tube is placed a zinc tube for a cathode, and in the centre is placed a wire of platinum, or copper wire coated with platinum, for anode. Each tube is closed by plugs at the top and bottom, and through these plugs pass the ends of bent glass tubes, communicating from the bottom of each cell to the top of the next in order.

These cells are connected in series. The liquid to be electrolysed is fed in at one end of the series and out at the other. The mechanism employed for automatic regulation of solution and electric current is also described. —J. C. R.

*Improvements in the Manufacture of Plates for Secondary Electrical Batteries.* C. H. Weise, Poessneck, Germany. Eng. Pat. 12,420, June 27, 1895.

In a plate constructed according to this invention, the lead oxide is contained within a frame, and between perforated plates or sheets. On one side of the frame is placed a thin sheet of lead or other suitable material. Over this is placed a perforated press-plate, which is secured in the frame by bending up the edges or flanges. The frame is then laid flat with the side plates underneath, and is filled with the soft paste of lead oxide. Similar plates are then placed on the upper side of the frame and are similarly secured. The frame is of lead or of a suitable alloy. After the frame has been filled and closed, pins of cellulose are passed into the perforations of the plates, and are forced through the plates and the contained mass of lead oxide, which is prevented from escaping by the close fit of the plates upon the pins. After formation in dilute sulphuric acid, the plates are dried in the air, when the pins will be found to be completely destroyed, leaving openings for the free passage of the electrolyte.—G. H. R.

### (B.)—ELECTRO METALLURGY.

### PATENTS.

*Improvements in the Manufacture of Aluminium and Aluminium Alloys, and the Electro-Deposition of the Same.* A. F. B. Gomess, London. Eng. Pat. 14,327, July 25, 1894.

In this process, which is an improvement on that described in Eng. Pat. 7205, 1894 (this Journal, 1895, 757), the anode, which consists of aluminium, carbon, or any other suitable material, stands in a solution of the hydrated oxide of aluminium which is contained in a porous cell. This solution is prepared from bauxite. The electrolyte in the bath is composed of the tartrate of aluminium in conjunction with chloride of an alkali, either with or without the addition of iodide or bromide of an alkali. The compositions of baths recommended are as follows:—

1.

| | |
|---|---|
| Tartrate of aluminium | 10 parts. |
| Chloride of an alkaline base | ½ part. |
| Water | 100 parts. |

2.

| | |
|---|---|
| Aluminium-ammonium tartrate | 10 parts. |
| Water | 160 „ |
| Chloride of an alkaline base | 1 part. |

Instead of tartrate of aluminium its isomers may be employed, or the salt derived from other suitable acids containing two carboxyl groups in the molecule.—G. H. R.

*Improvements in Apparatus for the Electrolytical Separation of Precious Metals from their Ores or other Materials containing them.* J. Y. Johnson, London. From L. Pelatin, Paris, France, and F. Clerici, Milan, Italy. Eng. Pat. 11,478, June 12, 1895.

This invention relates specially to the process described in Eng. Pat. 1514, January 22, 1895, and consists in an electrolytic vat constructed to facilitate the reactions required by a particular arrangement of anodes and cathodes, and in the means provided for circulating the liquid during electrolysis. The vat is made of brickwork or the like, the inner walls being coated with cement, and it is preferably raised from the ground. Depressions are formed at the bottom to receive the cathodes, which consist of amalgamated plates of metal resting on mercury. The ends of horizontal shafts rest on bearings fixed in the walls of the vat at a certain uniform distance from the bottom thereof, and support metal cylinders provided with agitators. Between each set of four cylinders are two plates mounted on supports fixed or not in the masonry of the vat. The shafts, the cylinder, and the plates are formed of, or are coated with, an electro-positive metal, such as iron, the two latter being employed as anodes. Means are provided for rotating the shafts and cylinders, which are furnished with agitating arms of wood or other suitable insulating material. In addition to the agitation thus caused, the liquid may be kept in motion by means of a powerful centrifugal pump or its equivalent. The solvent preferably employed is a weak cyanide solution, say, 3 parts cyanide to 1,000 water, and the conductivity of the bath is ensured by the admixture of an alkaline salt, such as chloride of sodium.—G. H. R.

*Electro-Deposition of Gold and Silver.* E. Andreoli, London. Eng. Pat. 11,752, June 17, 1895.

In this process the electrolytic tank may be used without porous partitions, or it may be divided into three compartments by the use of two such partitions. The anodes, which are perforated, are formed of peroxide of lead, and the space between them is filled by perforated plates or gauzes or pieces of wire network of amalgamated copper, or other suitable material, dipping into a thin layer of mercury which rests on the bottom of the tank, and forms the cathode. The electrolyte in the positive compartment may be varied, but preferably consists of caustic potash or soda solution, or it may be the same as that used in the negative compartment, namely, a solution of cyanide of gold.—G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Petroleum Soaps and their Solubility in Petroleum.* Zeits. ang. Chem. 1895, 225.

The question of the solubility of petroleum soaps in petroleum has been a matter of interest to the Baku chemists since 1884, in which year Eichler stated that the acid soaps were soluble, but the neutral insoluble in this reagent. Lissenko and Rosenblatt more recently found that the neutral salts of the petroleum acids could be powdered when dry, and that the acid salts formed a gummy yellowish mass, soluble without decomposition in a small quantity of water, more soluble in ether than the neutral salt, and miscible in all proportions with petroleum, and that concentrated soda solution separated practically the whole of the soap from such a mixture.

By treatment of the neutral sodium salts with chloride of calcium, a neutral lime soap was obtained, and an acid soap was made by the addition of the free acids to this. Rosenblatt further prepared basic salts by using excess of the base, and gave the various solubilities in 1,000 parts of petroleum as follows :—

| —— | Soda Soap. | Lime Soap. |
|---|---|---|
| Neutral............ | 1·53 | 1·15 |
| Acid ............... | Miseible | 1·10 |
| Basic ............... | 0·15 | 0·0 |

The recently observed dissociation of these soaps by Lissenko and Stepanoff has drawn fresh attention to the subject, and Kwitka and Tiedemann, members of a special commission appointed by the Baku chemists, have separately examined the relations of the solubilities and dissociation of these salts. Results by other chemists are also given. These indicate considerable variation, which is considered to prove the variable character of the product.

Kwitka proposes the following method to determine the acids and soaps in any petroleum :—The petroleum is treated with a caustic soda solution of 2° B., by which means the whole of the acids are withdrawn. From this solution the acids are precipitated by hydrochloric acid, causing a milkiness, which varies according to the amount of soaps in the soda solution.

Kwitka always works to a standard turbidity, and the amount of the soda extract necessary to produce this on addition of acid gives a measure of the amount of acids in the investigated oil.

The method gives sufficiently accurate results when the estimation of turbidity is made in the apparatus used in milk examinations.

From the statements of results made in the paper, it seems definitely proved that the petroleum soaps are of very variable composition. Of especial importance, from a practical point of view, is Kwitka's observation that for complete saturation of the acids in any petroleum, the strength of soda solution to be used varies with the percentage of acid present.—J. T. C.

### *Drying and Non-drying Oils.* A. Livache. Comptes rend. 1895, **120**, 842—845.

All fatty substances, when exposed to air, are attacked by oxygen ; and a certain number, especially among the vegetable oils, become transformed into a solid, dry, elastic substance, called by Mulder "linoxyn." Oils which behave thus, *e.g.*, linseed oil, are called drying oils. The author finds that other non-drying oils, such as colza and olive oil, exhibit the same properties when they are kept at a sufficiently high temperature (120°—160 , with or without previous treatment with litharge or borate of manganese). Similar results are obtained with solid animal fats, such as mixtures of stearin and "margarin."

Thus, the distinction between drying and non-drying oils is only admissible on the understanding that the oxidation is only carried on at the ordinary temperature. The author's experiments show that all fatty substances, without exception, whether of vegetable or animal origin, can be transformed into an elastic product similar to that obtained from the so-called drying oils, provided they are exposed to a suitable temperature. The transformation may be slow or rapid, according to the temperature used and the previous treatment to which the oils have been subjected ; but the final product remains solid, even at a high temperature, and in transparency, elasticity, and chemical properties it appears to be identical with linoxyn.—D. E. J.

### *Existence of a Sulphur-Compound in Cotton-Seed Oil.* J. Dupont. Bull. Soc. Chim. 1895, [3], **13**, 696—697.

When a current of steam is passed through cotton-seed oil, a volatile substance is carried over, and can be condensed with the steam, the resulting water being rendered slightly turbid, and having a disagreeable sulphurous odour. Ether extracts a small proportion of malodorous oily matter from the water, and, when this is oxidised with potassium chlorate and nitric acid, it yields sulphuric acid. Five grms. of cotton-seed oil treated in this way with the steam equivalent to 2 litres of condensed water, yielded 0·1523 grm. of barium sulphate, equivalent to 0·021 grm. of sulphur. The oil still showed the Bechi reaction with alcoholic silver nitrate, which the author attributes to the formation of silver sulphide, and not to the reduction of metallic silver by aldehydic compounds, as has been generally supposed. Since cruciferous oils do not show Bechi's reaction, the sulphur of cotton-seed oil is probably in a different condition from that of these oils.—A. G. B.

### *Natural Dihydroxystearic Acid.* P. Juillard. Bull. Soc. Chim. 1895, [3], **13**, 238—240. (See this Journal, 1894, 820.)

To prepare this acid, crude ricinoleic acid is kept at a temperature not exceeding 12°, whereupon a crystalline magma slowly separates, and may be drained on linen, pressed, and recrystallised from alcohol ; the product consists of a mixture of dihydroxystearic acid and stearic acid. The latter is removed by washing with hot toluene, and the dihydroxystearic acid is again crystallised from boiling alcohol ; the yield amounts to about 1 per cent. of the castor oil employed.

*Dihydroxystearic acid* is insoluble in ether, light petroleum, and benzene ; slightly soluble in cold toluene, more so in the hot solvent ; soluble in boiling alcohol and boiling acetic acid. It melts at 141°—143°. It is easily converted into stearic acid by reducing agents, and is a monobasic acid ; the alkali salts are but little soluble, and the barium salt is insoluble both in water and in alcohol ; the methyl salt crystallises in laminæ and melts at 104°—106°. When the acid is heated at 220° for some hours in a current of dry carbon dioxide it yields a product which appears to be formed by the condensation of four molecules of acid with the loss of three molecules of water, and is reconverted into dihydroxystearic acid ; it is probably a polydihydroxystearic acid analogous to the polyricinoleic acid (ricinoricinoleic acid).

Hydrochloric acid at 180° and subsequent saponification converts dihydroxystearic acid into the dibasic acid—

$$COOH(HO)C_{17}H_{33}.O.C_{17}H_{33}(OH)COOH$$

(m.p. 50°—55°), which readily passes into the corresponding monobasic lactonic acid ; this latter is probably the principal product of the action of hydrochloric acid on the dihydroxystearic acid (compare the formation of dibasic diricinoleic acid from ricinoleic acid ; this Journal, 1894, 820).—A. G. B.

### *Action of Mineral Lubricating Oils on Metals.* S. Aisinmann. Zeits. ang. Chem. 1895, [11], 313—315.

The discussion carried on some time ago by Albrecht, Holde, and Künkler on the permissible limit of acid-content in mineral lubricating oils induced Aisinmann to endeavour to obtain by experimental means some definite data to assist in the settlement of this hitherto open question. Referring to the standard allowed by the German State Railways—0·1 to 0·3 per cent. reckoned as $SO_3$—he asserts that this was not set up on any scientific basis, but was simply adopted because out of a number of oils submitted to examination only a few contained more than 0·3 per cent. of acid. In order to arrive at a correct decision on the question, it is necessary to ascertain clearly both the smallest percentage of acid capable of exerting any destructive effect on metals, the influence of temperature on the reaction, and the susceptibility of various metals to attack.

Since the presence of sulphuric acid in mineral lubricating oils indicates careless refining, and is not to be tolerated, it is to the organic (petroleum- or naphthene-) acids that we must look as the cause of any reaction on metal. Accordingly the oil taken for Aisinman's experiments was chosen with a view to having a large percentage of these acids, and was in fact prepared from the soapy compounds precipitated during the alkali treatment in the refining of mineral oils, its characteristics being: specific gravity, 0·9236; viscosity (Engler), 66·4 at 20° and 9·12 at 60°; flashing point, 209°; "cold test," 9 mm. at −15°; acid-content, 0·785, reckoned as $SO_3$.

The results of the series so far completed of the effect of this oil on polished metal plates may be thus summarised:—

*Series I.*—After an exposure of 65 days at a temperature of 20°, none of the metals experimented upon, viz., iron, lead, copper, tombac, brass, and German silver, were in the slightest degree affected, and careful examination of the polished surfaces failed to reveal any corrosion.

*Series II.*—In the case of 21 days' exposure at 50°, lead proved the most susceptible metal, losing 0·013 per cent. by weight; iron following with a loss of 0·012 per cent.; succeeded by copper, 0·009 per cent. Tombac suffered a diminution of 0·001 per cent. in the weight of metal, but neither German silver nor brass was affected, and in no instance was corrosion detected, on examination under a lens, though a slight residue was left behind on filtering the oil from the iron and lead.

*Series III.*—Time, 15 days at 100°. Here iron and lead changed places, the former suffering a loss of 0·034 per cent. and the latter 0·031. Copper lost only 0·007 per cent. (less than in the second series), and the remaining three lost traces "tailing down" to 0·001 per cent. in the case of German silver.

These results agree with those obtained by Redwood (this Journal, 1886, 362) with a 12 months' exposure. Other series of experiments with oil of normal acid-content, at temperatures ranging from 50° to 150°, are in progress, and the results may be looked for at an early date; in the meantime it may be taken for granted that for cold-running machinery the usual limit of 0·3 per cent. of acid may be overstepped without risk.—C. S.

*Solubility of Mineral Oils in Alcohol.* S. Aisinmann. Dingler's Polyt. J. 1895, **297**, 44—47. Compare Riche and Halphen, this Journal, 1895, 313.

The solubility was ascertained at the ordinary temperature, and, in the case of the heavy lubricating oils, in the following manner:—

10 c.c. of the oil were measured into a graduated cylinder and 10 times this volume of alcohol ("96°") added; after thorough agitation the mixture was left at rest until no further increase in the volume of the layer of oil was observed; the alcoholic solution was then decanted and replaced by another similar volume of alcohol, this procedure being repeated until either the oil was completely dissolved or an insoluble residue was left.

In the case of those light oils which are not miscible in all proportions with alcohol, the solvent was added from a burette, care being taken to note what volume had been introduced when the liquid first became turbid; this amount indicated the solubility of alcohol in the oil. The addition was then continued until the turbidity disappeared, which happened when the oil had completely dissolved in the alcohol. The table below gives the results obtained with the light oils, and it will be remarked that the lightest samples, from whatever source, are miscible in all proportions with alcohol. The author considers that it may be stated with tolerable certainty that those hydrocarbons are richest in carbon which dissolve least alcohol and are themselves least soluble in this menstruum.

| Oil. | Specific Gravity. | Source. | Alcohol Dissolved by 1 Volume of Oil. | Volumes of Alcohol required to Dissolve 1 Volume of Oil. | Remarks. |
|---|---|---|---|---|---|
| Benzine (petr. spt.) ....... | 0·720<br>0·710 | Various | Unlimited | Miscible in all proportions | .. .. |
| Petroleum, I*a* ............ | 0·820 | Russian | " | " " | .. .. |
| Solar oil.................... | 0·870 | " | .. | 14·0 | .. .. |
| Petroleum, I*a* ............. | 0·815 | Roumanian | Unlimited | Miscible in all proportions | *Middle or "Herz" fraction* |
| " II*a* ............ | 0·830 | Roumanian (Bustenari) | 50 per cent. | 2·0 | First and third runnings |
| " II*a* ............ | 0·805 | Roumanian | Unlimited | Miscible in all proportions | First runnings, "*Herz*" (*Middle*) *fraction*, and third runnings, mixed. |
| " I*a* .............. | 0·810 | Galician | " | " " | *Middle fraction* |
| " II*a* ............. | .. | " | 10 per cent. | 3·5 | First and third runnings |
| " II*a* ............. | .. | Roumanian | 45 per cent. | 1·5 | " " |
| *Kaiseröl*................... | 0·785 | American | 15 per cent. | 1·0 | .. .. |
| Solar oil ................... | 0·875 | " | .. | 13·0 | .. .. |
| " ................... | 0·885 | Hungarian (Derna) | .. | 5·5 | .. .. |
| Blue oil.................... | 0·890 | Roumanian | .. | 11·0 | .. .. |

In the second table (see next page) is recorded the behaviour of mineral lubricating oils with alcohol. It will be noted that the oils from different sources differ from each other not only in their total solubility, but also in their fractional solubility, and that this difference is born of the chemical constitution of the oils, and is independent of their specific gravity.

The Hungarian oils are the products of a once repeated distillation; they are derived from a bituminous sand which yields 45 per cent. of an oil of sp. gr. 0·930 when distilled under diminished pressure; the fractionation of this oil (likewise under diminished pressure) yields a series of lubricating oils, which, when duly refined, are not second to the best Russian lubricating oils. The high specific gravity of these oils must be taken as implying some chemical peculiarity.

To make sure that the fractional solubility of the oils is due to the presence of different hydrocarbons, a considerable quantity of Russian residue was fractionated in this way, and the fractions recovered by precipitation of the alcoholic solutions by water; the recovered oils plainly showed their dissimilarity when their physical constants were determined.

The author lays much stress on the value of fractionation by alcohol as a substitute for the usual process; the method will yield fractions of a similar nature to those obtained by distillation, with the advantage that they cannot have undergone any change, such as an exposure to a high temperature (frequently 500° C.), may be expected to induce in oils fractionated by heat. The colour of alcohol fractions is better than that of distillation fractions.

Oils containing paraffin-wax may dissolve to a clear solution in alcohol, but after a time needles or laminæ of paraffin will crystallise from the solution, particularly if it be cooled to 0°. Paraffin-wax recrystallised from alcohol is very pure.—A. G. B.

*Melting and Solidifying Points of Certain Acids of the Fatty Series.* G. Massol. Bull. Soc. Chim. 1895, **13**, 758.

*See under* XXIII., *page* 823.

*Detection of Cotton-Seed Oil in American Lards.* J. Dupont. Bull. Soc. Chim. 1895, **13**, 775.

*See under* XXIII., *page* 828.

*Detection of Vegetable Oils in Lard.* F. Jean. Bull. Soc. Chim. 1895, **13**, 780.

*See under* XXIII., *page* 828.

*Examination of Linseed Oil and Linseed-Oil Varnishes.* H. Amsel. Zeits. ang. Chem. 1895, 262.

*See under* XIII. B., *page* 814.

| No. | Oil. | Province. | Physical Properties. | | | | | | Percentage of the Original Volume of Oil dissolved by ten times its Volume of Alcohol (96°). Volumes per cent. | | | | | | | | | Volumes of Alcohol which Dissolve 1 Vol. Oil. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Specific Gravity. | Viscosity at 20° C. | Viscosity at 50° C. | Viscosity at 100° C. | Flashing-Point, ° C. | Cold Test, ° C. | Extraction I. | Extraction II. | Extraction III. | Extraction IV. | Extraction V. | Extraction VI. | Extraction VII. | Extraction VIII. | Extraction IX. | | |
| 1 | Mixed oil | Russian | 0·896 | 4·8 | 2·0 | .. | 150 | −22 | 60 | 30 | 10 | .. | .. | .. | .. | .. | .. | 30 | Refined. |
| 2 | Vaseline oil | | 0·900 | .. | .. | .. | .. | .. | 50 | 40 | 10 | .. | .. | .. | .. | .. | .. | 30 | Colourless. |
| 3 | Machine oil | | 0·907 | 42·0 | 6·2 | .. | 202 | −18 | 25 | 25 | 15 | 15 | 10 | 5 | 5 | .. | .. | 70 | Refined. |
| 4 | Cylinder oil | | 0·902 | .. | .. | 3·0 | 260 | + 4 | 15 | 15 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 90 | Insoluble residue. |
| 5 | Residue | | 0·913 | 47·8 | 7·67 | .. | 174 | −15 | 35 | 35 | 10 | 10 | 5 | 5 | .. | .. | .. | 60 | Unrefined. |
| 6 | Residue with 10 per cent. mixed oil. | | 0·910 | 35·0 | 6·0 | .. | 165 | −18 | 40 | 25 | 15 | 5 | 5 | 5 | .. | .. | .. | 60 | ,,<br>Insoluble residue. |
| 7 | Heavy waggon oil | | 0·920 | .. | 12·8 | 2·17 | 185 | + 5 | 20 | 20 | 10 | 10 | 10 | 10 | 5 | .. | .. | 70 | |
| 8 | Pale oil | American. | 0·885 | .. | .. | .. | .. | .. | 55 | 25 | 20 | .. | .. | .. | .. | .. | .. | 30 | Refined. |
| 9 | ,, | | 0·905 | 12·0 | 3·0 | .. | 200 | .. | 40 | 20 | 20 | 10 | 10 | .. | .. | .. | .. | 50 | ,, |
| 10 | Machine oil | | 0·920 | 28·0 | 5·2 | .. | 220 | .. | 25 | 25 | 15 | 10 | 10 | 5 | 5 | 5 | .. | 80 | ,, |
| 11 | Railway oil | | 0·920 | .. | .. | .. | .. | .. | 25 | 20 | 20 | 10 | 10 | 5 | 5 | 5 | .. | 80 | Unrefined. |
| 12 | Mixed oil | Galician. | 0·890 | 4·2 | .. | .. | 140 | .. | 100 | .. | .. | .. | .. | .. | .. | .. | .. | 12 | Refined. |
| 13 | Light machine oil | | 0·905 | 7·2 | .. | .. | 160 | + 2 | 75 | 25 | .. | .. | .. | .. | .. | .. | .. | 13 | ,, |
| 14 | Heavy ,, ,, | | 0·910 | 9·0 | .. | .. | 165 | + 2 | 75 | 25 | .. | .. | .. | .. | .. | .. | .. | 20 | ,, |
| 15 | Mixed oil | Hungarian. | 0·895 | 2·3 | .. | .. | 135 | .. | 100 | .. | .. | .. | .. | .. | .. | .. | .. | 10 | ,, |
| 16 | Spindle oil | | 0·915 | 8·0 | 2·4 | .. | 150 | .. | 100 | .. | .. | .. | .. | .. | .. | .. | .. | 10 | ,, |
| 17 | Machine oil | | 0·940 | 36·0 | 5·6 | .. | 185 | .. | 80 | 20 | .. | .. | .. | .. | .. | .. | .. | 16 | ,, |
| 18 | Mixed oil | Pechelbronn. | 0·870 | 2·35 | 1·5 | .. | 145 | .. | 70 | 20 | 10 | .. | .. | .. | .. | .. | .. | 30 | ,, |
| 19 | Dark oil | | 0·923 | 192 | 7·7 | .. | 143 | .. | 50 | 50 | .. | .. | .. | .. | .. | .. | .. | 20 | ,, |

*Examination of Fats used in the Leather Industry.* W. Schmitz-Dumont. Dingier's polyt. J., 1895, **296**, 210, 233, and 259.

*See under* XXIII., *page* 829, *and* XIV., *page* 815.

## PATENTS.

*Improvements in Filtering Apparatus.* P. E. Hodgkin, London. Eng. Pat. 16,914, September 5, 1894.

*See under* I., *page* 791.

*Improvements in the Manufacture of Soap and Glycerine.* J. K. Hill, Irvine, Ayrshire. Eng. Pat. 17,860, September 20, 1894.

Instead of using common salt for separating glycerin and impurities during the manufacture of soap, the inventor prefers an excess of caustic soda, or a mixture of caustic soda and sodium carbonate. This lye, after separation from the soap, is then used to saponify more fat, until the excess of alkali in the lye is spent. If any considerable quantity of carbonated alkali be present, lime is added to causticise it. The residual lye contains all the glycerin in a more concentrated form, thus effecting a saving of time, labour, and fuel, and the reduction of wear and tear in the plant in the recovery of glycerin from the lye.—J. J. K.

*Improvements in Machinery for Pressing Soap and other Plastic Substances.* J. Watson and Sons, Leeds. Eng. Pat. 6011, March 22, 1895.

The machine consists of a drum, in the periphery of which are four equally divided recesses or moulds. At every stroke of the machine, one of the moulds, after being fed at the top with soap, is brought into a horizontal position, and whilst in this position a ram or plunger enters the recess, and so presses the soap into the desired shape. The movements of the ram and cylinder are intermittent, being worked with cams or levers. The movable base in the recess is so arranged and worked by cams as to force the tablet out when in the bottom position, the tablet falling out on to a travelling band. During a complete movement of the machine, two brushes are brought into position to clean the ram or plunger and the base of the mould. It is driven by belt, and is geared up about three to one.—J. J. K.

*Improvements in Refining and Separating Wool-fat into Sundry Constituent Parts.* E. Maertens, Providence, State of Rhode Island, U.S.A. Eng. Pat. 9503, May 14, 1895.

The object of this invention is to separate wool-fat into three primary and two intermediate products, having different properties, by means of acetone and alcohol. Two methods are described, viz., the acetone-alcohol process and the alcohol-acetone process.

In the acetone-alcohol process three primary products, termed No. 4, No. 1, and No. 3, are obtained. The wool-fat is digested with cold acetone (or hot acetone, the solution being afterwards cooled) until the solution is saturated with a product called No. 5. It is decanted into a still, and the acetone distilled off, leaving the No. 5 product as a residuum, which is then digested with cold alcohol, the resulting solution decanted, and the alcohol distilled off, leaving a product No. 1; the insoluble portion, after being freed from alcohol by distillation, constitutes the product No. 3. The No. 4 product is the residue left after the extraction of No. 5 product.

The alcohol-acetone process consists in mixing alcohol with wool-fat, the solution containing No. 1 product; the remaining substance, No. 2 product (which is a mixture of No. 3 and No. 4 products), after being freed from alcohol, is incorporated with cold acetone. The soluble portion contains No. 3 product, and the insoluble residue is No. 4 product.

No. 4 product is an opaque, solid, and inodorous waxy fatty matter, of a whitish or yellowish-white colour, and consists of a mixture of ethers or fats of cholesterin, insoluble or but slightly soluble in cold or hot alcohol and cold acetone, but quite soluble in 30 times its volume of boiling acetone.

No. 1 product is a transparent fluid or semi-fluid of a yellowish-red colour, inodorous, and soluble in cold acetone and cold alcohol. It is composed of free fatty acids, fatty ethers, and resinous gummy matters; when this product is dissolved in 76° B. naphtha, the resinous matter precipitates on standing.

No. 3 product is an oily, opaque fluid or semi solid, inodorous, soluble in cold acetone, but insoluble in cold alcohol, and consists of a mixture of ethers of iso-cholesterin, cholesterin, and allied substances.

No. 5 product is an intermediate one, consisting of a mixture of No. 1 and No. 3.

No. 2 product is also an intermediate one, composed of a mixture of No. 4 and No. 3. (See also this Journal, 1892, 928.)—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

### PATENTS.

*Improvements in the Manufacture of Water-Colour Paints.* G. C. Dymond, Liverpool. From L. Auerbach and Co., Fuerth, Bavaria. Eng. Pat. 14,758, August 1, 1894.

The pigments are suspended in a medium consisting of gum arabic and linseed oil, each 2,250 grms., glycerin 960 grms., wax and tallow each 45 grms., soft soap 300 grms., dissolved in 7 litres of water. It is claimed that these paints possess all the advantages of oil colours as regards brilliancy, &c., and that they will keep in good condition much longer than the ordinary albumin distempers.—F. H. L.

*A New or Improved Process for Making Red Oxide of Iron Pigments from Hydrated Peroxide of Iron.* N. McCulloch, Glasgow. Eng. Pat. 17,113, September 8, 1894.

Precipitated ferric hydrate is heated in a closed vessel to a temperature of about 170° C. at a pressure of 250 lb. to the sq. in. until the water is driven off. The resulting pigment is washed and dried. The presence of alumina in the iron should be avoided, as it raises the temperature necessary for complete dehydration.—F. H. L.

*Improvements in Paint.* F. W. Oliver, London. Eng. Pat. 17,747, September 18, 1894.

The vehicle used for this material consists of a solution of "liquid celluloid," which replaces the ordinary oil and turpentine. Glycerin may be employed, if required, to retard the drying.—F. H. L.

*Improvements in the Manufacture of Gold Paint for Interior Gilding and other Purposes.* J. and W. R. Tennant, Aberdeen. Eng. Pat. 8095, April 24, 1895.

A stout varnish is prepared by boiling together 1 gall. of linseed oil, $1\frac{1}{2}$ lb. of litharge, and 2 oz. of lead acetate. After straining, it is "hermetically sealed" and put aside for six months. It is then diluted with 3 quarts of benzene (90 per cent.), and after a week's standing, 1 quart of petroleum spirit is added; 8 lb. of gold bronze per gallon being finally worked in.—F. H. L.

### (*B.*)—RESINS, VARNISHES.

*Examination of Linseed Oil and Linseed Oil Varnishes.* H. Amsel. Zeits. ang. Chem. 1895, 262.

The author upholds his objection to the polariscopic test (this Journal, 1895, 605) on account of it being possible with one only of the many different forms of polariscope and also because this test only allows of the detection of rosin oil but not of mineral oils. Notwithstanding Filsinger's doubts, adulteration of linseed oil with mineral oils and colza oil does occur, and the best means of detecting these oils is not by means of the Koettstorfer test but by the estimation of the drying power. Linseed oil varnishes which have been prepared by means of metallic resinates, instead of by boiling the oil with metallic oxides, have been the cause of frequent complaints and their practical value is therefore still very problematical, so that tests allowing of the discrimination of these two kinds of varnish are of much importance. Filsinger's statement that the cold prepared linseed oil varnishes are as satisfactory in practice as the boiled varnishes, is considered for the present beyond credibility.—C. O. W.

### PATENT.

*Improvements in or appertaining to Seals and Sealing-Wax.* J. B. Beare, London. Eng. Pat. 12,335, June 25, 1895.

The ordinary process of "sealing" letters, &c., provides no security against their contents being tampered with, owing to the ease with which a mould can be taken, and a fresh seal put on after the packet has been opened. The inventor, therefore, in preparing sealing-wax, adds to it some substance which, when a second substance is applied as a test or detector, will strike a distinctive colour, or obliterate the impression, thus indicating whether the original seal has remained intact or not. Among the compounds mentioned as sensitizers are copper sulphate or iron sulphate; the developers or detectors being ammonia and potassium ferrocyanide respectively.

—F. H. L.

### (*C.*)—INDIA-RUBBER, &c.

### PATENTS.

*An Improved Manufacture of Artificial India-Rubber, Gutta Percha, and Leather, suitable for Conversion into Varnish.* A. V. Newton, London. From A. Nobel, Paris. Eng. Pat. 15,914, August 21, 1894.

See Eng. Pat. 20,234, 1893 (this Journal, 1894, 1072). In this specification the inventor adds to the number of substances previously (*loc. cit.*) described as suitable for the "solution" of nitro-cellulose, &c., in the manufacture of a rubber substitute. He claims the use of the chloro and bromo derivatives of nitrobenzene and its homologues; similar compounds of camphor; nitrated rosin oils and resin; the esters of methyl, . . . amyl alcohol with oxalic, lactic, tartaric, citric, succinic, benzoic, hippuric, and other organic acids; and also the glycerin esters of acetic, benzoic, and hippuric acid. When using a solid substance to dilute the nitrocellulose, the mixture is effected by heat, and the inventor gives a number of formulæ for the production of different varieties of the finished product.

—F. H. L.

*An Improved India-Rubber Compound, Applicable to the Prevention and Repair of Punctures in Pneumatic Tyres.* T. Coppock, Manchester. Eng. Pat. 16,299, August 27, 1894.

Four pounds of pure rubber are dissolved in six gallons of benzene, "12 gals." of elemi resin stirred in, and the whole boiled or "burnt" together. The burning may take place on a fine sieve, the mass, as it drops through, being collected under water. Rosin can be used to replace the elemi, 1 gal. of the rubber solution being incorporated with 14 lb. of molten colophony. The finished material is rolled out and cut up into strips.—F. H. L.

## XIV.—TANNING, LEATHER, GLUE, SIZE.

*Progress in the Tanning Industry.* J. Pässler. Dingl. Polyt. J. 1895, **297**, 19—23, 40—44, 66—71, 89—94.

The author considers the subject in sections appropriate to the processes commonly adopted. Concerning the chemistry of hides and skins, their relation to preservatives and the yield of leather to be obtained from them; see this Journal, 1893, 610, 1894, 49. Among the tanning materials mentioned in the paper, attention is called to *cajota-bark* or *taracco-bark* which was at one time imported into Germany from Mexico and California, but has lately disappeared from the market, its tannin is but sparingly soluble, and the material imparts an objectionable red colour to the leather. An exhaustive monograph on canaigre will be found in *Bulletin No. 7 of the Arizona Agricultural Experiment Station* (this Journal, 1893, 650; 1894, 894). The excellency of quebracho-wood in conjunction with pine-bark for sole leather receives comment; the subject has been treated by Von Schroeder (*Deutsch. Gerberzeitung* 1889, No. 74); and import duty greatly retards the application of the wood in Germany. The use of sumach for brightening and softening tanned heavy leather is increasing. With regard to oak-bark it is pointed out that since the content of the bark in tannin undergoes no perceptible change throughout the year, the practice of harvesting the bark before the leaves have appeared is irrational; the young shoots and leaves contain a moderate quantity of tannin and are of value for extract making, they have also a certain feeding value. Acorns are of little service for extract making because of their high content of starch. It has been shown that so long as it is not corky, the bark of an oak and its branches decreases in content of tannin as the tree is ascended. Eitner has found that sumach leaves are richest in tannin in early July and that they suffer depreciation if dried in direct sunlight; this agency destroys tannin in all moist materials, but is without effect in the absence of moisture. Concerning the fermentation of tanning liquors see this Journal, 1894, 650.

Papers concerning the valuation of tanning materials and liquors will be found in this Journal, 1894, 487, 494, 649, 1072, 1101; 1895, 316.

In systematic leaching of tanning materials it is recommended that the nearly exhausted material should be heated with weak liquor or water and that the fresh material should be leached with stronger liquors at a low temperature, in this way destruction of ferments derived from the tan stuff and favourable to the tanning process, will be avoided.

The suggestions which have been made for more rapidly tanning heavy leather are reviewed, and it is pointed out that such rapidity can only be effected at the cost of quality in the finished product. The subject of electrical tanning is summarised by the statement that electricity is probably not without influence on the duration of the tanning process, but the observed influence is so small that the introduction of this agency into the tannery is not warranted, particularly since so much more can be effected by mere agitation.

Dongola leather is partly alum-tanned (*weissgar*) and partly bark-tanned, the latter tannage consisting of a mixture of catechu, myrobalans, valonia, and sumach. Sheep, goat, and calf skins, and split hides are thus treated, the product taking the place of kid, than which it is more resistant to water. "Transparent leather" is made by stretching the stocked skin in a frame and applying a mixture of glycerin, boric acid, salicylic acid, and picric acid, and subsequently a solution of potassium bichromate; it is soft and has a high tensile strength, but is little resistant to moisture.—A. G. B.

*Examination of Fats used in the Leather Industry.* W. Schmitz-Dumont. Dingler's Polyt. J. 1895, **296**, 210—215, 233—239, 259—264.

Wool-fat is chiefly used as an adulterant of dégras and tallow. It possesses great capacity for emulsifying, stability in air, and its fatty acids are of an amorphous character. As regards horse-fat, which is much used, see this Journal, 1893, 51, 164.

Goat and buck tallow also appear in the German market to some extent as "mutton tallow"; their fatty acids are nearly amorphous.

As to the use of refined fish-tallow, see this Journal, 1894, 894.

Fahrion has shown that a product similar to dégras can be made by chamoising with linseed-oil.

Vaseline for leather dressing must be free from mineral acid and should not have a lower specific gravity than 0·909, otherwise it tends to disappear from the grain during storage. A light oil containing dissolved paraffin is not unfrequently substituted for vaseline, but is objectionable.

Fish-oils in leather-dressing is a subject that has been studied by Fahrion (this Journal, 1893, 938, 1064). The higher the iodine absorption of the oil the greater its tendency to form resinous spots on the leather. The analytical constants of a fish oil only reveal its origin when it is fresh. The taste and smell will serve to distinguish between seal-oil, liver oil, and fish-oil (Japan fish-oil); the last-named is characterised by higher specific gravity and fatty acids of higher melting point than are possessed by other fish-oils. Mineral and rosin oils are practically the sole adulterants of the fish-oils; these are easily detected, since the amount of unsaponifiable matter in fish-oils is but small (see this Journal, 1893, 607).

Dégras is a highly inclusive term, but should be more strictly confined to the oily matter expressed from the oil-tanned chamois leather; it is the French moëllon. Sod-oil and various mixtures (artificial dégras) are frequently termed dégras. The peculiar value of dégras as a material for dressing leather is attributed by Fahrion to (1) the emulsifying capacity of the hydroxy fatty acids which it contains, which enables it to be easily taken up by the wet leather; (2) an after-tanning effect of either an oxidised or a polymerised product of the sod-oil, which renders the leather soft; (3) the specific effect of the hydroxy fatty acids or their compounds, whereby the leather becomes soft and full to the touch. The author rejects Simand's view that the dégras-former (hydroxy-acids) combines with the leather (*Der Gerber*, 1890, 266).

A genuine dégras, containing 20 per cent. of water, will have at least 12 per cent. of hydroxy-fatty acids. A good sample should not contain more than 25 per cent. of free acid, calculated as oleic acid on the anhydrous material. Tendency to resinify on the leather is judged by the iodine number, which should not exceed 100 calculated on the anhydrous material. Pure dégras is generally mixed with tallow for use. It is to be noted that in the long table of analyses which the author appends, all the genuine French dégras contain unsaponifiable matter varying from 2 to 40 per cent. For analyses of dégras, see this Journal, 1892, 639.

Among dégras-substitutes "corroïne," a mixture of vaseline and wool-fat emulsified with water, may be noted.
—A. G. B.

*Examination of Fats used in the Leather Industry.* W. Schmitz-Dumont. Dingler's Polyt. J. 1895, **296**, 210, 233, and 259.

*See under* XXIII., *page* 829.

### PATENT.

*Improvements in Machines for Treating Hides and Skins.* A. S. Jones, Wrexham. Eng. Pat. 11,037, June 4, 1895.

Generally, the improvements in the invention described, are in machinery for "fleshing, scudding, or cleansing, striking out or slicking, skiving or frizzing, unhairing or laying out, hides, skins, or leather." More especially, the invention relates to the class of machines in which the knife-wheel provided with spiral knives is rapidly revolved, the skins or hides being fed to it. Hitherto this knife wheel has tended to revolve at a much higher rate of speed than the feed apparatus can keep due pace with, and costly gearing has been used to modify the relative speeds. Rubber bands to act as feed-belts, have also been employed. A machine which may be driven without tooth gearing is now proposed.

## XV.—MANURES, Etc.

### PATENT.

*An Improved Hematite Slag Manure.* H. P. Pease, Middlesbrough. Eng. Pat. 12,566, June 29, 1895.

The slag from blast furnaces producing hematite iron is granulated and mixed with sodium chloride in the proportion of 95 to 5. Such a manure is said to be effective against insects and slugs, to be good for peaty and heavy soils, and (owing to the sodium chloride) to be good for farm crops.—W. G. M.

## XVI.—SUGAR, STARCH, GUM, Etc.

*Congress of the Association of Chemists of the Sugar and Distilling Industries of France, and the Colonies.* Chem. Zeit. 1895, **64**, 1453.

A congress of French chemists interested in these industries, was held in Paris on the 11th and 12th of July, under the presidency of C. Gallois.

On the first day, H. Robert read a paper by Pellet, on "The Unestimated Losses in the Manufacture of Sugar, and the Means of Preventing them." According to this author's views, such losses do not exist, but can be reduced to errors in sample taking and analysis.

Barbet discussed the question of the concentration of potato and grain refuse in the spirit industry; he proposed to concentrate the residual liquors from the spirit distillation by the aid of a multiple-effect apparatus, the vapour from the distillation being employed to concentrate the liquor, and to render it stable and more suitable for transport. Aimé Girard stated that he had made experiments in the same direction with a Sorel column, but Barbet contended that this apparatus necessitated the direct employment of steam, which in his process was not required.

P. Horsin-Déon communicated his researches on "Evaporation in the Sugar Factories."

On the second day, the President read a paper by Macherez on the question of sugar analysis. This subject is to be brought forward next year at the international congress in Paris.

Sidersky stated that, in considering the yield of sugar in the factory, the viscosity of the juices and syrups should be taken into account, for it has been observed that sugar juices of the same purity-quotient and salt-content, give different *rendements*, the reason of this being perhaps due to the varying viscosities of the solutions.

Raoul-Pictet spoke on the subject of distillation and rectification at low temperatures. Chemically pure ether can only be prepared through the medium of low temperatures; this is true also of chloroform and other liquids. The purification of alcohol by these means is thought by the author to be an important discovery. Whether applicable or not to the manufacture of sugar, must be ascertained by further investigation.

Trillat and Woussen consider that the advantages of the use of formaldehyde in the spirit distilling industry are self-evident, inasmuch as fermentation is promoted, and the butyric and lactic ferments are destroyed.

Grobert discussed the means for producing a directly marketable sugar in the works, and, in his experience, Praugeys' method has yielded excellent results.

Barbet and Weissberg reported on the "Rapid Estimation of the purity-quotient in Sugar," and in conclusion, Du Beaufret spoke on the reducing substances of the sugar-cane, and on "Diffusion in the Antilles." In the latter paper, he states the advantages of the baryta process. —J. L. B.

*Investigations on Pectins.* R. W. Tromp de Haas and B. Tollens. Annalen, 1895, **286**, 278.

Recent investigations on the pectins tend to show that they are closely allied to the gums in composition and properties, and thus may be classed with the carbohydrates. The authors have examined the pectins from apples, rhubarb, cherries, greengages, currants, and French turnips, and can state with certainty that these pectins at least are very closely related in composition to the carbohydrates. The considerably smaller proportions of hydrogen shown by former researches are not now confirmed. The pectin from French turnip, and some others to a less extent, showed the relation H:O = 1:8 to 1:9, whilst the pectin from apple and cherry gave the ratio 1 : 7·4 to 1 : 7·9. By the hydrolysis of pectins the authors always obtained reducing liquids and syrups, but no crystalline glucose, or at most only a trace. —J. L. B.

*Constitution of Pectins.* B. Tollens. Annalen, 1895, **286**, 292.

The author considers it probable that a smaller ratio of oxygen to hydrogen exists in the pectins (compare preceding abstract), as they mostly have a distinct acid reaction, and unite with bases. The author accordingly supposes that there is one or more COOH groups, which would probably stand in place of a COH or $CH_2.OH$ group in the carbohydrate. The original plant pectin may be neutral, the acid group existing as a lactone or ether. By treatment with alkalis the anhydride formation is destroyed, and the pectins are dissolved as pectic acid. Hydrolysis is accompanied by the splitting off of glucose (hexoses and pentoses). — J. L. B.

*New Method for the Quantitative Estimation of Starch.* Dennstedt and Voigtländer. Forschungsber. Lebensmittel. Hyg. forens. Chem. Pharmakogn, 1895, **2**, 173.

*See under* XXIII., *page* 830.

## PATENTS.

*An Improved Method of and Apparatus for Making Syrups.* R. H. Hunstock, of Hannibal Marion County, Missouri, U.S.A. Eng. Pat. 14,606, July 30, 1894.

*Improvements in the Purification of Saccharine Juices by Electrolysis.* J. Y. Johnson, London. From E. Javaux, C. F. Gallois, and F. Dupont, Paris, France. Eng. Pat. 14,858, August 2, 1894.

Lime or baryta is added to the juices in order to neutralise their natural acidity and prevent the partial inversion of the sugar, and also to precipitate from the commencement a large portion of the organic matters which contaminate them. The juices are then preferably heated to a temperature of about 75° C. for juices from beetroot, and 50° to 65° for juices from cane and sorghum. The juices then flow through electrolysers, divided into compartments by porous partitions. The anodes dipping into the saccharine juices, and the cathodes into water. The anodes are of soluble metals capable of forming insoluble compounds with the acids and organic matters. These anodes are "oxide of manganese combined with a conducting substance, or aluminium, or the two bodies together, or the two bodies united to lead" for the first set of electrolysers. For the second set, lead anodes only; and for the third set, iron, aluminium, or zinc. For the cathode "sheet iron" is preferred. "The juices and the water flow from one electrolysing vat into the following, so as to leave the last in a purified condition." Methods are explained for dealing with the plumbic mud from the anodes, and for keeping the anodes clean by brushes.—J. C. R.

*Improvements in the Purification of Saccharine Juices by Electrolytic Treatment, and Means employed for that Purpose.* O. Imray, London. From La Société Anonyme Raffinerie Say, Paris, France. Eng. Pat. 7108, April 6, 1895.

These improvements relate to methods of keeping anodes (of metallic alloys) clean from a deposit formed upon them in the electrolytic treatment of saccharine juices. A careful examination has shown that the principal constituent of these deposits is an oxide of lead, which a certain number of weak organic acids contained in the saccharine juices cannot saturate, in consequence of which the electrolytic action is incomplete. It is now proposed to obviate this by a combination of a chemical and a mechanical treatment, viz., adding to the saccharine juice a certain dose (which may be one-sixth to one-tenth of the weight of the ashes of the saccharine matter) of a salt such as chloride of sodium, or of an energetic acid that will combine readily with the lead, forming an insoluble salt, or one that is only slightly soluble. The mechanical treatment consists in employing an anode made in a pleated or corrugated form in vertical section, forming sinuosities or corrugations which occupy nearly the whole width of the compartment of saccharine juice. This anode (lead) can receive, by means of an eccentric, a reciprocating vertical motion, producing useful agitation of the saccharine liquid.—J. C. R.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Chlorosis in American Vines, and its Treatment by Sulphuric Acid.* Gastine and Degrully. Comptes rend. 1895, **120**, 1231—1234.

The authors have analysed the ash of vine leaves which had suffered from chlorosis, and compared its composition with that of the ash of healthy vine leaves, and with that of the leaves of vines which had been treated with solution of sulphate of iron in accordance with Rossignier's prescription. The analytical numbers are expressed in percentages both on the ash and on the dried leaves, and the results obtained led the authors to the belief that the beneficial effect of the Rassiguier treatment was due to the sulphuric acid of the iron sulphate and not to the iron. Joulie has also shown that the chlorotic leaves contained more iron than the healthy ones. An experiment was made with sulphuric acid, and the effect is stated to have been the same as that produced by sulphate of iron.—A. K. M.

*Yeast of very High Attenuative Power.* Van Laer and Denamur. Moniteur Scient. **46**, 1895, 499—503.

From the yeast employed in the brewery of Logos and Co., of Rio de Janeiro, the authors have isolated a yeast possessing a higher attenuative power than yeasts of the Frohberg type. Logos yeast, as the authors name it, presents the appearance of a *Pastorianus* yeast, and collects in masses of considerable size which possess great density. Although it has such a high attenuative power, its fermentative energy is much less than that of Saaz or Frohberg yeasts. The laws of secondary fermentation established by Van Laer (Trans. Inst. Brew. **12**, 55) for mixtures of yeasts of the Saaz, Frohberg and Burton types hold good when Logos yeasts form one of the mixed yeasts. The residue of a non-diastatic wort which is unfermentable by Logos yeast, cannot be fermented by Saaz, Frohberg, or fresh Logos yeast; but in the presence of diastase a slight further fermentation takes place. In the analysis of brewery worts by means of yeasts, the proportion of hydrocarbon fermented by Logos yeast forms a distinct constituent to be taken into consideration, and whatever be the respective value of the different theories of the degradation of starch under the action of diastase, brewery wort must be regarded as a mixture of bodies of unequal fermentability, the authors showing that the theory of "partial fermentative action" advanced by Prior and others to explain the various attenuative powers of different yeasts is untenable. The other German theories on the subject convey nothing more from a practical point of view than did the amyloïns theory of Brown and Morris.—J. G. W.

*Researches on Pectase and on Pectic Fermentation.* G. Bertrand and A. Mallèvre. Bull. Soc. Chim. 1895 [3], **13**, 252—256.

Pectase exists in solution both in the juice of acid fruits and in that of the root of the carrot; there is no insoluble pectase. In the juice of acid fruits the presence of this ferment may be masked by the acidity; its action then only becomes apparent after neutralisation (see this Journal, 1895, 377).—A. G. B.

*The Morphology of German Wine Yeasts (Sacharomyces Ellipsoideus).* R. Aderhold. Landwirthschaftliche Jahrbücher, 1894, **23**, 587–620.

The author has examined a large number of yeasts obtained from German wines with a view of determining whether yeasts yielding different wines are really morphologically distinct, or whether the difference is due to the nutritive media and conditions of growth. The yeasts were collected in the spring of 1892 from the lees left in the drawing off of the 1891 wines. As the yeasts were in a weakened state they were first re-cultivated in sterile must, and after being thus strengthened were subjected to plate cultivation in must gelatin. Care was taken to get the samples for gelatin cultivation free from surface moulds. The development and character of the colonies was observed on the plates and typical colonies were then inoculated into sterile must.

Whereas if the Rees classification be adopted, the pure yeasts of the German wines probably belong to the races of *saccharomyces ellipsoideus*, they more often resemble in general appearance *s. cerevisiæ*. The round or nearly round cells predominate, and in the same yeast there is very little variation in the size of the cells, and very few of the elongated cells so often occurring in *s. ellipsoideus* (Hansen) of the French wines. Besides *s. ellipsoideus*, a few cells of *s. apiculatus* were often present, but *s. pastorianus* was hardly ever found. The bacteria present, seldom exceeded about 5 per cent. of the total organisms, and of these the author distinguished three forms of *b. aceti* and two forms of *diplococci*. Of the latter the smaller variety appeared to play an important part in the production of ropiness. The moulds were mainly represented by *botrytis* spores, *penicillium*, and *dematium pullulans*.

In the wines of France, Italy, and the Crimea, on the other hand, the elongated cells are equally prevalent with the round and elliptical, *s. pastorianus* is generally present, and the proportion of bacteria sometimes reaches 60—70 per cent. of the total number of organisms present. The German yeasts generally require longer to spore (few sporing in less than 24 hours) than the French do, but this probably is mainly dependent on the difference of nutrient media and other conditions, and may, at least to some extent, be varied by varying these conditions.

Whilst the yeasts of the different wines undoubtedly vary to some extent both morphologically and physiologically the lines of demarcation are so ill-defined, slight and uncertain, that the author considers the multiplication of new names of species as very undesirable. It is also certain that many of the apparent differences are due at least partially to conditions of growth, and are gradually changed when those conditions are varied.—L. T. T.

*Influence of Aëration on Fermentation.* L. Briant, J. Fed. Inst. of Brewing, 1895, **5**, 472—484.

The practice of aërating the fermentation vats is commonly adopted, and should be distinguished from rousing, swaying, or pumping, which refer to mechanically-induced processes of agitation. Motion, which involves the removal of the excess of carbon dioxide, is shown to be beneficial by the following experiment. A gallon of hopped and boiled wort of 1057·8 gravity was pitched with yeast in the proportion of 1 lb. per barrel; and, after admixture, was divided, placed in two flasks and maintained at a temperature of 70° F. An arrangement was attached to one flask to allow of continuous stirring, projections being fitted into the sides, so that the liquid was thoroughly mixed. A slow current of carbon dioxide was passed into each flask to prevent any possible entrance of air. The results showed: firstly, that agitation assisted the speed of fermentation; secondly, that fermentation proceeded to a lower limit, and, thirdly, that a larger crop of yeast was produced.

A malt wort of a gravity of 1048·8 was sown with a small quantity of yeast; after mixing, equal parts were put into two flasks. One was closed with cotton-wool, and the other fitted with an arrangement enabling filtered air to pass evenly through the wort. The contents of both flasks were then fermented for 3 or 4 days at the ordinary temperature, and the results of the experiment indicated that in the aërated wort the attenuation had proceeded more slowly, the weight of yeast was greater, and the proportion of soluble albumin less.

Over-aëration is to be avoided; for, although it produces a large yeast outcrop, it gives a beer poor and thin in quality, and causes loss of hop flavour. For this reason aëration is more suited for the fermentation of mild ales, than for that of pale and bitter beers, especially in such as are heavily hopped. The author considers that brewers should adopt methods of fermentation including movement and aëration; the degree of which should be governed by the description of beer brewed, the character of the material, and the type of yeast employed.—J. L. B.

*Brewing in Belgium and Belgian Beers.* G. M. Johnson, J. Fed. Inst. of Brewing, 1895, **5**, 450—470.

In Belgium out of a total of 2,700 breweries, 2,500 employ the top fermentation process. Some 200 breweries use the so-called spontaneous fermentation. The worts produced from a mixture of raw wheat and barley-malt are run into casks of about the same capacity as hogsheads, and allowed to ferment without the addition of yeast. The fermentation takes two years, and is caused by yeast and bacteria, deposited during previous fermentations carried out in the casks. The contents are then left for another year to fine and mellow. The casks are only superficially cleaned, and never steamed.

The malt is generally prepared from winter-barleys (*escourgeons*) as they produce weak stock beers that will keep. The grain is allowed to remain from 6—8 days on the floors, and 24—28 hours on the kilns. Such a process tends to imperfect modification of the starch and accompanying destruction of diastase. The author considers that great advantages might accrue from the employment of English malting processes.

Belgian brewery plant is constructed entirely of iron, and the mash-tun is often devoid of grist-case and mashing-machine. Underneath the mash-tun is an under-back from which the wort is pumped into the coppers; one of these is fitted with a chain-stirrer, enabling the brewer to use raw grain, and also to boil part of his mashes, a necessary process in the production of low-gravity beers. The ordinary brewing copper is fitted with a strainer, and the necessity of a hop back is thus avoided.

Many brewers mash cold with as little water as possible. But a large number mash with water at about 118° F., and in quantities sufficient to get an initial heat of 108° F., at which temperature the mash is generally allowed to stand for about half-an-hour. An underlet, of one or two barrels to the quarter, of water at 155°—167° F. is let in, the temperature rising to 122°—131° F. The mash-tun taps are opened, the rakes still revolving, and the wort, which is milky in appearance, is run off to the under back and pumped to the thick wort copper fitted with a chain. It is then heated to 167° F. to gelatinize and convert the starch, and is afterwards boiled. While the last-mentioned operation is in progress, more water is run in under the mash-tun plates, the temperature is raised to 158° F., and on standing a short time, the bright wort is run off into the copper without a chain. When the bright wort has all run off from the tun, the contents of the thick wort copper cooled to 176° F. are let down on to the goods and mashed in. The mixture of the thick wort with the goods at 158° F. brings the tun up to 167° F., at which temperature the products of hydrolysis are very dextrinous. When the contents of the mash-tun have clarified, the taps are set and the filtered wort pumped into the bright wort copper to join what is already there.

Mashing with raw grain is carried out in the following manner. Ground rice or maize is run into the chain copper containing 4 hectolitres of water for every 100 kilos. of flour, and from 5—10 per cent. of malt added to prevent balling, and the whole then boiled for half-an-hour. About an hour after this operation has commenced, the malt is mashed at about 158° F., as above described. After boiling, the raw grain is cooled to 176° F., and this with the malt at 158° F. brings up the temperature of the tun gradually from 158°—167° F.

The beers are boiled from 4—10 hours with the hops (generally German), let down to the underback, pumped up to the cooler, whence it runs down over a refrigerator into a tun where it is pitched with yeast. After pitching the beer is run into a number of carriage-casks in which the fermentation is conducted. An abundant white froth containing a considerable amount of yeast works out at the bung hole, and is collected in a series of small tubs. When about one quarter of the contents of the cask has thus run over, it is poured back, being in this way thoroughly aërated and roused. After the casks are topped up, the yeast, now thick and viscous, commences to run out at the bung hole, and drops over into the tubs, as in the English cleansing process.

Finings prepared from fish-skins are next added, and the remainder of the yeast and the bottoms are thrown out with the finings, leaving the beer as good as racked bright, with little loss of aroma and carbon dioxide. Dry hopping is unknown, except in the case of vatted beers.—J. L. B.

*"Sludge" or Deposits formed in Various Stages of the Brewing Process.* E. R. Moritz. J. Fed. Inst. of Brewing, 1895, **5**, 487—494.

*Liquor Back-Sludge* is a deposit thrown down on boiling from nearly all brewing liquors, and consists of the carbonates of lime and magnesia, traces of the ordinary mineral constituents, practically all the iron contained in the water, and a considerable amount of any organic impurity that may be present. The carbonate of lime in a water thus constitutes a sort of fining agent. No sludge should be allowed to enter the mash-tun during mashing-operations; this can be avoided by placing the outlet 3 or 4 ins. above the bottom. If an impure or ferruginous water has to be dealt with, an intermediate vessel between the hot liquor back and the mash-tun is advisable.

*Hop Back-Sludge* is found as a greyish film on the surface of the hop bed in the hop back. It consists of albuminoids that have been coagulated and rendered insoluble in the coppers. When returning the first copper hops from the hop back to the second copper, this deposit can be conveniently removed by a spade.

*Cooler Sludge* consists of the glutins extracted from the malt and mixed with resinous matter and phosphates. The presence of this sludge in the beer is liable to cause greyness or turbidity, and it is desirable that the grounds deposited on the cooler should be swept off before the hop spargings pass over.

*Fermentation Sludge* is composed of sedimentary or bottom yeasts, bacteria, and amorphous matter. This deposit should not be allowed in the racked beers; and it can be retained in the vessels by racking from the side, or by inserting yeast traps about 1 in. in height into the racking outlet, if this be situated at the bottom.—J. L. B.

*Determination of the Volatile Acids in Wines.* E. Burcker. Comptes Rend. 1895, **120**, 1223.

*See under* XXIII., *page* 830.

*Method of Determining the Amount of Extractive Matter of Malt.* A. L. Stern. Jour. Fed. Inst. of Brewing, 1895, 448.

*See under* XXIII., *page* 831.

*Detection and Estimation of Alum in Wines.* Georges. Bull. Soc. Chim. 1895, [3], **13**, 692.

*See under* XXIII., *page* 831.

*Analysis of Spirits.* M. Mansfeld. Zeits. f. Nahrungsmittel-Untersuchung, 1894; Monit. Scient. 1895, 294.

*See under* XXIII., *page* 830.

*Composition and Analysis of Spirits.* X. Rocques. Monit. Scient. 1895, 265—272.

*See under* XXIII., *page* 831.

### PATENT.

*Preserving and Sweetening Food and Liquors.* J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 12,743, July 2, 1895.

*See under* XVIII. A., *page* 819.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

### PATENTS.

*A New and Improved Baking Powder.* G. Weddell, Newcastle-upon-Tyne. Eng. Pat. 14,179, July 24, 1894.

The inventor claims the preparation of a baking powder, which contains some of the mineral salts found in cereals. A mixture is made of calcium phosphate, 300 parts; magnesium phosphate, 180 parts; sodium phosphate, 180 parts; potassium phosphate, 18 parts. Occasionally a further addition is made of some phosphates of iron and manganese and a little calcium fluoride. Of this compound, 2 parts are added to 7 parts of ground rice or flour, bicarbonate of soda 15 parts, and tartaric acid 14 parts. The proportions may be varied.—L. de K.

*An Improved Process for Producing Substitutes for Coffee.* R. Haddan, London. Eng. Pat. 16,548, August 30, 1894.

Grain is soaked for a few days in water at 20°, which is changed every 6 or 8 hours. When the material is very rich in nitrogenous matters, addition of milk of lime before the last steeping is advisable, and in obstinate cases, caustic alkalis or their carbonates may be employed. The soaked grain is then piled up in high heaps, which are brought to a temperature of 20° and then turned. When the roots of the germ have just formed and completed a fork the germinating stage is ended, which may be chemically ascertained by roasting some of the grain and exposing to its fumes a filter-paper moistened with ferric chloride, when a violet colour is produced. The grain is then roasted in roasting-drums, care being taken that the roots which separate from the germs are allowed to fall out of the drum. During the roasting, suitable flavouring materials may be added.—L. de K.

*Improvements in Milk Sterilisers.* E. Leslie, Paterson, U.S.A. Eng. Pat. 19,064, October 8, 1894.

A hot-water boiler with furnace, safety-valve, and thermometer is used for sterilising, and a pipe for the milk to be introduced runs parallel to the axis of the boiler. This is provided at one end with a milk inlet and a water inlet for cleaning purposes, and at the other end with an upper and lower milk outlet. In the centre of the conduit, is suitable stirring gear. In the upper milk outlet is placed a thermometer, and both are connected by valves with one end of a covered cooling table, the bottom of which is sloped and diagonally fretted to further the flow, circulation, and cooling of the milk, which is finally drawn off into receptacles from the opposite end. The inventor claims that the apparatus works automatically without the milk being handled or exposed to the air, and that the construction is such that the temperature of the liquid is raised gradually and is perfectly under control.
—L. de K.

*An Improved Alimentary Product and Process of Manufacturing the Same.* J. Escuyer, Paris, France. Eng. Pat. 19,987, October 19, 1894.

The inventor claims the preparation of an improved condensed milk containing but little sugar. Milk is heated in a double vessel at 80° for 15 minutes, then brought up to the boiling point, and 2—5 per cent. of sugar is added. It is then evaporated in a vacuum apparatus, the operation being stopped when the desired density is reached. The product is then poured into tins, which are at once hermetically sealed, and the contents are then sterilised either directly by high-pressure steam or by means of a digester.—L. de K.

*A Composition for Admixture with the Flour of Wheat, Rice, or other Grains, to restore to such Flour the Lost Natural Mineral or Saline Food Substances or their Equivalents.* G. Weddell, Newcastle-on-Tyne. Eng. Pat. 8165, April 24, 1895.

The invention consists in restoring to flour the valuable mineral constituents which are partly lost during the process of milling. The following mixture is made:—Calcium phosphate, 300 parts; magnesium phosphate, 136 parts; potassium phosphate (sometimes omitted), 50 parts; sodium phosphate, 182 parts; calcium fluoride, 18 parts. To this may be added, if desired, calcium carbonate 65 parts; magnesium carbonate, 39 parts; phosphate of iron, 25 parts; oxide of iron, 20 parts. Of this compound $1\frac{1}{2}$—4 per cent. may be mixed with the flour.—L. de K.

*Preserving and Sweetening Food and Liquors.* J. Y. Johnson, London. From F. von Heyden, Nachfolger, Radebeul, Germany. Eng. Pat. 12,743, July 2, 1895.

The anti-fermentation property of saccharine (orthobenzosulphonimide) being, in comparison with its sweetening qualities, too low to allow of its advantageous employment as an edulcorant and preservative for such liquors as beer, it is proposed to employ for this and similar purposes, amidobenzosulphonimide. This body, with a sterilising action equal to that of saccharine, is only half as sweet as the latter, and is therefore, for the former purpose, twice as effective, without producing the characteristic unpleasant after-taste of the orthobenzoic compound.

The sweet flavour imparted by the sodium salt of amidobenzosulphonimide is also pure, but this salt possesses no antiseptic properties.—C. S.

### (*B.*)—SANITARY CHEMISTRY.

### PATENTS.

*Improvements in the Treatment of Sewage.* H. L. Sulman, London. Eng. Pat. 14,760, August 1, 1894.

*Improvements in Screening and Mixing Chambers for Precipitating Tanks and the like for Treating Sewage and other Foul or Waste Waters.* E. W. Ives, Derby. Eng. Pat. 16,724, September 3, 1894.

### (*C.*)—DISINFECTANTS.

### PATENT.

*Improvements in the Manufacture of Disinfecting Preparations.* G. Dawson, Reddish. Eng. Pat. 11,908, June 19, 1895.

In order to facilitate the packing and transport of phenol tar acids, without prejudicing their efficiency as germicides and disinfectants, the inventor incorporates with the concentrated liquids a small proportion (amounting for temperate climates to about $2\frac{1}{2}$ per cent.) of beeswax or other waxes, such as carnauba, ceresine, paraffin, &c., to gelatinise the acid mixture, forming a more or less stiff paste and constituting a medium less likely to cause injury to the persons using it than the liquid acids employed without such admixture.—C. S.

## XIX.—PAPER, PASTEBOARD, Etc.

*Dyeing and Colouring Paper.* A. M. Villon. Bull. J. des Fab. de Papier, 1895, [15], 2.

*See under* VI., *page* 802.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Solubility of Quinine in Alkalis.* E. Doumer and E. Deraux. Jour. Pharm. Chim. 1895, [6], **1**, 50.

Since quinine is by no means insoluble in alkalis, it becomes important to ascertain the extent to which it is soluble in each of these. Tables are therefore given showing the solubility of quinine in ammonia, potash, soda, and their carbonates. It is considered best to employ a small quantity of very strong ammonia solution. If potash or soda be used the alkali should be in excess, but dissolved in the least possible quantity of water. In all cases some carbonate of soda should be added, whatever other form of alkali be employed.—A. G. B.

*Crystallised Cinchonicine.* F. Roques. Comptes rend. 1895, **120**, 1170—1173.

Cinchonicine may be obtained in the crystalline form as follows:—An ethereal solution of the base is carefully dried by means of fused potash, and quickly filtered; the solution is then concentrated by evaporating the ether in a current of pure dry hydrogen, a water-bath at 45° being used for the purpose. The syrupy product is quickly cooled by means of methyl chloride, and after standing for a few hours solidifies to a magma of colourless crystals. The crystals thus obtained may be advantageously used for assisting the crystallisation of a further quantity. Several derivatives of cinchonicine are also described.—A. K. M.

*Derivatives of a Right-handed Terebenthene, "Eucalyptene."* G. Bouchardat and Tardy. Bull. Soc. Chim. 1895, **13**, 765—769.

The authors have prepared a number of derivatives from a dextro-rotatory terebenthene, identified by Voiry as occurring in small quantities in the essential oil of *Eucalyptus globulus.* They find that this hydrocarbon is complementary to a levo-rotatory terebenthene present in French oil of turpentine. They conclude that it may be established that various natural terebenthenes of different rotatory powers are merely mixtures, in diverse proportions of a dextro-rotatory and a levo-rotatory hydrocarbon, and quote the case of the terebenthene from American oil of turpentine, which is obtained from two kinds of pine.—B. B.

*Improvements in Iodoform.* Chem. and Druggist, Sept. 14, 438.

It is well known that the objectionable odour of iodoform arises from impurities generated in the process of manufacture, and eliminable only by a very expensive treatment, which, while producing a pure article, would make it too costly for commercial use. Such absolutely pure odourless iodoform has hitherto only been made in small quantities, never on a wholesale scale. Attempts to cover the odour of commercial iodoform by means of cumarin, otto of rose, or mixing with bituminous substances have also proved ineffectual. Now, however, a German firm announces the discovery of a process by Dr. A. Eichengrün, whereby an absolutely odorless product, containing 75 per cent. of iodoform, is obtained. It occurs as a white powder, turning yellow by exposure to light, and is easily decomposed by alkalis, &c.—in fact, contact with the tissues ensures the breaking-up of the product, and thereby the absorptive influence of iodoform is exhibited. It is to be called iodoformin. It is claimed for iodoformin that it causes no irritation whatever, and acts as a powerful exsiccant, in the same way as dermatol, probably on account of its exceedingly fine powder-form.

*Detection of Ionone and Irone, the Odoriferous Principles of the Violet.* F. Tiemann and P. Krüger. Ber. 1895, **28**, 1754.

*See under* XXIII., *page* 827.

### PATENT.

*The Manufacture of Sulphocyanides of the Quaternary Ammonium Compounds of Quinoline, Pyridine, Antipyrine, and Isoquinoline, and their Derivatives.* A. M. Clark, London. From A. Edinger and A. Müller, Germany. Eng. Pat. 18,516, September 29, 1894.

The bodies forming the subject of this patent are non-poisonous disinfectants and sterilising agents, and their preparation is effected by displacing the halogen of the halogen alkylates and acid chlorides of quinoline, &c. by a salt of hydrosulphocyanic acid, according to the general formula, $\mathrm{Cl.R.alkyl + KSCy = KCl + CyS.R.alkyl}$, wherein R denotes the corresponding tertiary amine.

Examples are given in the specification of the methods of treatment required for the performance of the reaction in various cases.—C. S.

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## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### PATENT.

*A Process for Photographing in Colours.* V. Mathieu. Eng. Pat. 17,758, September 18, 1894.

Three negatives of the object are taken (see this Journal, 1891, 482): one on a plate sensitised for blue, a yellow screen being used in the camera; a second sensitised for red, through a green screen; and a third for yellow, employing a violet screen. To prepare the blue sensitive plates, 0·25 grm. of eosine is added to every 10 grms. of silver nitrate in the emulsion, and after the ingredients are mixed together in the usual manner, the whole is soaked in an alcoholic solution of chlorophyll before the plates are coated. For the red emulsion, the eosine is omitted, and a 1 per cent. alcoholic solution of aurin used to replace the chlorophyll. The yellow plate requires no special treatment. Instead of exposing through screens of the complementary colour, the plates may be stained to the same tint by suitable baths.

The positive is prepared in a manner resembling the "carbon" process, three separate films being required, in which the pigments are chrome yellow, Prussian blue, and carmine respectively. After exposure beneath the corresponding negative, the films are stripped off the paper support on to glass, "developed," and finally transferred to the permanent support, one on top of the other, the yellow print being preferably at the bottom, and the red next the surface.—F. H. L.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### PATENTS.

*Improvements relating to Smokeless Explosives.* H. S. Maxim, Bexley, Kent. Eng. Pat. 17,994, September 21, 1894.

The main object of this invention is the production of explosives of the "cordite" class in tubular forms, which may also be corrugated on the outer and inner sides, instead of the solid cord or rod hitherto used. Drawings accompany the specification.—W. M.

*An Improved Explosive.* F. W. Bawden, Klerksdorp, South Africa. Eng. Pat. 18,496, September 29, 1894.

The inventor proposes sugar and potassium chlorate mixed with water, and then dried and granulated.—W. M.

*New or Improved Process and Apparatus for the Manufacture of Perforated Grains or Rods of Explosive or other Material.* H. Maxim, New York, U.S.A. Eng. Pat. 8569, April 30, 1895.

This invention relates generally to a process and apparatus for making perforated grains or rods of plastic material. In making, for example, an explosive grain or rod, the inventor employs an impervious explosive compound, which consists preferably of an impervious colloid of pyroxylin made by means of a volatile solvent of the pyroxylin with or without an admixture of nitroglycerin, providing an amorphous mass which, whilst in a plastic condition, is capable of flowing under pressure, and assuming any desired shape. Such material is moulded into a continuous body or rod, whilst simultaneously forming therein one or more continuous perforations, the product being cut into sections or grains. "It furthermore consists in moulding a plastic material into a continuous body or rod, and simultaneously applying an exterior coating or envelope thereto, either alone or in conjunction with simultaneously forming in such body one or more continuous perforations, and whether or not, such coated body be cut into grains." The specification contains drawings and descriptions of the special means by which the inventor produces the perforated rods.—W. M.

*Manufacture of Matches and Apparatus therefor.* M. Bals, C. Noël, and G. Gerrersdorfer, all of Vienna, Austria. Eng. Pat. May 13, 1895.

This invention relates to an improved manufacture of matches from pasteboard or cardboard-like material, and consists "in treating the separate sheets, before forming the pasteboard, with a mixture of dilute paste or other cementing material, copperas, and phosphate of ammonia solution. The pasteboard prepared from such sheets is then heated and soaked in a mixture of melted paraffin wax, or other fatty body, and petroleum or a resin solution, and whilst still in a hot and soft condition it is cut up into matches, which may or may not be treated with saltpetre or the like for rendering them windproof. Drawings and descriptions of apparatus employed are given.—W. M.

*Improvements in Blasting Compounds.* S. R. Divine, Loch Sheldrake, New York. Eng. Pat. 11,424, June 11, 1895.

Lead nitrate mixed with a nitrated hydrocarbon of the benzene series, preferably dinitrobenzene, is the explosive compound claimed in this invention.—W. M.

*Improvements in Smokeless Powder.* H. H. Lake. Communicated from abroad by the International Powder Co., New York, U.S.A. Eng. Pat. 12,768, July 2, 1895.

This "smokeless" powder is composed of nitroglycerin, trinitrocellulose which has been mixed with 40—50 per cent. of its weight of a nitrate, *e.g.*, barium nitrate, a neutraliser of free acid—urea, and a "deterrent," such as vaseline, resin, or Kauri gum.—W. M.

# XXIII.—ANALYTICAL CHEMISTRY.

## *APPARATUS, ETC.*

*Determination of Boiling and Fusing Points.* H. Le Chatelier. Comptes rend. 1895, **121**, 323—326.

The thermo-electric pyrometers, which are largely used in measuring high temperatures, are generally graduated by means of certain points of fusion determined by Violle. This uniformity of method has led to a very happy uniformity in results. Thus the numerous determinations of the different points of transformation of iron and steel, which have been made in various countries, have given values agreeing to within about 10°. It does not follow that the actual temperatures thus measured are known with the same precision; for the values of the melting-points used in the graduation may be, and probably are, incorrect by two or three times this amount. But the employment of a common scale of temperatures is none the less of practical utility; and it is not advisable to modify the scale until we can replace it by one which is known with certainty to be much more correct.

In recent years the melting-point of gold has been several times re-determined, and almost all the results are higher than Violle's. Already some experimenters are beginning, perhaps somewhat rashly, to use these new values in graduating pyrometers. The author discusses the various re-determinations, and comes to the conclusion that the value (1,045°) obtained by Violle for the melting-point of gold is probably too low. But the error certainly does not exceed 20°; and none of the new determinations are sufficiently accurate to justify the adoption of a temperature different from 1,045° for the point of fusion of gold. For the sake of uniformity, it is most desirable that the scale of temperatures at present used should be retained until fresh determinations, made by direct comparison with a gas-thermometer, furnish results which will be accurate to within a few degrees.—D. E. J.

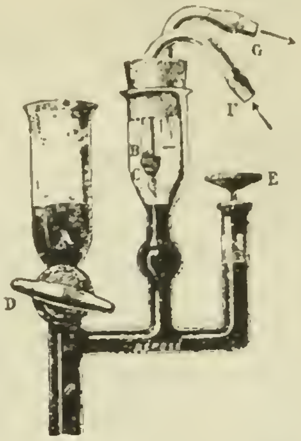
*New Method of Measuring Temperatures.* D. Berthelot. Comptes rend. 1895, **120**, 831—834.

Gases obey laws which are relatively simple, and as the temperature of a gas increases it approaches more nearly to a perfect gas. Solids, on the other hand, obey laws which are relatively complex, and suffer profound changes at high temperatures. Hence methods depending upon the behaviour of gases are the most suitable for measuring high temperatures. In fact, there is only one method, viz., that of the gas-thermometer, which enables us to measure high temperatures directly; and even this is complicated by the behaviour of a solid, since we require to know the expansion of the containing vessel. The author has endeavoured to discover a method based solely upon the properties of a gas, and independent of the form and dimensions of the containing vessel. The method depends upon the principle that the refraction ($\mu - 1$) of a gas is exactly proportional to its density; a given refraction always corresponds to a given density, although the pressure and temperature may be different. The principle is carried out by means of an interference method. A luminous beam is split up into two parts, which traverse two tubes filled with the same gas, and the initial position of the interference fringes is noted. One of the tubes is next raised to the temperature which has to be measured, the pressure remaining constant and equal to the atmospheric pressure. As the density of the gas diminishes, the fringes become displaced. By reducing the pressure in the second (cold) tube the fringes are brought back to their initial position; and when this is done the density is the same in both tubes. Now the density in the second (cold) tube is known from the pressure; hence the density in the first (hot) tube is known, and from this its temperature is deduced.

Measurements of the boiling-points of alcohol, aniline, and water, at pressures of 740—763 mm., show that the method is capable of giving accurate results. It appears to be well adapted for determining high temperatures, such as those of furnaces.—D. E. J.

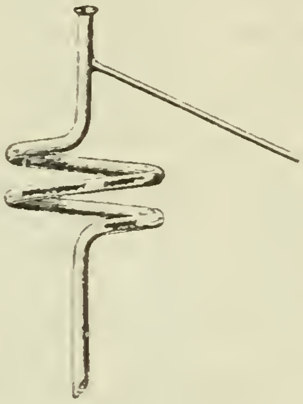
*A Thermostat.* Berlemont. Bull. Soc. Chim. 1895, [3], **13**, 228—229.

The apparatus is filled with mercury through the cup A. The stopcock D is then closed and the temperature of the oven allowed to rise until the mercury has covered the end of the tube C. The stopcock is then opened until the temperature is within 10° or 15° of that required, when it is once more closed and the regulation finished by adjustment of the screw E. The by-pass, B, prevents extinction of the gas which finds entrance at F and exit at G. The temperature is easily maintained within three degrees.—A. G. B.



*New Tube for Fractional Distillations, modified by Lebel.* G. Berlemont. Bull. Soc. Chim. 1895, [3], **13**, 674—675.

The results obtained with the fractional distillation tube illustrated, are as good as those obtained with the usual dephlegmators, and its simplicity of structure and compactness are much in favour of this apparatus; one measuring 30 centimetres in height is equal in effect to a column of 4 bulbs.—A. G. B.



## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

*Errors in Alkalimetry.* P. Dobriner. Zeits. ang. Chem. 1895, 259.

Standard solutions of caustic alkali containing carbonate may be used for the titration of acids in the cold, using phenolphthalein as indicator. It is, however, essential to use for this purpose solutions of caustic alkali which have been standardised in the cold and to employ for the solution of the acids, water free from carbonic acid.—C. O. W.

*Estimation of Fuming Sulphuric Acid.* G. Lunge. Zeits. ang. Chem. 1895, 221.

Fuming sulphuric acid of commerce contains $SO_2$, account of which is taken in most published analytical processes. Nevertheless, mistakes leading to very incorrect results are liable to be made in the analysis of Nordhausen acid.

It is usual to estimate the $SO_2$ by titration with iodine solution, and to obtain the amount of $SO_3$ by deducting this value from the total acidity, and it is in this subtracted value for the $SO_2$, which varies according to the indicator used, that an analytical error is likely to arise. Titrating in the presence of phenolphthaleïn, the colour change occurs when $Na_2SO_3$ is produced (1 mol. $SO_2$ requires 2NaHO), whilst using methyl orange as indicator the end reaction is given as soon as $NaHSO_3$ is formed in the solution (*i.e.*, 1 mol. $SO_2$ requires 1 mol. NaHO).

The uncertain end reaction when litmus is employed and the difference of behaviour of phenolphthaleïn towards caustic alkali and carbonate, and the unavoidable presence of this latter in all caustic soda solutions, make both these indicators unsatisfactory.

It is therefore necessary to use methyl orange, at the same time bearing in mind that with this indicator 1 c.c. n. NaHO neutralises $\frac{1}{2}$ mol. $SO_3$ (0·040 grm. $SO_3$), but a whole molecule $SO_2$ (0·064 grm.), and that therefore for each c.c. 1/10 *n*-iodine solution added, only 0·05 c.c. n. NaHO, and not 0·1 c.c., must be subtracted from the total acidity.

If this is not done a double error is introduced; firstly, too small a value is obtained for the amount of $SO_3$ present, and, secondly, since all that is not $SO_2$ and $SO_3$ is calculated as water, the quantity of this will be found as much too large as that of $SO_3$ is too small. Further, since the combined $SO_3$ is calculated from the water thus found (= water × 4·444), and the difference between this and the total $SO_3$ being taken as free, the latter value may become several per cents. too small, the error amounting in an analysis published in full, to $8\frac{1}{4}$ per cent.

The author further points out that in calculating the value of $SO_3$ by means of Gnehm's tables similar precautions are necessary, and also indicates the necessity of determining the fixed impurities (by volatilisation) to prevent the value for the combined $SO_3$ falling too low.—J. T. C.

### *Separation of Calcium from Strontium or Barium.* J. Dupasquier. Bull. Soc. Chim. 1895, [3], 678—681.

This process is based on the fact that calcium is entirely converted into tartrate in a liquid containing the tartrate or bitartrate of an alkali and a soluble sulphate, whilst strontium and barium remain as sulphates.

*Calcium from Barium.*—If the calcium and barium be present as soluble salts the solution should be neutral or very feebly acid. A solution containing 10 per cent. of normal ammonium tartrate and an equal weight of ammonium sulphate is added, and the liquid is heated on the water-bath for one hour. The precipitate, containing all the barium as sulphate and a large portion of the calcium as tartrate, is washed by decantation with hot water until free from ammonium salts. The calcium tartrate is then dissolved by hot dilute hydrochloric acid (6—8 drops of strong acid for every 0·2 grm. of CaO), the barium sulphate washed and weighed, and the calcium precipitated as oxalate. The filtrate and washings from the original treatment with ammoniacal salts will contain a small quantity of calcium, which must be precipitated as oxalate and weighed with the bulk.

*Calcium from Strontium.*—The precipitate or solution is treated with the mixture of ammonium salts on the water-bath, as described above. There is thus obtained a precipitate containing the bulk of the strontium as sulphate and the bulk of the calcium as tartrate, and a solution which contains the rest of the calcium, and is virtually free from strontium. The precipitate is treated for the solution of the calcium tartrate, as in the case of the separation from barium, but since some of the strontium sulphate dissolves at the same time the solution must be treated as follows:—It is neutralised exactly with ammonia containing a little ammonium tartrate, and left to crystallise for 24 hours. The calcium tartrate is filtered and washed, and the filtrate and washings are mixed with a few drops of strong hydrochloric acid, and then with twice their volume of alcohol. The strontium sulphate thus precipitated is added to the bulk. The filtrate, still containing some strontium, is evaporated to expel alcohol and mixed with the original filtrate from the treatment with ammoniacal salts.

The author recommends the precipitation of calcium as tartrate when it is to be separated from a small proportion of strontium or barium, since the bulk of the calcium is thus easily removed.

In estimating the amount of calcium, strontium, and barium, when these are together, the solution should be treated in the manner already described, with a solution of ammonium tartrate containing a known amount of ammonium sulphate. The filtrate contains all the added sulphate, save that which has been removed as barium and strontium sulphate. It is divided into two portions, and the small quantity of calcium is determined in the one, and the sulphate in the other. The amount of $SO_3$ in the original precipitate is thus deduced. This original precipitate is then treated as described for the separation of calcium from strontium, and the total weight of barium and strontium sulphates ascertained. From this weight, and from the percentage of $SO_3$ already determined in it, the proportion of barium to strontium can be calculated.—A. G. B.

### *Method for Determining Sulphur in Burnt Sulphur Ores.* H. F. Keller and P. Maas. J. Franklin Inst. 1895, **139** 286—289.

From 5 to 6 grms. of caustic potash (purified by alcohol) are fused in a nickel crucible, and heated until excess of water is expelled; the flame is now reduced until the alkali only just remains liquid, when 0·5 grm. of the finely-crushed ore is gradually introduced, and then 1 grm. of sodium peroxide, when the mixture is brought up to, and maintained for a few minutes at a red heat. After cooling, the mass is dissolved in water, and the solution filtered with the aid of a pump. The residue is washed four or five times with hot water. The filtrate should be colourless, although the solution may originally have been purple, owing to the presence of potassium ferrate; but if it be blue (due to copper) too much potash has been used. About 8—9 c.c. of HCl (sp. gr. 1·2) are added to the filtrate, which is then boiled to expel carbon dioxide. The sulphuric acid may be estimated gravimetrically in the usual way, or results may be obtained volumetrically in 30 minutes with fair accuracy, by rendering alkaline with (5 c.c.) ammonia, adding a slight excess of standard barium chloride solution, and titrating back with an equivalent potassium bichromate solution, until a permanent yellow colour is observed in the liquid—if necessary after filtering. By using a barium chloride solution containing 38·109 grms. of the crystals per litre, or a bichromate solution containing 23 grms. of that salt per litre, 1 c.c. will be equivalent to 1 per cent. of S. It is essential that the stated proportions of alkali and peroxide be not exceeded, or copper will certainly be dissolved. Five volumetric estimations by this process gave with one sample of ore, a mean result of 6·92 per cent., with maximum and minimum readings of 7·14 and 6·74 per cent. respectively.—W. G. M.

### *Analysis of Tin-Plate.* G. Lunge and E. Marmier. Zeits. ang. Chem. 1895, 429—430.

From 2 to 3 grms. of the tin-plate, cut into strips 2 to 3 cm. long by 3 to 5 mm. wide, are placed in a dry bulb tube. A current of carefully dried chlorine gas is then passed through the tube, at first in the cold; it is then warmed gently by a Bunsen flame at most 3 cm. high, and placed at least 15 cm. beneath the bulb, the object being the complete chloridisation of the tin, without any attack upon the iron. If the temperature be unduly high, the iron will be violently acted upon and the experiment spoiled. The excess of chlorine, laden with stannic chloride, is passed successively through two Peligot tubes and a small Erlenmeyer flask containing water, in which the tin is retained partly as the tetrachloride, partly as metastannic acid. The connections of these tubes should be entirely of glass and cork, unjointed with rubber, and the delivery tube of each part of the apparatus should reach nearly to the bottom, to prevent undue crystallisation of the tin salt upon the moist upper walls of the condenser. The current of chlorine must be so regulated that, on the one hand, no stannous chloride is formed, whilst on the other hand, no tin is lost by the chloride being swept through the washing tube; it is continued until the surfaces of the strips are uniformly brown without white spots. Stannic chloride condensing in the narrow portion of the bulb tube is carried forward by the application of gentle heat. The essentials for success are, dry chlorine and the minimum temperature possible.—W. G. M.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

* Detection of Artificial and Natural Colouring Matters on the Fibre. A. Lehne and A. Rusterholz. (*Continued from page 687.*)

| —— | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 154.<br>Sulphone Cyanine [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre sea-green, liquid colourless. When rinsed, the original colour reappears.<br>*Dil.*:—Heated—fibre more greenish shade, liquid colourless. | *Conc.*:—Fibre at first sea-green, then dark grey, and finally bright brown. On addition of water—yellow, liquid colourless.<br>*Dil.*:—Slowly warmed—fibre at first sea-green, then green, and finally, brownish-yellow. | *Conc.*:—Fibre greenish-blue, liquid bluish; heated—fibre blue. On addition of water—fibre greenish-blue, liquid reddish-violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—No action. | No action. | Heated—fibre decolorised. | No action. | .. .. |
| 155.<br>Paraphenylene Blue R. D.<br>Fast New Blue for cotton.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre unaltered, liquid bluish.<br>*Dil.*:—Heated—liquid blue; with excess of soda-lye—pale violet. | *Conc.*:—Fibre bluish-black, liquid violet-grey. Heated, with subsequent addition of water—fibre grey.<br>*Dil.*:—Heated—fibre dark grey, liquid violet-grey; with excess of soda-lye—brownish. | *Conc.*:—Fibre bluish-black, liquid faint dirty bluish tint. On addition of water—liquid blue.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Fibre violet-black, liquid colourless; heated—fibre lighter. On addition of water—fibre dark violet, liquid rose.<br>*Dil.*:—Heated—fibre dark violet, liquid pale violet. | No action. | Cold—fibre dark green; on boiling—fibre decolorised, liquid yellowish-green. | Boiled—small quantity of the dye extracted, forming a bright violet solution. | Toluylene Blue [O.] exhibits the same reactions. |
| 156.<br>Capri Blue N O. [L.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately bluish-red, liquid the same. On addition of water—fibre as originally.<br>*Dil.*:—Fibre immediately reddish-violet, liquid rose; heated—fibre light violet, liquid red; excess of soda-lye slowly added—greenish blue. | *Conc.*:—Fibre immediately moss-green, liquid the same. On addition of water—fibre green, liquid greenish-blue.<br>*Dil.*:—Fibre immediately reddish-violet, liquid rose; slowly warmed—fibre colourless, liquid changes to blue. | *Conc.*:—Fibre immediately dark green, liquid green. On addition of water—fibre and liquid bluish-red.<br>*Dil.*:—Cold—fibre unaltered, liquid rose. Heated—fibre almost decolorised (very light violet), liquid rose. Excess of soda-lye slowly added—greenish-blue. | *Conc.*:—Fibre immediately intense green, liquid colourless. Heated, with subsequent addition of water—liquid yellowish-rose.<br>*Dil.*:—Fibre bluish-green, liquid bluish; heated—fibre green, liquid greenish. Rinsed with water, the original colour is restored. | No action. | Fibre quickly bleached in the cold. | A small quantity of the dye is extracted on boiling. | .. .. |
| 157.<br>Azo Blue. [By.] [A.] [L.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre somewhat darker.<br>*Dil.*:—Heated—fibre darker. | *Conc.*:—Fibre pale yellow. | *Conc.*:—Fibre bluish-black, liquid intense greenish-blue. | *Conc.*:—Fibre dark reddish-violet. | Fibre dark reddish-violet, liquid light reddish-violet. | Fibre decolorised on heating. | Boiled—pale red solution. | Acetic acid of 8° Beaumé—pale bluish-red solution. |
| 158.<br>Sulphone Azurin. [By.] [L.]<br>(*Animal fibre.*)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre darker.<br>*Dil.*:—Heated—fibre darker. | *Conc.*:—Fibre reddish-yellow, liquid yellow. | *Conc.*:—Fibre pale reddish-violet, liquid the same. | *Conc.*:—Fibre darker. | No action. | Fibre decolorised on heating. | Dyed wool—No action.<br>Dyed cotton—deep blue solution. | Acetic acid of 8° Beaumé—bluish solution. |

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| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 159.<br>Diamine Blue B X, 2 B, 3 B. [C.]<br>Benzo Blue B X, 2 B, 3 B. [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre darker.<br>*Dil.*:—Heated—fibre somewhat darker. | *Conc.*:—Fibre light brown, liquid the same. | *Conc.*:—Fibre blackish-blue, liquid greenish-blue. | *Conc.*:—Fibre deep reddish-violet. | Fibre dark reddish-violet, liquid violet. | Fibre decolorised on heating. | Boiled—pale red solution. | Acetic acid of 8° Beaume—bluish-violet solution. |
| 160.<br>Benzo Azurin G. [By.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre darker. | *Conc.*:—Fibre pale yellow. | *Conc.*:—Fibre darker, bluish-green solution. | *Conc.*:—Fibre deep reddish-violet. | Bluish-red solution. | Fibre decolorised on warming. | Boiled—pale reddish-violet solution. | .. .. |
| 161.<br>Alizarin Blue in paste. [B.] [M.]<br>Alizarin Blue R and G W. [By.]<br>Alizarin Blue S, in powder and in paste. [B.]<br>(*Animal fibre.*)<br>(*Vegetable fibre.*) | *Conc.*:—Reddish solution.<br>*Dil.*:—Boiled—reddish solution. | *Conc.*:—Fibre yellow (brownish-yellow as with vat blue).<br>*Dil.*:—Boiled—fibre yellow. | *Conc.*:—Greenish-blue solution. On addition of water—reddish-violet. | *Conc.*:—Fibre dark green. | Fibre becomes a little more greenish on warming. | Heated—fibre brown, liquid reddish-yellow. | No action. | Alizarin indigo blue: with concentrated sulphuric acid—greenish-blue solution; on addition of water—bluish-violet; with concentrated nitric acid—fibre dark brown, liquid reddish. |
| 162.<br>Gallamine Blue. [G.]<br>(*Vegetable fibre.*) | *Conc.*:—Intensely reddish-violet solution.<br>*Dil.*:—Boiled—intensely reddish-violet solution. | *Conc.*:—Fibre brownish-orange. | *Conc.*:—Intensely bluish-violet solution.<br>*Dil.*:—Warmed—intense violet-coloured solution. | *Conc.*:—Fibre darker. | Warmed—violet solution. | In the cold—fibre at first greenish, then yellow. | No action. | .. .. |
| 163.<br>Indophenol.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre grey, brownish solution. | *Conc.*:—Fibre light brown, solution the same. | *Conc.*:—Fibre dark olive, solution brownish-olive.<br>*Dil.*:—In the cold—fibre immediately grey. | *Conc.*:—Fibre darker. | No action. | In the cold—fibre brown. | No action. | .. .. |
| 164.<br>Indigo Carmine.<br>(*Animal fibre.*) | *Conc.*:—Fibre darker, more greyish tint. | *Conc.*:—Fibre immediately yellow. | *Conc.*:—Fibre dark grey, solution opaque blue. | *Conc.*:—Fibre greenish-yellow. | Warmed—bright greenish-blue solution. | Warmed—fibre orange-yellow, solution yellow. | No action. | .. .. |
| 165.<br>Indigo Blue. Vat Blue. Propiolic Acid. [B.] [M.]<br>(*Vegetable fibre.*)<br>(*Animal fibre.*) | *Conc.*:—Fibre unaltered. | *Conc.*:—Fibre intensely yellow. | *Conc.*:—Fibre olive-green, solution the same. | *Conc.*:—No action. | No action. | Warmed—fibre at first green, then yellow; solution yellow. | No action. | Chloroform extracts some of the dye from dark-dyed fibres, forming a bluish-violet solution. |
| 166.<br>Logwood Blue.<br>(*Vegetable fibre.*)<br>(*Animal fibre.*) | *Conc.*:—Fibre brownish-red, rose-red solution. On addition of ammonia—fibre again blue. | *Conc.*:—Fibre yellowish-brown, yellowish solution. | *Conc.*:—Fibre yellowish-brown, solution yellow. | *Conc.*:—Deep bluish-violet, solution bluish-violet. | Warmed—fibre somewhat more bluish. | Warmed—fibre yellowish-red; solution the same. | No action. | .. .. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 167.<br>Ultramarine.<br>(*Vegetable fibre*)<br>(*printed material*). | *Conc.*:—Fibre decolorised.<br>*Dil.*:—Fibre decolorised. Sulphuretted hydrogen is evolved which renders a piece of filter paper moistened with lead acetate solution brown. | *Conc.*:—Fibre decolorised. | *Conc.*:—Fibre duller, solution reddish-brown. | No action. | No action. | Warmed—fibre decolorised. | No action. | .. .. |
| 168.<br>Naphthol Green B.<br>[C.]<br>(*Animal fibre.*) | *Conc.*:—Fibre olive-brown, solution yellow; on addition of potassium ferrocyanide—greenish-blue; on addition of ammonium thiocyanate—red. | *Conc.*:—Fibre reddish-brown, solution yellow. On addition of ammonium thiocyanate—red. | *Conc.*:—Fibre dark olive-brown. On addition of water—brownish yellow, solution reddish-brown.<br>*Dil.*:—Warmed—yellow solution. On addition of ammonium thiocyanate—dark red. | No action. | No action. | Fibre decolorised on heating. | No action. | When the fibre is incinerated the ash obtained is reddish-brown, from the presence of ferric oxide. |
| 169.<br>Alizarin Green S.<br>[B.]<br>(*Animal fibre.*)<br>(*Vegetable fibre.*) | *Conc.*:—Reddish solution. | *Conc.*:—Fibre immediately brown, light brown solution. | *Conc.*:—Greenish-blue. On addition of water—bluish-violet solution. | *Conc.*:—Fibre greener. | Fibre somewhat more greenish. | Heated—fibre reddish brown, dark yellow solution. | No action. | The ash left on incineration contains chromium. |
| 170.<br>Malachite Green.<br>[A.]<br>Malachite Green B.<br>[B.]<br>New Victoria Green<br>[B.]<br>New Green. [By.]<br>Solid Green. [C.]<br>Vert Diamant.<br>[Mo.]<br>Benzaldehyde Green.<br>Fast Green.<br>Benzoyl Green.<br>Benzal Green. [O.]<br>Diamond Green B.<br>[By.]<br>(*Vegetable fibre.*)<br>(*Animal fibre.*) | *Conc.*:—Fibre intense yellowish-red, solution yellow. | *Conc.*:—Fibre at first red, then decolorised. | *Conc.*:—Fibre yellowish-brown. | *Conc.*:—Fibre light yellowish-brown. On addition of acid the original colour reappears. | Gently warmed—fibre decolorised; on addition of acetic acid, fibre again green; solution green. | Fibre immediately intense yellowish-red, solution the same. Fibre after being rinsed with water becomes again green. | Heated—the alcohol is strongly coloured. | .. .. |
| 171.<br>Light Green S F bluish. [B.]<br>Acid Green. [By.]<br>(*Animal fibre.*) | *Conc.*:—Heated—fibre yellowish-orange, liquid almost colourless; rinsed—fibre as originally. | *Conc.*:—Fibre immediately yellowish-olive, then yellowish-orange; rinsed—fibre again green, but darker than originally. | *Conc.*:—Fibre at first yellowish-green, then yellowish-olive; heated—yellowish-orange; rinsed—fibre again green, but lighter than originally. | *Conc.*:—Fibre slowly but completely decolorised. | Same as with soda-lye. | Warmed—fibre at first brownish-orange, and on being boiled by degree decolorised. | No action. | Light Green S F. yellowish, exhibits the same reactions. |
| 172.<br>Azo Green in paste.<br>[By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre quickly yellowish-olive, then reddish-orange; liquid golden yellow. Rinsed—fibre the same as originally; liquid, on addition of water—greenish. | *Conc.*:—Fibre immediately reddish-orange, liquid orange. Rinsed—the colour is partially restored; liquid, on addition of water—greenish. | *Conc.*:—Same as concentrated hydrochloric acid. | *Conc.*:—Fibre a lighter and more yellowish shade. | Same as with soda-lye. | Fibre unaltered, liquid brownish-yellow; heated—fibre decolorised. | The dye is extracted on boiling, forming a greenish-blue solution. | .. .. |

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 173.<br>Methyl Green. [By.] [P.]<br>(*Vegetable fibre.*)<br>(*Animal fibre.*) | *Conc.*:—Fibre immediately yellow, liquid yellow. Rinsed—fibre again light green. | *Conc.*:—Fibre immediately yellow; on addition of water—fibre and liquid decolorised. | Same as hydrochloric acid. | Fibre decolorised (dirty) in the cold. | Fibre decolorised in the cold. | In the cold—fibre and liquid yellow; on boiling—fibre decolorised, liquid yellow. | No action. | .. .. |
| 174.<br>Coerulein. [B.] [By.] [M.]<br>Alizarin Green.<br>Anthracene Green.<br>(*Vegetable fibre.*)<br>(*Animal fibre.*) | *Conc.*:—No action in the cold. | *Conc.*:—Fibre yellowish-brown, solution yellow. | *Conc.*:—Fibre dark brown, solution brown. | No action. | No action. | Heated—fibre dark brown, solution brownish-red. | No action. | The ash contains chromium. Aluminium salts are also sometimes used as mordants. |
| 175.<br>Mikado Brown M. [L.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre dark grey. | *Conc.*:—Fibre yellowish-grey. | *Conc.*:—Fibre blue, solution blue. | *Conc.*:—Fibre dark red. | Warmed—fibre more reddish shade, solution pale brown. | Fibre at first grey; warmed—completely decolorised. | No action. | .. .. |
| 176.<br>Naphthylamine Brown. [B.]<br>Fast Brown N. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre bluish-violet, solution the same. | *Conc.*:—Fibre yellowish-brown, solution yellow. | *Conc.*:—Fibre dark blue, solution the same; on addition of water—reddish-violet. | *Conc.*:—Warmed—fibre dark violet, solution bluish-red. | Intense bluish-red solution, fibre dark Bordeaux red. | Heated—fibre light brown. | No action. | Warm ammonium acetate solution of 5° B., extracts much of the dye. |
| 177.<br>Fast Brown 3 B. [A.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark reddish-violet. | *Conc.*:—Fibre at first reddish-violet, then yellow; solution yellow. | *Conc.*:—Fibre dark blue, solution the same; on addition of water—reddish-violet. | *Conc.*:—Fibre cherry-red, solution bluish-red. | Warmed—fibre bluish-red, solution the same. | Heated—fibre completely decolorised. | No action. | Warm solution of ammonium acetate of 5° B., extracts some of the dye. |
| 178.<br>Alkali Brown. [D.]<br>Benzo Brown 5 R. [By.]<br>Cotton Brown R. [B.]<br>Terra-cotta. [G.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre red, liquid bluish-red; on addition of water—fibre and liquid brown.<br>*Dil.*:—Heated—liquid brownish. | *Conc.*:—Fibre and liquid yellowish-brown; on addition of water—fibre partially decolorised. | *Conc.*:—Fibre Bordeaux-red, liquid faint bluish-red; on addition of water—both brown.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Heated—liquid brownish.<br>*Dil.*:—Heated—liquid faintly brownish. | Same as dilute soda-lye. | Fibre gradually decolorised, liquid faint yellowish shade. | No action. | .. .. |
| 179.<br>Acid Brown G. [A.]<br>(*Animal fibre.*) | *Conc.*:—Fibre more reddish-brown shade, solution pale reddish-brown. | *Conc.*:—Fibre darker, solution pale yellowish-brown. | *Conc.*:—Fibre dark reddish-brown; warmed—solution yellowish-brown. | No action. | Warmed—solution yellow. | Heated—fibre decolorised (pale brown). | Dull yellow solution. | Heated with ammonium acetate solution of 5° B., the dye is extracted with the production of a dull yellow coloration. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 180.<br>Bismarck Brown.<br>Manchester Brown.<br>Phenylene Brown.<br>Aniline Brown.<br>Leather Brown.<br>Cinnamon Brown.<br>Canelle.<br>English Brown.<br>Golden Brown.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre more reddish-shade, solution bluish-red; on addition of water—fibre light brown, liquid brown. | *Conc.*:—Fibre at first more reddish shade, then brownish-yellow; solution yellow: heated—fibre almost decolorised. | *Conc.*:—Fibre deep reddish-brown, solution reddish-brown; on addition of water—solution yellowish-brown; on the rim of the watch-glass—yellow. | *Conc.*:—Fibre yellowish-brown, solution yellowish. | Warmed—fibre somewhat more yellowish. | Warmed—fibre decolorised. | Boiled—the dye is extracted with the formation of a brownish-coloured solution. | .. |
| 181.<br>Congo Brown R. [A.]<br>(*Vegetable fibre.*) | *Conc.*:—Fibre immediately violet; rinsed with water—fibre as originally. | *Conc.*:—Fibre immediately reddish-violet, liquid reddish; on addition of water—liquid decolorised, fibre again brown. | *Conc.*:—Same as concentrated hydrochloric acid. | *Conc.*:—Fibre immediately intense red, liquid rose; acidified—colourless. | No action. | Fibre immediately decolorised. | No action. | Solution of ammonium acetate of 8° B.—brownish-yellow solution. |

—A. R. L.

*Detection of Ionone and Irone, the Odoriferous Principles of the Violet.* F. Tiemann and P. Krüger. Ber. 1895, **28**, 1754—1758.

For the detection of the above odoriferous substances (derived from the violet), or the discovery of their adulteration, the author makes use of the fact that they yield characteristic condensation products.

*Ionone - semicarbazone*, $C_{13}H_{20}:N.NH.CO.NH_2$. — To a solution of sodium acetate in glacial acetic acid, an equivalent quantity of semicarbazide sulphate (prepared from hydrazine sulphate) is added and the mixture allowed to stand for 24 hours. Ionone, or the liquid supposed to contain that body, is then added, and after the lapse of three days, the liquid is largely diluted with water, extracted by ether, the latter agitated with soda to separate traces of acetic acid, and evaporated. The residue is washed with petroleum ether, which dissolves out impurities, and is finally crystallised from a mixture of benzene and petroleum ether. Ionone-semicarbazone crystallises out in slender needles melting at 109°—110° C.; soluble in alcohol, ether, glacial acetic acid, and benzene; almost insoluble in petroleum ether. By heating with dilute mineral acid it is decomposed, ionone being regenerated.

*Irone-semicarbazone*, $C_{13}H_{20}:N.NH.CO.NH_2$, obtained by the same process, is an uncrystallisable oil, somewhat more soluble in benzene and petroleum ether than the preceding. From a mixture of the two carbazones, the ionone derivative soon crystallises out.

*Ionone-p-bromophenylhydrazone*, $C_{13}H_{20}:N.NH.C_6H_4Br$. —This compound separates almost immediately in colourless or yellowish crystals, when ionone, or a solution of the same in a miscible solvent, is added to a cold solution of *p*-bromophenylhydrazine in water and sufficient glacial acetic acid to prevent precipitation of the reagent on further addition of water. In presence of very little ionone, and if no precipitate appears in 10—15 minutes, the desired result may usually be attained by the gradual addition of water. From pure ionone the new compound is at once obtained in long, shining leaflets. Impure specimens may be recrystallised from hot, slightly diluted methyl alcohol, or from petroleum ether, or boiling glacial acetic acid. The solution in the latter must not, however, be boiled too long, otherwise the hydrazone is converted into an isomeric modification not attacked by mineral acids. Ionone-*p*-bromophenylhydrazone is soluble in all the usual organic solvents, almost insoluble in water. When heated it softens (shrivels) at 134° C., and fuses at 140°—145° C. to a clear oil, which rapidly recrystallises on cooling. Traces of impurities, however, considerably depress the melting point. The pure substance is not decomposed by boiling water, but when heated with dilute mineral acids ionone is liberated, and may be recognised by its odour of violets.

*Irone-p-bromophenylhydrazone*, $C_{13}H_{20}:N.NH.C_6H_4Br$, obtained like the preceding compound, forms groups of concentric needles. It softens at 156° C., and melts at 168°—170° C., and in general resembles the ionone compound, but is somewhat less soluble, especially in glacial acetic acid and methyl alcohol. A solution of the two hydrazones in warm glacial acetic acid when gradually diluted with water deposits the irone compound.

The hydrazone reaction may be made quantitative by employing an excess of the reagent. It is advisable, however, at the beginning to separate the impurities, such as aldehydes, other ketones, bodies insoluble in acetic acid, or non-volatile with steam, as completely as possible—somewhat after the fashion described under the preparation of crude irone (this Journal, 1894, 272).—H. T. P.

*Detection of Vegetable Oils in Lard.* F. Jean. Bull. Soc. Chim. 1895, **13**, 780—784.

50 grms. of lard are saponified, the fatty acids are separated, washed with hot water, and placed in a flask together with 250 c.c. of carbon disulphide and 8—10 grms. of zinc oxide. The zinc salts of the liquid fatty acids are formed and dissolved in the carbon disulphide, and can thus be separated

from the solid fatty acids. The carbon disulphide is evaporated, the fatty acids liberated with hydrochloric acid, well washed with hot water, dried at a temperature of 120° C. and examined in the oleo-refractometer.

The following table gives the analytical figures obtained by this procedure, together with others referred both to the original lard and to the liquid fatty acids obtained therefrom.

| —— | Reading of Oleo-Refractometer T 45 – Scale OB. | | Iodine Absorption of the Liquid Fatty Acids. | Mgrms. of KOH to Saturate the Liquid Fatty Acids. |
|---|---|---|---|---|
| | Original Lard. | Liquid Fatty Acids. | | |
| | | | Per Cent. | |
| Typical lard ........ | −12·5 | −30 | 91 | 190·0 |
| Pure lard........... | −12·5 | −30 | .. | 191·2 |
| Steam lard ......... | −13·0 | −30 | .. | 191·0 |
| Beef fat ............ | −17·0 | −40 | .. | .. |
| Pressed beef fat..... | −34·0 | .. | 75 | .. |
| Cotton-seed stearin.. | +25·0 | +20 | .. | .. |
| Cotton-seed oil...... | .. | +10 | 129 | 186·6 |
| Sesame oil.......... | .. | −18 | .. | 170·5 |
| Arachis oil.......... | .. | −15 | .. | 175·6 |
| Lard + 20 per cent. arachis oil. | − 8·0 | −23 | .. | 186·0 |
| Lard + 20 per cent. sesamé oil. | .. | −20 | .. | 180·0 |
| Lard + 20 per cent. cotton-seed oil. | − 6·0 | .. | .. | .. |
| Lard + 50 per cent. beef fat. | .. | −33 | .. | 200·0 |
| Lard, 40 per cent.; beef fat, 40 per cent.; cotton-seed oil, 20 per cent. | .. | −24 | .. | 189·4 |
| Steam lard, 60 per cent., beef fat, 15 per cent.; arachis oil, 25 per cent. | − 8·0 | .. | .. | .. |
| Lard, 60 per cent.; mutton fat, 25 per cent.; arachis oil, 15 per cent. | −13·0 | −22 | .. | .. |

It will be seen from these figures that differences which are but slightly marked in the case of the original fats or mixtures become accentuated when the liquid fatty acids are separated and operated upon, and thus the detection of vegetable oils is much aided.—B. B.

*Detection of Cotton-Seed Oil in American Lards.* J. Dupont. Bull. Soc. Chim. 1895, **13**, 775—780.

The three analytical results commonly used in France to ascertain the purity of lard are the reading of the oleo-refractometer of Amagat and Jean, the iodine number and the reaction with silver nitrate. For European samples typical results are: Reading of oleo-refractometer −12·5°; iodine number 59; reaction of silver nitrate, nil. With American lards on the other hand considerable irregularities are observed.

The following table shows the figures obtained with guaranteed samples of such lard:—

| Kind of Lard. | Reading of Refractometer. | Iodine Number. |
|---|---|---|
| | ° | |
| Leaf lard .................. | −11·5 | 58 |
| Back „ .................. | − 5·0 | 64 |
| Belly „ .................. | − 7·0 | 62 |
| Head „ .................. | − 7·9 | 63 |
| Foot „ .................. | − 4·0 | 65 |
| Gut „ .................. | −11·0 | 60 |
| Rancid „ .................. | − 7·0 | 63 |
| Sour „ .................. | − 6·5 | 64 |
| Mixed sample (as marketed) | − 7·0 | 63 |
| Lard oil (1) ................ | − 1·0 | 80 |
| „ (2) ................ | 0 | 82 |

Using the original Bechi test, all these samples gave a coloration, the rancid specimens being noteworthy in this respect. Using Milliau's modification, *i.e.*, working on the fatty acids, negative results were obtained in all cases, save those of the rancid samples which gave doubtful results. When these two samples were purified by washing with alcohol before the preparation of their fatty acids, the result of the test was negative.

From the foregoing figures it is evident that these samples would, if judged by the European standard, be condemned as containing cotton-seed oil. The origin of a sample of lard is therefore to be considered in interpreting the results of analysis. See also this Journal, 1895, 79.—B. B.

*Melting and Solidifying Points of Certain Acids of the Fatty Series.* G. Massol. Bull. Soc. Chim. 1895, **13**, 758—759.

It is stated in the text-books that the solidifying points of propionic and normal valeric acids, as well as those of isobutyric and isovaleric acids, are below − 20° C. The author, using pure specimens of these acids, and working with methyl chloride and with a mixture of solid $CO_2$ and ether, succeeded in determining the solidifying and melting points of all four acids:—

(1.) Propionic acid when cooled remains superfused until − 40° C., and then solidifies suddenly, the temperature rising sharply. It melts at − 36·5° C.

(2.) Normal valeric acid begins to solidify at − 64° C. The melting-point is − 58·5° C.

(3.) Isobutyric acid begins to solidify at − 82° C., the temperature rising to − 79° C. The melting-point is − 79° C.

4. Isovaleric acid has a melting-point slightly higher than that of the normal acid, the figure observed being − 51° C. The solidifying-point is − 57° C.

All four acids exhibit the phenomenon of superfusion, the occurrence of which is most strongly marked in the case of normal valeric acid. Valeric acid has the lowest melting-point of all known normal fatty acids. Of their isomers, isobutyric acid has the lowest melting-point.

—B. B.

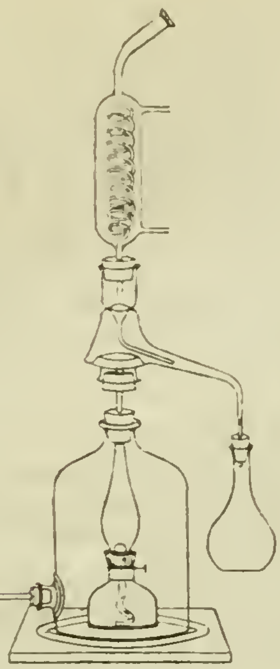
## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

*Estimation of Paraffin in Crude Anthracene.* F. Heusler and J. Herde. Zeits. ang. Chem. 1895, 254.

The method is based upon the observation that all the constituents of crude anthracene, excepting the paraffin, are soluble in fuming nitric acid, and it is carried out by treating about 2 grms. of the crude anthracene in a flask of about 150 c.c. capacity with 25 c.c. of fuming nitric acid. The latter is added drop by drop, the flask being kept in ice-water. All the acid being added, the whole is kept at the ordinary temperature until all the anthracene is dissolved, and after this it is heated on the water-bath until the paraffin is melted. The solution, after cooling, is filtered through an asbestos filter and the paraffin on the filter washed with fuming nitric acid until the filtrate dissolves in water without any turbidity. The washing is then continued with water until the filtrate is neutral. Finally, the paraffin is washed with alcohol and dissolved in warm ether and the filtrates collected in a weighed porcelain dish. After evaporation of the alcohol and ether, the paraffin left, is dried for half an hour at from 105° to 110° C. and then weighed.—C. O. W.

*Estimation of Sulphur in Petroleum.* F. Heusler. Zeits. ang. Chem. 1895, [10], 285—286.

Having in the course of some researches on the desulphurisation of petroleum distillates, &c., had occasion to determine very small quantities of sulphur—0·02 per cent. and lower—the author devised for his purpose a modification of F. Fischer's apparatus for estimating the sulphur in illuminating gas. The form finally adopted consists of a small petroleum lamp with chimney, a return flow condenser and an intermediate portion containing a small funnel through which the liquid dropping from the condenser is conveyed to a receiver situated at the side, as shown in the figure.



The upper end of the condenser coil is closed by a stopper bored in two places, the one aperture communicating with an aspirator inducing a constant draught, and the other forming the means of admitting a supply of potassium permanganate solution—this salt being chosen as oxidising agent on account of the ease with which, by observing the colour, a sufficient supply can be maintained to ensure complete oxidation. The idea embodied in the apparatus is to burn in the lamp a weighed quantity of oil, causing the whole of the products of combustion to pass through the condenser and permanganate, and finally to determine the sulphuric acid in the liquid collected in the receiver by precipitation with a barium salt. This is carried out by connecting the condenser with the lamp chimney, a sufficient air draught to maintain a proper degree of combustion being induced by the aspirator. To prevent error due to the presence of sulphur in the air the lamp is enclosed in a bell glass and the air passed through a soda-lime tube on its way to the flame.—C. S.

*Examination of Fats used in the Leather Industry.* W. Schmitz-Dumont. Dingler's Polyt. J. 1895, **296**, 210—215, 233—239, 259—264.

*For the Estimation of Water* in dégras and other currying fats, 2—3 grms. are heated in a platinum crucible over a very small flame. Or, if only 1—2 per cent. of moisture be present the sample should be dried at 100° C. with frequent stirring (see this Journal, 1893, 938).

*Ash* is determined by burning 10—20 grms. in a flat platinum dish; it should be examined for iron oxide, which has been known to amount to 0·102 per cent. The author remarks that leather discoloured by iron in the grease, may be renovated by washing with 1 per cent. oxalic acid solution.

*Mineral Acids* are washed out of 10—20 grms. of the fat by agitation for five minutes with 200 c.c. of hot water; the mixture is allowed to stand until fat and water have separated, filtered through wet paper, the filtrate shaken twice with 20—30 c.c. of neutral ether to extract soluble fatty acids, and titrated.

*Matter other than Fat* is determined by dissolving 10—20 grms. in petroleum ether (boiling below 75°) and weighing the insoluble residue, dried at 100°. It consists of animal and vegetable fibres, gelatin, albuminoids, and soap. The soap is estimated by warming the undissolved residue with 5 c.c. of sulphuric acid (1 : 10), shaking with 30—50 c.c. of ether and weighing the residue from an aliquot part of the ethereal extract; the fatty acids thus isolated are dissolved in alcohol, titrated as usual and calculated into the soap appropriate to the alkali found in the ash.

*Unsaponifiable Matter* may be extracted from the saponified fat, and weighed, in the usual manner. In the presence of soaps of high molecular weight and insoluble in dilute alcohol, the petroleum ether used for extraction is wont to form a slowly-separating emulsion; the addition of a few c.c. of hot alcohol will cause rapid separation. In the case of a wool-fat, saponification can only be effected by Herbig's method (this Journal, 1891, 1068); Cochenhausen has pointed out (this Journal, 1894, 1100) that the saponification of wool-fat soon reaches a certain limit (about 13 per cent. remains unsaponified), when the process is conducted under a vertical condenser; the author confirms this, and since the limit seems to be practically a constant, whatever the source of the wool-fat, a large deviation from the figure given above will serve as an indication of the presence of other fats.

*To estimate Hydroxy-fatty Acids* ("dégras-former" *cf.* Fahrion, this Journal, 1891, 557; 1892, 639; 1893, 937) 10 grms. of the fat are heated in a dish with a solution of 5—6 grms. of caustic soda in 10 c.c. of water and 50 c.c. of alcohol (95 per cent.) After the alcohol has evaporated, the soap is dissolved in 100 c.c. of hot water, washed into a separating funnel (500 c.c. capacity), and decomposed with dilute hydrochloric acid. When cold the mixture is shaken vigorously for five minutes with 100 c.c. of petroleum ether (boiling below 75°). After some hours the petroleum ether will have separated, and the aqueous liquid may be drawn off, leaving the undissolved hydroxy-acids on the sides of the vessel. The petroleum ether is decanted from the hydroxy-acids which are then washed with the same solvent and dissolved in hot alcohol (to separate salt); the solution is evaporated and the residue dried at 100°—105° and weighed. According to Simand (*Gerber* 1890, 243) some of the hydroxy-acids remain dissolved in the aqueous liquid, but the author finds that the amount thus lost is too small to warrant the adoption of Simand's scheme for its recovery.

The unsaponifiable matter may contain mineral oil (occasionally rosin oil), higher alcohols and wool fat. The specific gravity or iodine number will decide between, rosin oil and mineral oil. If wool-fat be suspected, complete saponification may be effected by heating the "unsaponifiable" matter for 1—2 hours with 25 c.c. of 2 N alcoholic potash in a thick-walled stoppered 100 c.c. glass flask (which is more convenient than Herbig's copper tube) immersed in an oil-bath at 105°—110°. The contents of the flask are cooled to 50° and shaken with petroleum ether to extract the still unsaponified portion.

*Detection of Wool-fat.*—The author discusses at length the problem of the detection of wool-fat. The separation of cholesterol in the form of its acetate, which melts at 114° (Benedikt still erroneously gives the melting point as 92°), will serve this purpose, provided it be many times recrystallised from alcohol. The unsaponifiable matter should be heated in a small flask with 15—20 c.c. of acetic anhydride for two hours under a vertical condenser; the mass is then heated for 15—20 minutes with 100—200 c.c. of water, the liquid is cooled and filtered and the acetate recrystallised from hot alcohol, weighed and calculated into cholesterol by multiplying by the factor 0·9. This method of detection and estimation is at the best inaccurate and frequently fails, particularly in the presence of mineral oils. The determination of the saponification number of the acetylised mass, according to Lewkowitsch's method (this Journal, 1892, 134) will serve in such cases, the result including, of course, other acetylised alcohols that may be present. Simand (*der Gerber*, 1893, 278) gives the following features as characteristic of dégras containing wool-fat: (1.) The material, deprived of water, will have a tenacious consistency and a lustrous, non-crystalline surface. (2.) The melting point of the fatty acids will be high if any of them belong to wool-fat, and it will be difficult to determine, since the substance will become transparent in a capillary tube before it melts. (3.) The characteristic odour of wool-fat will be detected when the sample is rubbed in the hand. In the author's experience samples exist in which wool-fat cannot be detected by these indications, although in the majority of cases they are effective.

The acid number is determined as usual and the iodine number by Fahrion's method (this Journal, 1892, 183;

1893, 68), it being found to be unnecessary to isolate the anhydrous fat from its emulsion with water. The saponification number is determined in the usual way, but if the sample contain more than 30—40 per cent. of water the fat must be separated. In ascertaining both this constant and the acid number the possible presence of mineral acid, particularly in sod oil (*Weissgerber dégras*), must be borne in mind. In the case of wool-fat Herbig's method (this Journal, 1892, 134, and 1894, 1068) must be adopted for complete saponification (compare above).

*Determination of Rosin* (see this Journal, 1894, 668). See also this Journal, 1895, 78.—A. G. B.

### *New Method for the Quantitative Estimation of Starch.*
Dennstedt and Voigtländer. Forschungsber, Lebensmittel, Hyg. farens. Chem., Pharmakogn 1895, **2**, 173.

The authors base their method on the fact that the depth of colour produced by mixing starch and iodine solutions under certain experimental conditions is proportional to the starch content. For the preparation of a solution for comparison, a starch is employed, the same as that of the body the starch content of which is to be estimated. The water, fat and protein is next determined in the starch, and the difference of these values from 100 is taken as pure starch. A quantity corresponding to 0·5 grm. of starch is weighed, boiled with 1,000 c.c. of water for an hour, and on cooling made up to a litre. When the starch cellulose is deposited, 5 c.c. of this solution is measured into a number of 100 c.c. cylinders of similar shape, and graduated to 0·5 c.c.; one drop of a 2 per cent. solution of iodine in iodide of potassium is added, and each cylinder filled up with water to 100 c.c. The resulting colour will be the same in all cylinders, but the tint may not be the best for comparison, and the most suitable blue can be produced by varying the amount of iodine.

To render the comparison more accurate, in two series of cylinders are placed 4·9 c.c. and 5·1 c.c. respectively of the prepared starch solution; then on adding the iodine and water the clearest of the first and the darkest of the second are selected for the comparison. The moisture in the material of which the starch content is to be determined is then estimated, and a quantity equal to 0·5 grm. of the dry substance is weighed, and, as above stated, boiled with water. 5 c.c. of this solution is placed in each of the cylinders, and, after addition of the iodine solution, water is added until the tint of colour corresponds with the standard. The percentage of starch is directly read off. Inferior meals sometimes give a starch solution forming a violet coloration with iodine, the comparison of the colour with the standard is thus rendered impossible. In such cases the meal is mixed with a little alcohol, and, on standing for some time, is filtered through a filter free from starch, and washed first with alcohol, then ether, and finally alcohol. The meal and filter are put into a flask, boiled with water as before described, and made up to 1,000 c.c.

The authors state that by this method it is possible to estimate the starch content of a substance within 0·5 per cent., or often still more closely.—J. L. B.

### *Determination of the Volatile Acids in Wines.*
E. Burcker. Comptes rend. 1895, **120**, 1223—1225.

In this paper the author describes a number of experiments which were undertaken in order to determine the degree of accuracy attainable in estimating the volatile acids of wine by the method of distillation in a current of steam. The results obtained by this method are shown to be sufficiently accurate, and comparable with those obtained by the much longer method of evaporation in a vacuum.

The maximum limit of the volatile acid (expressed as $H_2SO_4$) should not exceed 0·7 per litre in the case of sound French wines, but in Algerian and Tunisian wines may be as high as 1·6 per litre.—A. K. M.

### *Analysis of Spirituous Liquids (Liqueurs, &c.).*
M. Mansfeld. Zeits. f. Nahrungsmittel-Untersuchung. 1894; Monit. Scient. 1895, 294—298.

Prior to analysis, the odour and flavour of the spirit should be observed. After some experience, most valuable indications are thus afforded. The odour is best rendered evident by allowing a small quantity of the spirit to evaporate spontaneously in a thin layer, when the ethers, &c., to which the "bouquet" is due, will remain behind.

*Density.*—Determined at 15° C. by means of a pyknometer.

*Alcohol.*—Determined by distilling 100 c.c. of the spirit previously rendered alkaline with a few drops of soda solution. The distillate is made up to the same volume as the original spirit, and the specific gravity taken at 15° C. In case of strong spirits, the condenser tube should be drawn out, and should dip below the surface of a little water contained in the receiver.

*Extract.*—50 c.c. of the sample are evaporated in a platinum dish, the residue dried for 2½ hours at 100° C., and weighed. If the residue be moist or liquid, the presence of glycerol is indicated. The latter may be detected by heating the extract with powdered potassium bisulphate (acroleïn vapour is given off). In the case of liqueurs, the extract may be deduced indirectly from the density of the de-alcoholised sample.

*Ash.*—As a rule the amount of ash is insignificant, and it is only estimated in order to determine whether the spirit has been diluted with water, in which case the ash will probably contain lime. Copper, if present, is detected colorimetrically in the ash.

*Sugar.*—50 c.c. are evaporated to a small bulk in presence of animal charcoal, filtered, and again diluted to 50 c.c. The sugars (usually consisting of invert and cane sugars) are then deduced from the optical activity of the solution before and after inversion. If the results indicate the presence of starch glucose, the latter is determined by Fehling's solution.

*Colouring Matters.*—The colouring matter of spirit is derived from the storage cask, or may consist of added tannin, caramel, coal-tar dyes, &c. Tannin is readily detected (in the residue from the distillation) by the ferric chloride reaction; and, if no other colouring matter be present, the sample should be completely decolorised by precipitation with albumin. As a rule, however, the tannin is accompanied by caramel. The latter may be precipitated by paraldehyde (Amthor's method). 10 c.c. of the residue are treated with 30 c.c. of paraldehyde, sufficient alcohol being added to secure intermixture of the liquids. After about 24 hours a precipitate, which adheres to the sides of the containing vessel, separates. It is washed with alcohol dissolved in water, the solution filtered, and evaporated to 1 c.c. A quantitative estimation may be made by colour-comparison with a caramel solution of known strength. In presence of much sugar, a portion of the latter is precipitated along with the caramel. In such cases, the above solution is tested with phenyl-hydrazine in the cold. A precipitation augmented by heating the solution indicates the presence of caramel with certainty. For the detection of coal-tar dyes, the de-alcoholised spirit is rendered alkaline with ammonia, extracted with amyl alcohol, the amylic solution evaporated, the residue heated with strong sulphuric acid to destroy sugar, redissolved in water, made alkaline with ammonia, and again extracted with amyl alcohol. The alcoholic solution when evaporated leaves behind the colouring matter in a state of purity. Its nature may be determined by making dye experiments with wool or silk, &c. in the usual way.

*Bitter Substances.*—As the isolation and identification of these substances is a matter of extreme difficulty, it will usually suffice to demonstrate the absence of harmful bitter principles (aloes, &c.). For this purpose, the de-alcoholised sample is extracted with amyl alcohol, and the latter evaporated. The residue should be quite free from bitter flavour. In presence of aloes, the extract is yellowish, and if heated and evaporated with nitric acid, yields the reactions of picramic acid (production of a red coloration when heated with ammonium sulphide).

The estimation of ethers and other secondary products of fermentation is usually effected in the distillate from the spirit—diluted if necessary, to a standard strength by the addition of water or absolute alcohol, as may be required.

*Acids.*—25 c.c. of the original spirit are titrated with $\frac{N}{10}$ sodium hydrate, using phenolphthaleïn as indicator. Results to be stated in terms of acetic acid.

*Aldehydes.*—The following test solution is required: the ingredients to be mixed in the order given—

| | |
|---|---|
| Freshly prepared aqueous solution of fuchsin (1 per cent.) | |
| Saturated solution of sodium bisulphite ...... | 100 |
| Distilled water ................................ | 1,000 |
| Sulphuric acid (conc.)........................ | 15 |

4 c.c. of the reagent are added to 10 c.c. of the distilled spirit (containing 50 per cent. of alcohol by volume). A pink coloration is developed — attaining its maximum intensity in about 20 minutes—in presence of aldehyde. Its amount is determined by comparing the tint with that produced in a solution of acetic aldehyde (1:20,000) in 50 per cent. alcohol. The comparison is best made in narrow glass cylinders (1 cm. diameter, 15 cm. high), standing on a white surface, and viewed from above. The tints are equalised by varying the depth of the column in the comparison cylinder.

*Furfurol.*—Determined colorimetrically by the reaction with aniline acetate. 10 c.c. of distillate (50 per cent.) are treated with 0·05 c.c. of aniline and 2 c.c. of acetic acid, and the reddish-orange coloration matched by a solution of furfurol (1:200,000) in 50 per cent. alcohol.

*Ethers.*—25 c.c. of distillate are exactly neutralised, and boiled with 25 c.c. of $\frac{N}{10}$ caustic soda under an inverted condenser for 15 minutes. 25 c.c. of $\frac{N}{10}$ HCl are then added and the excess titrated by standard alkali. Results to be expressed as ethyl acetate.

*Higher Alcohols.*—The spirit, previously rendered alkaline with soda, is distilled, and the distillate diluted until it contains, as nearly as possible, 30 per cent. of alcohol by volume (± 0·05 per cent.). In this liquid, the higher alcohols are determined by Röse's method. (This Journal, 1886, 498, 1888, 396, 871; 1889, 559). Or the sulphuric acid test (employed in the municipal laboratory of Paris) may be used, which is based on the fact that alcohol containing fusel oil, is coloured yellow or brown by heating with strong sulphuric acid. Aldehydes must be first of all removed by treatment with *m*-phenylenediamine, and the coloration yielded by a solution of isobutyl alcohol in 50 per cent. spirit employed for comparison.

*Nitrogenous Compounds* (Amide, pyridine, and alkaloid N).—Wanklyn's method is used. The distillation residue of the spirit is diluted with 500 c.c. of water. 20 grms. of caustic soda added, distilled, and the distillate "nesslerised" in the usual way. (Result = amide N.) 80 c.c. of alkaline permanganate solution (8 grms. $KMnO_4$, 20 grms. KOH per litre) are then added, and the distillation, &c., continued. (Result = basic N.) The total nitrogen may also be determined by Kjeldahl's process.

Certain spirits ("Kirsch" and "eau-de-vie de prunes") contain hydrocyanic acid, which may be estimated colorimetrically. To 10 c.c. of the spirit, three drops of a solution of copper sulphate (0·5 per cent.) and 1 c.c. of tincture of guaiacum (15 grms. of the resin dissolved in 100 c.c. of 50 per cent. alcohol) are added, and the coloration matched by means of laurel water of known strength in HCN. A more accurate process consists in distilling the alkaline residue from the alcohol determination with 2 c.c. of syrupy phosphoric acid. The hydrocyanic acid is received in weak alkali, and determined by titration with $\frac{N}{50}$ silver nitrate, one drop of hydrochloric acid being added as indicator.

Artificial spirits sometimes contain benzaldehyde. To detect the latter, the spirit is diluted with twice its volume of water, and extracted by ether. The ethereal solution is agitated with sodium bisulphite solution, the latter acidified and extracted with fresh ether. The ethereal solution when evaporated, leaves behind benzaldehyde in the form of oily drops.—H. T. P.

### *Composition and Analysis of Spirits.* X. Rocques. Monit. Scient. 1895, 265—272.

In an extensive table the analyses of a series of "eaux de vie de vin" and "de marc," cognacs and rums are given. The more important constituents were estimated as under:—

*Total Acids.*—By direct titration with $\frac{N}{10}$ alkali, using phenolphthaleïn as indicator.

*Ethers.*—By saponification with $\frac{N}{10}$ alkali, and subsequent titration.

*Aldehydes.*—Determined colorimetrically by means of bisulphite of rosaniline.

*Furfurol.*—Estimated by the colour reaction with aniline acetate.

*Higher Alcohols.* — Determined colorimetrically—the aldehydes being previously removed by means of *m*-phenylenediamine—by heating with concentrated sulphuric acid, a solution of isobutyl alcohol being used for comparison.

*Ammonia* (saline, amide, and basic N).—Determined by Kjeldahl's method.

The results exhibit considerable variations between the respective maximum and minimum values obtained in the case of different samples (the variations are least in the case of rums), and no reliable conclusions can be formed as to the genuineness of a given spirit from any one determination. The author, however, is of opinion that the ratio of ethers to higher alcohols is an indication of some value, and will, when taken in conjunction with the proportion of total volatile impurities, and the flavour, odour, &c., of the spirit, suffice to reveal the nature of the sample under examination. In practice four possible cases may occur:—

1. The spirit is genuine. In this case the chemical composition will be normal and the flavour good.
2. The sample consists of a mixture of genuine spirit with highly rectified industrial alcohol. Apart from flavour (good), spirits of this kind are indicated by an abnormally low content in *all* the usual impurities, owing to the fact that rectified alcohol is practically free from impurities, and therefore acts simply as a diluent.
3. The spirit consists of badly rectified industrial alcohol, or of a mixture of the same with genuine spirit. Here, again, the total amount of impurities will be small (but normal in constitution). The odour (of sugar-beet, or molasses alcohol, &c.) is, however, frequently characteristic, and may be readily distinguished—after some practice—when the sample is diluted with warm water.
4. Artificial spirit, produced by the addition of essences, &c. to rectified alcohol. Spirits of this description are usually decisively indicated by analysis, the impurities being small in amount and abnormal in character.—H. T. P.

### *Method for Determining the Amount of Extractive Matter of Malt.* A. L. Stern. Journ. Fed. Inst. of Brewing, 1895, 448—450.

Two portions of ground malt, each weighing exactly 50 grms., are mashed under the usual conditions, each with about 200 c.c. of water. The two mashes are cooled, and about 150 c.c. water added to one; they are weighed, and the difference in their weights noted. The specific gravities of a filtered portion of each mash are also determined. Then if S.G.′ and S.G.″ be the two specific gravities, and A the difference in weight of the two mashes, the volume of the first mash free from grains $= V = \frac{S.G.''-1}{S.G.'-S.G.''} \times A$. Then, knowing the volume of the first mash free from grains, its specific gravity, and the quantity of malt, it is easy to calculate the extract as brewers' pounds per barrel per quarter.—A. L. S.

### *Detection and Estimation of Alum in Wines.* Georges. Bull. Soc. Chim. 1895, [3], **13**, 692—696.

Twenty c.c. of the wine are measured into a wide test-tube and 2 c.c. of a solution of pure tannin (from ether), containing 3·4 grms. per 100 c.c., are added; after agitation, 3 c.c. of a solution of sodium acetate, containing 24 grms. per 100 c.c., are added, and the mixture is again shaken. If, after five minutes at rest, a clotted precipitate appears, the presence of alum may be affirmed; if, on the other hand, the sample remains clear or becomes but slightly clouded, the wine is normal or contains a smaller proportion of alum than 0·1 grm. per litre. After one hour the precipitate should be filtered, when its appearance will further indicate its origin. When it is from an adulterated wine it will have a gelatinous appearance on the filter, and will break up into little clots under the stream of water directed upon it from the wash-bottle; its colour will be a more or less dark bluish-black. When it is from a normal wine, on the other hand, it will coat the paper with a thin, uniform, red layer, and will wash through the paper.

For the estimation of the alumina, a solution of 1 grm. of pure tannin in water is added to 500 c.c. of the wine, and is followed by a solution of 25 grms. of sodium acetate. The precipitate is washed by decantation, filtered, ignited, and the alumina separated from the wine by any known method, and weighed.—A. G. B.

## XXIV.—SCIENTIFIC AND TECHNICAL NOTES.

*The Contributions of Chemistry to the Methods of Preventing and Extinguishing Conflagrations.* T. H. Norton. Jour. Amer. Chem. Soc. 1895, **17**.

This paper summarises in the following references the bibliography of the subject:—

Hexamer: Jour. Franklin Institute, 1885.

Pharm. Centralbl. 1885, 447.

Versmann and Oppenheim: Report to British Association, 1859.

Sir F. Abel's Rep. to Brit. Ordnance Dept. on preceding of 1859 and 1860: Amer. Arch. **13** and **14**. J. Soc. Arts. 1883.

Gay-Lussac: Ann. Chim. Phys. **18**, 211.

Frémy: Dict. de Chimie, 10.

Patera: Flammenschutzmittel, Wien, 1871.

Vendt and Herard: Génie civ. **6**, 227.

Scient. Amer. Cyclop. of Receipts, 217.

Rymer-Jones: Ecl. Eng. Mag. 1885, **33**, 55.

Boudin and Donny: Rapport sur les procédés destinés à assurer l'uninflammabilité des bois, Gand, 1887.

Helbig: Archiv. f. Hygien, 1888, 111.

Troost: Bull. de la Soc. d'encouragement, 1880, 384.

F. Fischer: Dingler's polyt. Jour. **245**, 36.

Lochtin: Dingler's polyt. Jour. 1893, **290**, 230 (this Journal, 1894, 512).

This Journal, 1883, 494.

The subject is then considered in two sections, the first devoted to fire extinguishers and the second to protective agents.

The most recent chemical extinguisher is that of Weidig (1893); it consists of a steel vessel containing liquid carbon dioxide, so arranged that it may be connected with a receptacle filled with carbonated water, or a solution of ammonium carbonate, under any desired pressure. The carbonated water discharged through an exit pipe, meets with a stream of ammonia discharged from a cylinder of liquefied ammonia. The carbon dioxide is thus ejected in a combination in which it is more soluble at atmospheric pressure than in water, and the ammonia is liberated together with the carbon dioxide at the seat of conflagration. One volume of the mixture yields 25 volumes of these two gases.

Geissler analysed three kinds of hand grenades; they contained solutions of calcium and magnesium chlorides, sodium and ammonium chlorides, and sodium carbonate and chloride respectively.

Mixtures of nitre, sulphur, and charcoal, with or without inert materials are also used in the form of powders, so as to produce sufficient carbon and sulphur dioxides to check combustion.

The result of experience with protective agents has shown that for textile fabrics, sodium tungstate and magnesium borate yield the best results when the materials are to be ironed, while ammonium phosphate or sulphate is preferable in other cases. According to Abel, calcium chloride is valuable to protect rope mantelets for gunners, and stannic oxide, or, better, double silicate of sodium and lead, will protect canvas.

The author arranges the results of Boudin and Donny with regard to the efficiency of the different current protectives for wood in the following series, ascending from what are stated to be the least effective to the most effective:—

*Preparations alleged to be of little value.*

1. Solution of sodium tungstate, 56 kilos. per cb.m.
2. „ copper sulphate, 20 „ „
3. „ calcium chloride, 50 „ „
4. „ ammonium chloride, 18 „ „
5. Coating of water-glass (43 per cent. solid residue), 1 coat, 286 grms. per sq. m.
6. Coating of water-glass and zinc oxide, 4 coats, 1 kilo. per sq. m.
7. Coating of Martin's ignifuge, No. 4; 2 coats, 450 grms. per sq. m. [Ammonium chloride (15 parts), boric acid (6 parts), borax (3 parts), water (100 parts).]
8. Coating of Brocher's preparation, 3 coats.
9. Coating of Blanc's asbestos paint, 2 coats, 1 kilo. per sq. m.
10. Coating of cyanite (basic aluminium silicate), 2 coats, 450 grms. per sq. m.

*Preparations stated to be of some Value which lessen the Inflammability of Wood.*

11. Covering of cyanite, 3 coats, 570 grms. per sq. m.
12. Covering of asbestos paint, 3 coats, 820 grms. per sq. m.
13. Covering of water-glass and ferric oxide, 4 coats, 700 grms. per sq. m.
14. Covering of water-glass and powdered glass, 6 coats, 900 grms. per sq. m.
15. Covering of water-glass (undiluted), 3 coats, 475 grms. per sq. m.

*Preparations stated to be of High Efficiency.*

16. Covering with asbestos paint, consisting of water-glass, sodium aluminate, and asbestos; 3 coats, 850 grms. per sq. m.
17. Injection of ammonium phosphate, absorption of 75 kilos. per cubic metre after boiling for 12 hours in a 16 per cent. solution of the salt.

The explanation of the action of protectives is summed up as follows:—The combustion consists of two stages, the burning of inflammable gases from the wood and the subsequent combustion of the charcoal. Two distinct agents can retard the process: the first is the evolution of an inert or non-combustible gas or vapour from the wood through the influence of heat; the second is the presence of an external coating, which is not only a poor conductor of heat, but also protects the outside zone of charcoal from the atmosphere.—A. G. B.

*Properties of the Kola Nut.* J. Soc. of Arts, 1895, 831.

The physiological properties of the kola nut are said to be due to a glucoside, which exists in the red portion of the nut, and is decomposed by hydrolysis into caffeine and a colouring substance.

Those who desire to use the kola nut are advised to masticate slowly fragments of the fresh nut, and to reject absolutely all other preparations.

It is difficult to adulterate fresh nuts, whilst the dried preparations are frequently spurious.—A. L. S.

*Additive Compounds of Ferric Chloride with Nitric Oxide.* V. Thomas. Bull. Soc. Chim. 1895, [3], **13**, 229—231.

When dry nitric oxide is passed into a flask containing dry ferric chloride until an attached manometer shows no further decrease of pressure due to absorption, two compounds are formed. The first of these, $Fe_2Cl_6.NO$, is the sole product when the operation is conducted at the ordinary temperature; the second, $2Fe_2Cl_6.NO$, is produced at 40°—60°. At higher temperatures than that just named, nitric oxide reduces ferric to ferrous chloride, with formation of nitrosyl chloride. Both the above compounds are deliquescent powders, and decompose in contact with water, evolving nitric oxide; heated in the air, they yield ferric oxide.—A. G. B.

### *Tin Oxides and their Uses.* Erik Enequist. Eng. and Mining J., Sept. 7, 1895, 219.

Tin oxide or stannic oxide ($SnO_2$) is used as a polishing material for glass. It is generally mixed with lead oxide, and sold under the name of putty powder. It is prepared from metallic tin by melting it and pouring the hot metal into water, thus granulating the tin. In this state it is introduced into an earthenware pot containing hot dilute nitric acid, which rapidly oxidises it. Water is added during the process, otherwise the precipitate would not be obtained in a thin state. When sufficient tin has been added the process is interrupted, water is introduced, the contents of the pot discharged, and more water added. The stannic acid ($H_2SnO_3$), now settles to the bottom, and after washing three or four times, the last water becomes milky, and all acidity is eliminated. Tin oxide can also be manufactured from metallic tin by heating it and condensing the oxide which volatilises.

Tin oxide is a very important factor in the manufacture of all kinds of glazes in which whiteness is desired, also in the manufacture of enamel. A small quantity of the pure oxide will give enamel an intensely white colour, and it is the best material known for making opaque glaze or glass. The enamelling industry consumes considerable quantities. Glazed brick and tile manufacturers also use large quantities of it.

Stannous oxide (SnO) is best prepared by precipitating stannous chloride with carbonate of soda or caustic soda, washing the precipitate with water free from air, and heating the lixiviated product with exclusion of air. It is then obtained in a nearly pure state. It is a dark grey powder, which absorbs oxygen from the air, and is violently oxidised by nitric acid and other oxidising agents. It is employed in glass, enamel, &c., to prevent oxidation. It is used in the production of copper-ruby glass. It is quite likely that this material can be put to more important uses when it can be obtained at a lower price than the present, which is about 60 c. per pound. Very little, if any, of that in the market is of satisfactory quality.

### *Aluminium.* Eng. and Mining J., Sept. 7th, 227.

The new aluminium plant of the Pittsburg Reduction Company at Niagara Falls started actual work on August 28th last. The plant consists of long lines of iron pots, 30 in all, lined with carbon, which are connected up "in series." The positive end of one pot is connected with the negative end of the next. The current is conducted by copper bars extending over each pot down through round copper rods to carbon anodes. The aluminium produced goes to the negative electrodes, which are the bottom of the pots in which the operation is conducted, and remains there in a molten mass. The aluminium is taken out of the pots either by tapping from a vent in the bottom of each pot or by taking out some of the carbon anodes and ladling the molten metal out into ingot moulds. The pots are tapped every 24 hours. The current, as it comes from the dynamo of the Niagara Power Company, is received in a "step-down" transformer. Thence it is transferred to the rotary transformers, changing the alternating current of 116 volts to a direct current of 160 volts. The two dynamos now in position will probably be run alternately for periods of 72 hours. The dynamo is at present generating about 2,000 horse-power, which is all demanded by the Reduction Company. The maximum capacity is supposed to be 5,000 horse-power, but a preliminary test showed the dynamo capable of 5,400 horse-power. This, however, is not greatly in excess of 5,000 when delivered. The dynamos are made of nickel steel, and are 11½ ft. in diameter.

### *Reduction of Nitrous Oxide by Metals in the Presence of Water.* P. Sabatier and J. B. Senderens. Comptes rend. 1895, **120**, 1212—1215.

In a previous paper (see following abstract) it was shown that, in the presence of moistened iron or zinc, nitric oxide is reduced, not only to nitrous oxide, but also to nitrogen. The authors now confirm the view, previously expressed, that nitrous oxide is reduced to nitrogen; this reduction takes place at the ordinary temperature in the presence of magnesium, zinc, iron, or even cadmium when the metal is moistened with water. A small amount of ammonia is simultaneously formed.—A. K. M.

### *Reduction of Nitric Oxide by Moist Iron or Zinc.* P. Sabatier and J. B. Senderens. Comptes rend. 1895, **120**, 1158—1161.

It is known that when nitric oxide is kept in contact with moist zinc or iron it becomes slowly reduced to nitrous oxide, whilst some ammonia is also formed; the conditions of the reactions, however, have not been determined.

The authors have experimented under different conditions, and they find that with moist iron the reaction is at first in accordance with the equation—

$$6NO + 3Fe = N_2 + 2N_2O + Fe_3O_4$$

Later on, the nitrous oxide gradually decreases, whilst the nitrogen increases and hydrogen is also formed in abundance; the latter, however, is accounted for by the action of the iron on the solution of ferrous sulphate employed. Only a small quantity of ammonia was produced. It appears from the experiments described, that nitrous oxide is itself reduced to nitrogen by moist iron or zinc, and this is a point which the authors intend to investigate.

—A. K. M.

### *Copper Ferrocyanide.* G. Rauter. Zeits. ang. Chem. 1895, [11], 315—316.

Highly contrary opinions exist as to the composition of the precipitate produced by the reaction of solutions of copper salts on potassium ferrocyanide. According to Reindel the formula should be $K_2Cu_3[Fe(CN)_6]_2$; Wyrouboff gives it as $Cu_2Fe(CN)_6$; whilst Luckow attributes to it the following constitution (according to the circumstances attendant on the precipitation), viz., either $K_2Cu_3[Fe(CN)_6]_2$, $K_{10}Cu_{11}[Fe(CN)_6]_8$, $K_6Cu_5[Fe(CN)_6]_4$, or $K_{14}Cu_9[Fe(CN)_6]_8$.

From the results of analyses performed by the author it would appear that the precipitate from solutions of medium concentration, although always containing potassium, does so merely as an impurity, the potassium ferrocyanide being very difficult to remove by washing. This view is supported by the fact that the proportion of potassium varies inversely with the extent to which the precipitate is washable. The water present seems to be retained hygroscopically, and diminishes as the percentage of potassium increases.—C. S.

### *The Properties of Thorium Nitrate.* Chem. Trade J., Sept. 14, 1895, 165.

Owing to its increased use for making incandescent lighting mantles, nitrate of thorium has become an article of commerce. The following particulars will therefore be useful in valuing the purity of the salt. The pure salt crystallises colourless, and becomes white on drying. A faint yellow colour of it or its solution is unimportant if due to traces of organic bodies; but if due to iron oxide, uranium oxide, cerium oxide, &c., is objectionable. The pure nitrate should not give a coloration with sulphuretted hydrogen, nor with ammonium sulphide when in solution in alkaline carbonates. It is completely soluble in excess of carbonate, and is not thrown out of solution by ammonia or by dilution. On warming, the solution becomes cloudy through separation of the hydroxide, which, however, dissolves again on addition of ammonia. The nitrate crystallising with 12 mols. of water gives on ignition 37·95 per cent. of thoria. The same sort dried at 100° C. contains 4 mols. of water, and yields on ignition 47·84 per cent. of pure white thoria. More water may be removed from the salt by drying at a higher temperature; but there is risk of the formation of difficultly soluble basic salts. If the salt with 4 mols. of water gives a residue of more than 47·8 per cent. on ignition, it may be concluded that it is contaminated with earths of lower molecular weight.

## New Books.

The Gas, Coal, and Iron Interests of Western Pennsylvania, and Gas Engineering Tables. Compiled and edited by F. L. Slocum. Published by The Fort Pitt Engraving Company. Pittsburgh, Pa., U.S.A. 1895.

This work, published in commemoration of the Eighteenth Annual Meeting of the Western Gas Association, held in May of the present year, contains an illustrated account of the present development of the industries concerned in the Manufacture of Gas, Coal, and Iron in Western Pennsylvania. It contains 174 pages of descriptive subject-matter, and is illustrated by 54 plates and a frontispiece portrait of the President of the Western Gas Association—Isaac C. Baxter, of Detroit. There are Tables useful to Gas Engineers, preceded by an alphabetical index, occupying thirty-six pages.

Hanwörterbuch der Pharmacie. Praktisches Handbuch für Apotheker, Ärzte, Medicinalbeamte und Drogisten. Herausgegeben von A. Brestowski. Wien und Leipzig: Wilhelm Braumüller, k.u.k. Hof- und Universitäts-Buchhändler. 1894. London: H. Grevel and Co., 33, King Street, Covent Garden. Price per number, M. 2.40.

In continuation of this Dictionary of Pharmacy, Part 23 now appears. It commences (page 785) with "*Vitale Lungencapacität*," and ends (page 864) with "*Zucker*," which is to be continued in Part 24, yet to appear.

Jahrbuch der Chemie. Bericht über die Wichtigsten Fortschritte der Reinen und Angewandten Chemie. Unter Mitwirkung von H. Beckurts, R. Benedikt, C. A. Bischoff, E. F. Dürre, J. M. Eder, P. Friedländer, C. Häussermann, M. Märcker, W. Nernst, F. Röhmann, und K. Seubert. Herausgegeben von Richard Meyer. IV. Jahrgang, 1894. Braunschweig: Friedrich Vieweg und Sohn. 1895. Price 16*s*. London: H. Grevel and Co., 33, King Street, Covent Garden.

This 8vo work contains a report for the year 1894 of the advance of Pure and Applied Chemistry. The subject-matter occupies 609 pages, preceded by a table of contents and terminated by alphabetical indexes of subject-matter and authors. The various branches of the pure and applied science are as follows:—

I. Physical Chemistry. W. Nernst and F. W. Küster. II. Inorganic Chemistry. Karl Seubert. III. Organic Chemistry. C. A. Bischoff. IV. Physiological Chemistry. F. Röhmann. V. Pharmaceutical Chemistry. H. Beckurts. VI. Chemistry of Foods, &c. H. Beckurts. VII. Chemistry of Agriculture. M. Märcker and W. Naumann. VIII. Metallurgy. E. F. Dürre. IX. Fuel and Inorganic Chemical Technology. C. Häussermann. X. Explosives. C. Häussermann. XI. Technology of Carbohydrates and of the Fermentation Industry. M. Märcker, E. H. Schultze and W. Naumann. XII. Technology of Fats. R. Benedikt. XIII. The Chemistry of Tar and of Dyestuffs. Richard Meyer. XIV. Chemical Technology of Textile Fibres. P. Friedländer. XV. Photography. J. M. Eder and E. Valenta.

The Brewing of Non-Excisable Beers. By J. Pocock. Bangor: Nixon and Jarvis. 1895. Price 2*s*. 6*d*., post free.

This 12mo work contains frontispiece illustrating the microscopic appearances of *Saccharomyces cerevisiæ* and the ferment from a bottle of hop bitters, a preface, and 63 pages of text with 6 woodcuts, illustrations of micro-photographs of various yeast organisations.

The gist of the work may be stated in one sentence, viz., to show how so-called "teetotal beverages" may be brewed so as to avoid the formation of an excess of alcohol! The following suggestive statement is quoted from the preface:—"The analysis of 40 typical samples of these drinks have proved that they contain on an average 4·8 per cent. of proof spirit; the proportions of the intoxicant actually ranged from 3·1 to as high as 8·2 per cent. The original gravities of these temperance beverages range from 12·8 to 68·4 degrees; the last named, being also the most alcoholic, is actually stronger than some heavy ales and stouts, and ought to have paid at the present rate a duty of 8*s*. 4*d*. per barrel."

Abstract of Thirteenth Annual Report of the Committee on Indexing Chemical Literature. From Vol. **44**, Proc. of the Amer. Assocn. for the Adv. of Science, Aug. 1895.

The Committee on Indexing Chemical Literature has presented its thirteenth annual report.

Several chemists have made reports of progress:—

Prof. Henry Trimble, of Philadelphia, states he continues to collect references to the literature of the Tannins with the expectation of further publication at no very distant date.

Prof. Arthur M. Comey reports that his Dictionary of Solubilities, Vol. I., is nearly all in type, and should appear early in the autumn.

Dr. Alfred Tuckerman expects to complete the MS. of his Index to the Mineral Waters of all Nations in a few months.

Dr. H. Carrington Bolton reports having done much work on the supplement to his Bibliography of Chemistry, the MS. now comprising about 6,500 titles.

Mr. George Estes Barton, of the same Institution, is at work on a Bibliography of Glycerol; and Mr. George Baden Pfeiffer, also of the Columbian University, is engaged on a Bibliography of Picric Acid and the Nitrophenols.

At the request of the Smithsonian Institution Dr. H. Carrington Bolton has undertaken to edit a new edition of his "Catalogue of Scientific and Technical Periodicals, 1665—1882," published in 1885 in the Smithsonian Miscellaneous Collections. The new edition will bring down to date the old periodicals and include new ones established since 1882. The work is well under way.

Mr. W. D. Bigelow, of the Chemical Division of the U.S. Department of Agriculture, has completed the MS. of an Index to Methods for the Detection and Estimation of Fusel Oil in Distilled Liquors. The channel of publication has not been determined.

In a communication to the chairman, Professor W. Percy Wilkinson, of Melbourne, states he is engaged on an Œnological Bibliography, to include works relating to the vine, viticulture, wine-making, vine-diseases, and wine-analysis, published in Germany, France, England, America, Italy, Portugal, and Spain. He expects the bibliography to number 2,000 titles, and will give full details as to date, size, editions, &c. It is to be published by the Royal Society of Victoria.

The following special bibliography has recently appeared in France: "Bibliographie de la technologie chimique des fibres textiles. Propriétés, blanchîment, teinture, matières colorantes, impression, apprêts. Par J. Garçon. Paris, 1893. 8vo." This work has been honoured with a prize by the "Société industrielle de Mulhouse."

## Prizes.

### Prizes for Research.

*Pharm. J., September* 21*st*, 1895, 256.

The following are among the subjects for the investigation of which the Royal Society of New South Wales offers its medal and the sum of 25*l*., provided the communications are found to be of sufficient merit: The physiological action of the poison of any Australian snake, spider, or tick; the chemistry of the Australian gums and resins; the chemical composition of the products from the so-called kerosene shale of New South Wales. The competition is not subject to any restrictions, and the successful papers will be published in the Society's annual volume, fifty reprints being furnished to the authors free of expense. Further particulars can be obtained from the honorary secretaries, T. W. G. David and J. H. Maiden, 5, Elizabeth Street, Sydney.

# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

### France.

#### *Customs Decisions.*

According to the *Journal des Tarifs et Traités de Commerce* for July 18 last, it has been decided that copper wire, tinned, will pay the same duty as copper wire, plain, the amount of tin used being so minute.

From the same source it appears that salicylate of soda will pay the tax on alcoholic consumption on the basis of 75 centilitres of alcohol for 1 kilo. of salicylate, that being the proportion of alcohol present.

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### Sources of Monazite.

*U.S. Consular Report, August* 1895, 541—551. (*See also this Journal, June* 1895, 610.)

In compliance with a request from the Manufacturers' Record of Baltimore, Md., the Department of State instructed the U.S. Consuls to report on the uses of monazite—a mineral recently found in considerable quantities in North Carolina—in their districts, and the market therefor. The following reports have been received since the last publication:—

*Frankfort.*—Monazite is a natural phosphate of cerium and lanthanum, and usually contains oxides of one or more of the other rare earths, notably didymium and thorium. It ranges in colour from yellow to brown and yellowish-green, and occurs in small monoclinic crystals which vary in specific gravity from 4·9 to 5·3. European authorities do not mention thorium as one of the constituents of monazite, so that it may be inferred that whatever traces of that element may have been found in the earlier samples of this mineral were considered, like silica, &c., as impurities.

For a long time monazite was used industrially only as a raw material for the production of cerium, lanthanum, and their derivates, but in recent years the manufacture of mantles for the Auer-Welsbach, the Stobwasser, and other similar incandescent gas burners, has created a new and important demand for thoria or oxide of thorium ($ThO_2$), which is of all metallic oxides one of the most infusible and refractory to heat.

American monazite is found in a district which comprises portions of Cleveland, McDowell, Burke, and Rutherford counties, in North Carolina, and extends across the State line and covers a nearly equal area in South Carolina. Throughout this region it is found in the sand and gravel which form the bed of small streams, the richest deposits being usually found near the headwaters, among the detritus of crystalline gneiss and schists, where it is associated with feldspar, mica, magnetite, garnet, zircon, &c. In such localities monazite is obtained in two commercial forms, either pure as crystals, which are of all sizes up to that of grains of wheat, or larger, and as monazite sand, in which minute crystals of mineral are mixed with a greater or less proportion of ordinary sand and other worthless material.

The larger monazite crystals are gathered by hand, principally by labouring people living in the district above specified, who employ in this manner their leisure time, selling or trading their gleanings to neighbouring grocers or storekeepers, who, in turn, sell them to the agents of a firm in New York, which has, hitherto, practically monopolised the trade in this material, and, therefore, controlled its price. Monazite sand is obtained by washing the sand and gravel of the stream beds in wooden sluice boxes, as is done with gold in placer mining. The gravel is shovelled into the box, through which flows a current of water; it is stirred with a fork or openwork shovel, so that the water carries away the lighter sand and pebbles, leaving the heavier monazite, generally mixed with particles of iron, garnets, &c., in the bottom of the sluice. It is then taken out, dried, and if found to contain particles of magnetite—which, from their nearly identical specific gravity, are very difficult to separate by washing—they are removed by treatment with a magnet. The grains of titaniferous iron ore, which are also generally present, are insensible to the magnet, and cannot be thus separated. When purified, as far as is readily practicable by the methods now employed, the marketable sand contains from 50 to 65 per cent. of monazite particles, and has been sold during the past two years at the place of production for from 5 to 7 cents per lb. The prices of pure monazite crystals are relatively higher, and range from 10 to 12 cents per lb.

From a somewhat careful examination of the subject, it would appear that, by proper management, the exports of American monazite to Germany may be considerably increased. Several new incandescent gas burners, rivals to the Auer-Welsbach, have been recently invented and placed upon the market at reduced prices. The use of such burners is extending rapidly, and they all include as an essential feature the incombustible hood or mantle, for which the best known material is oxide of thorium.

Since the use of monazite as a material for the production of cerium and lanthanum and their derivates is, and will probably always remain, limited, it follows that the value of American monazite depends primarily upon the percentage of thoria which it may contain. The highest grades have thus far been received from Burke and Cleveland Counties, in North Carolina, and have yielded from 4 to 6·5 per cent. of thoria, but the average monazite sands run from 2·5 to 3·5 per cent., with which degree of richness consumers are generally satisfied, provided the monazite sand is reasonably clean and free from iron and such other impurities as will interfere with the chemical reduction of the material and elimination of the thoria. An essential improvement would seem to be some sort of annealing process by which the nonmagnetic particles of iron ore in the sand can be rendered susceptible to the influence of the magnet and thereby removed.

The monazite industry of the Carolinas will never be properly organised until there is established there, at the place of production, a laboratory which, by practising the most improved and economical process, shall refine the whole monazite output of the district, extract the precious oxide of thorium, and control the market for that product in Europe. There has been recently invented by a mining chemist and engineer of great experience at Wiesbaden a new process for this purpose, which appears to be a substantial improvement over any of the methods hitherto employed.

*Berlin.*—The Consul reports that the largest consumption of monazite is for the manufacture of Welsbach mantles in Vienna. The mantles are plunged into a liquid the chief ingredients of which are obtained from monazite.

On burning these there remains a white skeleton formed of the ashes of the cotton and the ingredients of the liquids. According to the way these are mingled, the colour of the light varies.

Some nine minerals are used in the liquid mentioned, but the chief is thorium, obtained from thorite, which is one of the chief ingredients of monazite. On the proportion of thorite in monazite, depends the value of the latter in the market. Other ingredients are zircon, lanthanum, didymium, cerium, erbium, and yttrium. Not only the proportions of these ingredients, but the sequence in which they follow, affects the resulting liquid in which the "stockings" or hoods are steeped.

The following are the prices per kilo. of the various constituents of monazite:—

| Description. | Price. | Description. | Price. |
|---|---|---|---|
| | M. | | M. |
| Cerium | 80 | Thorium (clean) | 1,000 to 1,200 |
| Didymium | 650 | " brilliant | 3,200 |
| Erbium | 600 | Yttrium | 750 |
| Lanthanum | 800 | Zirconium | 105 |
| Thorium | 1,800 | | |

These prices induce the Consul to consider that at present the supply does not equal the demand.

*Cologne.*—The Consul reports as follows :—The value of monazite sand has varied so greatly that up till now it has been impossible to fix anything like an average price. Its value depends on its percentage of certain rare earths, especially thorium. A smaller amount than 1 per cent. of thorium will not pay for working; besides, no chemical method has yet been adopted for extracting the thorium from such poor ores.

In those factories in which monazite sand is worked, the strictest secrecy is observed.

In the beginning, the analyses, which frequently showed very high amounts of thorium, were incorrect, because the chemists had not been able to separate the different rare earths from each other, and they put down the whole as thorium. According to recent analysis by R. J. Gray, of New York, the highest amount of oxide of thorium in the Brazilian monazite sand was from 1·2 to 7·6 per cent.; in sand from Quebec, 1·1 per cent.; in sand from Connecticut, 1·4 per cent.; and in sand from North and South Carolina, only 0·23, 0·32, to 0·8 per cent.

As it requires expensive technical establishments for working monazite sand, it does not pay to manipulate sand containing only a small percentage of thorium. Therefore, only such ores as contain large proportions of thorium are eagerly sought. As long as the chief value depends on the contained thorium—the preference will be given to the Brazilian monazite sand.

Owing to the active demand last winter for sand containing thorium, there apparently was more attention given to placing a large quantity on the market than to good quality, so that partly valueless sand was offered, which caused the quality from the United States to be somewhat discredited.

In summer, when the incandescent lights are not much in use, there is naturally a corresponding falling off in the demand for monazite sand. At present the supply exceeds the demand, and I am informed that large quantities lie in Hamburg and other seaports awaiting buyers. The prices, therefore, will be depressed, and, at present, those offered for monazite sand from the United States are scarcely one-third of the prices which were willingly paid some six months ago.

Smaller establishments work more advantageously Norwegian ores, which are dearer, but give better and surer profits. Thorium ores with a minimum guaranty of 20 per cent. of thorium are preferred. The price is fixed according to the percentage of thorium per kilo. (2·2046 lb.), which is from 6 to 8 marks (1·43 dols. to 1·90 dols.) per kilo. of each per cent.

*Hamburg.*—The Consul reports as follows:—Soon after the introduction of these new (Welsbach) lamps, the demand for minerals containing thorium increased to a considerable extent, first among which were the Norwegian thorite and orangite ores containing from 40 to 62 per cent. of thorium ($ThO_2$).

At first, the prices paid for pure thorium were as high as 240 dols. per lb., but, as the output of the Norwegian mines increased, the prices receded to 180 dols., 144 dols., 72 dols., 48 dols., and 36 dols. per lb.—only now and then showing an improvement, as the output was less plentiful.

At first the manufacturers imported their supply of raw material solely from Norway, but afterwards Brazil, Canada, and the United States, and latterly also Russia, appeared in the market with monazite and monazite sand, which articles were, on account of the small amount of thorium they contained (2 to 5 per cent.), offered at unreasonably low prices. While the first shipments of Brazilian monazite sand, containing about 3 to 3½ per cent. of thorium, brought 85*l.* per ton, c. i. f. Hamburg, the prices for monazite and monazite sand, on account of extensive shipments from all quarters, have, in the course of this winter, declined to such an extent that at first 75*l.*, then 50*l.*, and 30*l.*, and, finally, 15*l.* per ton, c. i. f. Hamburg, were paid.

The reason why the price of monazite is so much lower than that of the Norwegian thorium ores, is that the extraction of the thorium from monazite is much more expensive than from thorite, monazite showing a combination of thorium with phosphoric acid and silicates, which requires a most expensive manipulation by the manufacturers. This is also demonstrated by the fact that analyses of Norwegian thorite cost about 12 dols., while those of monazite and monazite sand cost about 17·85 dols.

*Gottenberg* (*Sweden*).—The Consul reports:—After applying to the mineralogical authorities here for information, I have the honour to report that neither monazite nor other minerals usually containing thorium have been discovered, in any part of Sweden, and the only place on the Scandinavian peninsula where thorium is found is the southern part of Norway, where, according to the best information obtainable, the annual output is about 500 kilos. (1,102 lb.).

*Bahia* (*Brazil*).—The Consul reports:—Following is all the reliable information I have been able to obtain regarding monazite in this consular district: The locality of deposits is in the southern part of this State, on the coast, near latitude 17 degrees south. The deposits are found in a sand beach of enormous extent. Vessels of 400 to 500 tons burden and light draft have carried large quantities. The mineral is shovelled up as an ordinary sand from the beach. It is impossible to ascertain the amount shipped. Until recently it was free to the world, and ships only paid labourers for loading, which cost about 2·50 dols. per ton on board ship. I cannot learn the present price. The mineral is shipped to England. The percentage of thorium contained in the sand, I am told, is very high. A gentleman who showed me a sample of the sand which he analysed, said it contained about 80 per cent. of monazite. I am told that this Government has recently taken steps to protect the industry.

## GENERAL TRADE NOTES.

### PETROLEUM IN JAVA.

The *London and China Telegraph* of July 29 last says that petroleum-boring in Java continues to do well. In the districts around Sourabaya, the oil wells yield abundantly, and a brisk local trade in the produce has sprung up. In Mid-Java this line of business has also been started with success. At first difficulties arose from inadequate means of transport, which prevented the supply from meeting the demand. Pipe lines have been laid in consequence from the wells to the neighbouring tramway, and from there tank cars are filled for conveyance to Samarang. At Samarang the petroleum company concerned has secured land on which to establish oil warehouses for Mid-Java, with all the necessary appliances and fittings. The Java oil trade is now making steady progress, and there is every promise that the efforts made to develop that island's oil resources will be crowned with greater success.

### EXPORTATION OF TISSUE PAPER TO SPAIN.

According to the *Bollettino di Notizie Commerciali* the Austro-Hungarian Consul at Valencia, in a late report, speaks of the large quantity of tissue paper used in Spain in packing fruits for export. As each separate fruit has to be wrapped in this paper, the amount required in considerable; the greater part of it comes from France and Italy, Germany having ceased to export it for some time past. The month of September is the usual time for the orange-packers to lay in stocks of this paper.

### PAPER-MAKING IN BOMBAY.

The *Times of India* of 5th July last, says that hitherto the chief difficulty of the paper-making industry of Bombay has always lain in the cultivation of the right kind of grass for paper manufacture, but a Government resolution issued a few days ago contains a memorandum by Mr. Woodrow, the officer in charge of the Bombay Botanical Survey, which seems to indicate that this difficulty has been overcome. In Northern India there grows a special kind of grass known locally as *Sabai* or *Bhabur*, and scientifically as *Ischœmum augustifolium*, which was brought to the notice of paper manufacturers some two or three years ago by Dr. King, the Director of the Botanical Garden at Calcutta. This grass has proved itself exceptionally adapted to the purpose of paper-making, and but for the heavy railway freight would doubtless have met with an active demand in India.

Experiments conducted at Poona, however, have shown that *Sabai* will grow freely on a variety of soils; and though it has been slightly irrigated so far in order to increase the quantity available for seed purposes as quickly as possible, there is, says Mr. Woodrow, "every reason to believe that it will grow without irrigation, and that it will soon become an important export material, taking the place in the paper manufacture of Europe of the fast failing supplies of Esparto." The Survey Commissioner, in communicating the fact that the Deccan paper mill has already obtained a concession of half the fixed irrigation rate for growing *Sabai* grass experimentally for five years on 50 acres of land, observes that "the Deccan ryot, who has got many more valuable crops to grow with irrigation if he can afford to do so, is not likely to go in for *Sabai* cultivation unless there is an active demand for it either from the local paper manufacturers or from foreign shippers." It will probably be some time before the foreign shippers will be induced to inquire for *Sabai* in any large quantities, but the experience of its excellence elsewhere should certainly lead to a considerable development in the local paper trade. At any rate, the experiment will be watched with considerable interest, for if *Sabai* is a success there would seem to be no *primâ facie* reason why the paper-mill industry should not be as active in Bombay as on the Bengal side.

### Reducing the Price of Calcium Carbide.

*Chemist and Druggist. September 14th*, 1895, 420.

A German aluminium company announces that, in consequence of improvements in their manufacture, calcium carbide can now be supplied in quantities of not less than one ton at 20*l.* 5*s.* 7*d.* per ton.

### Chrome Iron Ore Mining in Asia Minor.

*Engineering and Mining Journal (New York).*

Asia Minor is more remarkable for the rarity in the quality than for the magnitude of its mineral production, being one of the chief sources of supply of such uncommon materials as emery stone, boracite, meerschaum, and chrome iron ore. Although the ores of the more widely distributed metals occur in many parts of the country, their exploitation has not on the whole attained much success: probably ores of the more common metals, such as lead and copper, occur in such a way that high technical skill is required to mine them and bring them to a marketable state. The difficulties of communication and the paralyzing effects of the Turkish Government have, no doubt, prevented such mines from being worked in a proper manner. On the other hand, the uncommon minerals mentioned above occur at or near the surface, are capable of being worked in a primitive manner, and require less technical skill to render them marketable.

At the present time the larger part of the mineral production is derived from quarries or shallow workings which are capable of being worked with a minimum of skilled labour and management. Among this class of mines the chrome iron ore quarries hold a foremost place. The ores are noted for their purity, and contribute a large portion of the world's supply. There are three principal localities in Asia Minor where the ores are found, one in the Vilayet of Aleppo, near the towns of Alexandretta and Antioch; another in the coast district south of Smyrna; and a third in the province of Broussa in the north. This last district is by far the most important. Chrome ore has also been shipped from Salonica, a port on the south coast of Turkey, the mines being probably at no great distance.

The ore is found in Asia Minor in pockets or masses in serpentine. The deposits are very irregular in form and size, and the method of working is by open quarrying. The ore having been found at surface is followed down until it is exhausted or the operations have to be stopped on account of difficulties in removing the over-burden or in draining the water. Owing to the uncertainty that exists in the quantity of ore available at each quarry, preparatory work in removing the over-burden or in opening out the quarry in a scientific manner is not, as a rule, undertaken. The quarries now working in the district south of Broussa are situated about 60 miles from the sea, and the chief expense in the production of the ore is the carriage to the port of Gemlek. Owing to the absence of roads for wheel traffic, the carriage of the ore is done entirely by camels. The average load for a camel is 300 okes, or about 816 lb.

Mining in this comparatively inaccessible country is naturally of a very primitive description. The ore is roughly sorted at the loading place outside the quarry, the waste rock and poor qualities being rejected. It is then loaded on camels and sent off to the coast, and shipped in this state to England, Germany, and elsewhere. The camels belong to a contractor, and the ore is, of course, weighed and paid for on its arrival at the port. The cost of carriage in 1894 was about 53*s.* per ton from the mines to the port. It is anticipated that the new railway to Kutahia, a branch of the Ismid-Eskichehir and Angora main line, will reduce this rate.

The ore from this district contains an average of 50 per cent. of sesquioxide of chromium, worth about 93*s.* per ton in England. Some samples taken by the writer contained over 53 per cent. The cost of mining is very low, the wages paid being only 10*d.* per day in summer and 8*d.* in winter. The men work from sunrise to sunset. Mining appears, however, to be carried on very little in winter, as the paths are then more or less impassable.

It is extremely difficult to obtain reliable statistics of the mineral production of Turkey, and especially of chrome iron ores. Some idea, however, of the magnitude of the industry may be obtained from studying the imports of ore into other countries, as all the ore is exported. It appears that Great Britain, the United States, and Germany, probably the three largest consumers, take on an average about 24,000 tons of Turkish chrome iron ore annually.

These figures agree fairly well with the information obtained in the country about the production. The trade, therefore, seems to be a comparatively small one. Owing to the absence of official figures, the statements made in handbooks and books of travel must be received with great caution. Although from the evidence it appears that there has been considerable variation in the amount annually produced, yet the average annual output during the last 10 years from all these districts has probably been under 30,000 tons.

The great drawback to mining in Asia Minor, and one cause that prevents the mineral resources of the country being properly developed, is the difficulty in obtaining a proper title to a mining concession. The want of roads, and the obstacles that are put in the way of travellers by the Turkish Government, of course play a considerable part in preventing progress or discovery, but the difficulties that have to be met with by the miner in obtaining proper security for a mining property is the chief cause of the backward state of mining in Asia Minor. One of the most frequent causes of dispute is on the question of boundaries, brought about by the absence of correct maps. If a proper survey of the country were set about, and facilities were granted to miners and explorers that are given in more civilised countries, it is probable that this rich mineral country would soon yield a large revenue, and help to restore the finances of Turkey to a satisfactory condition.

### Gypsum in Newfoundland.

*E. and M. J., August 31st*, 1895, 201.

Perhaps in no part of Eastern British America is gypsum so extensively distributed as on the west coast of Newfoundland, mainly in the Codroy Valley and about Bay St. George, but in large or probably profitable working quantities it occurs only in three places, one on Fishel's Brook, about two miles inland from where the brook flows into Bay St. George, 35 miles east of Cape Auguille. Another is at Cairn Mountain, which is about five miles inland from St. George's Harbour or, as it is more commonly called, Sandy Point. The third, which is the most extensive deposit of all and the most favourably situated for economical working and shipping, is on Kippen's or Romaine's Brook, on the north-east head of Bay St. George. This deposit is about 750 ft. up the brook from the shore of the bay, at a place where for five or six months any sized vessel or steamer could lay and load within 750 or 600 ft. of the shore, or a total distance from the gypsum of less than a quarter of a mile. The country about this locality is fairly well settled, and the fishermen and farmers, who make good quarrymen, would supply all the needed help at a moderate cost. It is estimated that the gypsum at this place could be quarried and put on board vessel at not over 50 c. per ton, and by employing steamers, it could be laid down in in New York not greatly, if anything, in excess of 1·75 dols. per gross ton.

### African Saltpetre.

If credit is to be given to the representations made concerning the deposits of nitrate of potash lately explored in South Africa, there may be considerable changes in the market for that material. The existence of the mineral was known some time ago, but until recently no efforts have been made for its exploration or development. Now, however, some large properties have been taken up and companies organised in London to work them with a large capital. These deposits are in the extreme northern part of Cape Colony and in the adjoining district of Griqualand, the latter being about 100 miles westward from the diamond mines of Kimberley. It is claimed that both deposits are very large, and that the working can be economically conducted, while transportation could be provided by a branch line less than 100 miles in length from the Cape Government railroad. The claim put forward by the projectors is that the saltpetre from Prieska, in the Cape Colony, could be delivered in England at 8*l.* 10*s.* per ton. As the German and Indian products now sell at about 20*l.*, the supply from the Cape, even making a considerable allowance for undercalculation, could be sold very much below the present prices.—*Eng. and Mining Journal.*

### The Price of Explosives in France.

*Chemist and Druggist, August* 31*st*, 1895, 339.

An official notice has been issued, fixing the prices as follows:—For nitrates of ammonia and soda, used as mine-explosives, and sold at the Government depôts, type N, No. 1 (nitrate of ammonia and nitronaphthalene), 2 fr. 25 c. per kilo.; No. 2 (nitrate of soda and nitronaphthalene), 1 fr. 25 c. per kilo.; type C, No. 1 (nitrate of ammonia and cresylate of ammonia), 2 fr. 25 c. per kilo.; No. 2 (nitrate of soda and cresylate of ammonia), 1 fr. 45 c. per kilo.; type P, compressed cartouches, No. 1, 20 per cent. of cotton-powder, 3 fr. 10 c. per kilo.; No. 2, 9·50 per cent. of cotton-powder, 2 fr. 85 c. per kilo.

### Drug Trade Regulations in Japan.

Exporters of drugs to Japan are in the habit of complaining that the authorities in that country often arbitrarily analyse imported chemicals, and, if found below the exceedingly stringent requirements of the Japanese Pharmacopœia, refuse their admission into the country. It appears, however, that the law of Japan does not provide for the compulsory analysis of drugs, but that the wholesale druggists usually obtain the guarantee of the Hygienic Laboratories established by Government, or of those started by private enterprise, such as the Osaka Drug Examination Company (known in Japanese as the Yakuhin-shiken-kaisha), for their chemicals and drugs, simply as a satisfaction to themselves and a means of securing the confidence of buyers. As regards the report that certain proprietary medicines have been submitted to analysis and rejected, it is said that the regulations regarding proprietary medicines simply require that no poison shall be contained in them. Even very small quantities of dangerous medicines and drugs are prohibited if the authorities think that such quantities may be the source of danger if taken imprudently. Such medicines as Scott's emulsion of cod-liver oil with hypophosphites, Ayer's hair-restorer, or Brandreth's plasters are sold with Government stamps upon them. The stamp-duty of such medicines is now 1 rin, or the one-thousandth part of a silver dollar, for those costing 2 sen (1 sen being the one-hundreth part of a dollar) per package; 3 rin for those under 3 sen; 5 rin for those under 5 sen; 1 sen for those under 10 sen; and 5 rin for every 5 sen above 10 sen.—*British Trade Journal, through Chemist and Druggist.*

### French Drug Statistics.

*Chemist and Druggist, August* 31*st*, 1895, 360.

We give below an abstract of the French Board of Trade Returns for the first quarters of 1895 and 1894 respectively, showing the imports and exports of the principal kinds of drugs and chemicals during those periods. The French returns, though they are not issued with the promptitude that distinguishes the publications of our own Board of Trade, are very much more detailed than any statistics issued in this country, and are on that account more valuable to the trade concerned than our British Board of Trade returns. The figures, except where otherwise stated, denote kilogrammes.

| — | Imports. | | Exports. | |
|---|---|---|---|---|
| | 1895. | 1894. | 1895. | 1894. |
| Gums (true) European | 27,500 | 48,100 | 30,700 | 42,400 |
| „ „ Exotic (England) | ‡ .. | .. | 475 | 388 |
| „ „ „ (other countries). | ‡2,535 | 2,964 | 911 | 970 |
| Scamony resin | 2,400 | 2,100 | 500 | 200 |
| Other exotic resins | ‡1,136 | 680 | 408 | 328 |
| Musk, in pod or grain | 1,320 | 1,232 | 197 | 268 |
| Balsam: Benzoin | ‡ 112 | 31 | 76 | 39 |
| „ Copaiba | 8,700 | 15,900 | 500 | 2,090 |
| „ Other kinds | 18,900 | 15,900 | 3,800 | 17,100 |
| Cinchona bark | ‡ 469 | 380 | 42 | .. |
| Other barks | ‡ 33 | 100 | 13 | .. |
| Camphor, raw | ‡ 428 | 242 | 117 | 38 |
| „ refined | 22,900 | 74,400 | 28,300 | 17,400 |
| Opium | 43,600 | 35,300 | 38,800 | 32,700 |
| Bromine | 25,800 | 18,600 | 2,000 | 6,100 |
| Bromides | 3,800 | 6,400 | 6,100 | 6,800 |
| Iodine | 18,000 | 13,500 | 4,900 | 8,100 |
| Iodides and iodoform | 1,600 | 100 | 17,500 | 14,000 |
| Phosphorus | ‡ 23 | 5 | 140 | 173 |
| Acids: Acetic | ‡ 466 | 31 | 357 | 227 |
| „ Arsenious | ‡ 425 | 38 | 11 | 6 |
| „ Boric | ‡ 160 | 273 | 45 | 26 |
| „ Hydrochloric | ‡1,408 | 1,404 | 92 | 441 |
| „ Citric | 900 | 800 | 37,300 | 15,800 |
| „ Gallic | 1,300 | 900 | 12,500 | 42,600 |
| „ Nitric | ‡ 395 | 260 | 391 | 565 |
| „ Oxalic | ‡ 333 | 40 | 17 | 9 |
| „ Sulphuric | ‡1,698 | 1,290 | 1,486 | 1,798 |
| „ Tannic | 66,700 | 62,500 | 1,500 | 5,600 |
| „ Tartaric | ‡ 17 | 16 | 293 | 157 |
| Borax, refined | ‡ 202 | 321 | 92 | 59 |
| Borate of lime | ‡1,146 | 489 | 134 | 56 |
| Carbonate of magnesia | 38,600 | 38,600 | 2,400 | 4,500 |
| Chlorate of potash | ‡38,600 | 38,600 | 833 | 490 |
| Ether, acetic and sulphuric | 18,000 | 3,100 | 40,900 | 30,400 |
| Chloroform | 2,800 | 800 | 3,900 | 1,400 |
| Collodion | 1,800 | 800 | 700 | 3,600 |
| Glycerin | ‡ 331 | 356 | 3,281 | 2,590 |
| Soda: Caustic | ‡1,122 | 920 | 2,511 | 997 |
| „ Crystals | ‡ 106 | 1,678 | 1,300 | 2,762 |
| „ Bicarb. | ‡ 519 | 559 | 150 | 73 |
| Quinine and quinine salts | 600 | 800 | 5,600 | 5,827 |
| Prussiate of potash | 47,000 | 57,600 | 45,400 | 78,300 |
| Wine lees | ‡3,074 | 3,157 | 646 | 627 |
| Raw tartars | ‡ 687 | 1,273 | 2,460 | 2,805 |
| Tartar crystals | ‡ 77 | 131 | 17 | 8 |
| Cream of tartar (England) | ‡ .. | .. | 1,074 | 1,129 |
| „ „ (other countries) | ‡ 800 | 215 | 311 | 204 |

‡ Indicates tons of 1,000 kilos.

### The Russian Chemical Industry.

*Chemist and Druggist, September* 21*st*, 1895, 450.

There has been a great increase in the demand and the production of sulphuric acid in Russia lately, says the Austrian Consul in Moscow, and in 1894 the Russian manufacturers for the first time sold the whole of their output locally, instead of sending part of it to the annual fair at Nishni Novgorod. The principal increase in the demand has been caused by the smokeless-powder factories, one of which, at Kasan, requires 200,000 poods of vitriol yearly. Formerly the bulk of the Russian sulphuric acid was made from pyrites obtained in the Ural mountains, but in the course of the last year or two the decline in the price of Sicilian sulphur, and the reduction of the railway rates and the import duties on that article, have caused the manufacturers to resort to it again. The production of hydrochloric acid has grown even more rapidly than that of sulphuric acid, the output of a single factory in the Moscow district having advanced from 35,055 poods in 1893 to 114,854 poods in 1894. The principal consumers of this acid are factories which convert it into chloride of zinc, for the purpose of impregnating sleepers. In the course of the last two years hydrochloric acid has also superseded sulphuric acid in the preparation of fine cotton fabrics, which cannot be successfully dyed unless freed from lime residues. The production of acetic acid has also increased.

### AMERICAN DRUG STATISTICS.

*Chemist and Druggist, August 31st*, 1895, 360.

The returns of imports and exports of merchandise into and from the United States for the fiscal year from July 1st, 1894, to June 30th, 1895, have just been published. The figures relating to some of the principal pharmaceutical goods are given below, together with the corresponding figures for the year 1893–94:—

*Imports of Duty-free Foreign Merchandise.*

| — | | 1893-94. | 1894-95. |
|---|---|---|---|
| Bark, cinchona | Lb. | 2,497,439 | 1,911,489 |
| Cochineal | „ | 104,284 | 134,205 |
| Gum arabic | „ | 1,089,589 | 1,561,239 |
| Camphor, crude | „ | 1,323,932 | 1,500,739 |
| Shellac | „ | 4,868,681 | 6,401,060 |
| All other gums | Value | $2,783,420 | $2,884,543 |
| Lime (chloride) | Lb. | 81,610,463 | 100,256,774 |
| Mineral waters, not artificial | Galls. | 1,627,965 | 2,047,542 |
| Opium (crude) | Lb. | 716,881 | 358,455 |
| Potash (chlorate) | „ | 4,131,180 | 4,505,575 |
| „ (muriate) | „ | 81,611,438 | 89,773,029 |
| Saltpetre (crude) | „ | 9,671,217 | 8,735,290 |
| Quinine (salts of) | Oz. | 2,485,490 | 1,520,649 |
| Soda (nitrate) | Tons | 88,079 | 124,803 |
| Sulphur (crude) | „ | 86,965 | 126,860 |
| All other drugs, chemicals, and dyes | Value | $4,486,116 | $4,497,000 |
| Oils, essential | „ | $914,023 | $1,126,876 |

*Imports of Dutiable Foreign Merchandise.*

| — | | 1893-94. | 1894-95. |
|---|---|---|---|
| Coal-tar, colours, and dyes | Value | $1,499,978 | $2,549,350 |
| Glycerin | Lb. | 8,321,853 | 13,488,825 |
| Dyewoods, extracts and decoctions of | „ | 2,582,646 | 3,711,315 |
| Opium, prepared | „ | 50,102 | 139,765 |
| Caustic soda | „ | 38,987,832 | 56,853,959 |
| Sal soda | „ | 16,892,760 | 28,760,028 |
| Soda ash | „ | 256,293,395 | 300,599,257 |
| Soda, all other salts | „ | 16,893,760 | 28,760,028 |
| All other chemicals and drugs | Value | $3,810,106 | $4,753,352 |
| Bottles, vials, demijohns, carboys, and jars, empty or filled | „ | $505,183 | $531,904 |
| Olive oil | Galls. | 757,478 | 775,046 |
| Other vegetable oils | Value | $393,995 | $516,833 |
| Essential oils | „ | $188,085 | $272,074 |
| Paints and colours | „ | $980,715 | $1,178,207 |
| Perfumery, cosmetics, &c. | „ | $427,850 | $603,730 |
| Soap, fancy, perfumed, and all toilet | Lb. | 693,760 | 748,038 |
| All other kinds | Value | $283,940 | $312,328 |

*Exports of American Merchandise.*

| — | | 1893-94. | 1894-95. |
|---|---|---|---|
| Ashes, pot and pearl | Lb. | 650,261 | 664,876 |
| Medicines, patent or proprietary | Value | $1,621,919 | $1,978,144 |
| Roots, herbs, and barks, n.e.s. | „ | $244,438 | $232,095 |
| All other chemicals, dyes, and medicines | „ | $3,960,580 | $4,129,067 |
| Peppermint oil | Lb. | 80,225 | 87,633 |
| Other essential oils | Value | $64,907 | $190,798 |
| Perfumery and cosmetics | „ | $327,835 | $338,495 |
| Quicksilver | Lb. | 1,599,013 | 1,089,603 |
| Soap, toilet or fancy | Value | $101,290 | $144,656 |
| Soap, all other | Lb. | 25,028,944 | 23,778,398 |
| Spermaceti and spermaceti wax | „ | 312,786 | 231,217 |

### MINERAL DISCOVERY IN NORWAY.

*Chemist and Druggist, September 21st*, 1895, 450.

Ore, very rich in copper, has been found in Kaafjord, Norway. As water-power is available in the neighbourhood, and the facilities for transport are favourable, the discovery seems to be a promising one.

### CARRIAGE OF LIQUID AMMONIA ON BOARD SHIP.

*Chemical Trade Journal, September 21st*, 1895, 177.

The following notice is being issued:—The Board of Trade are advised that both the aqueous solution of ammonia and ammonia gas compressed into liquid form should be classed as dangerous goods, not only on account of the danger of explosion involved when they are contained in vessels not sufficiently strong to withstand the pressure which may be produced by a rise in temperature, but also on account of the highly dangerous nature of the gas. The following precautions should be adopted when either of those liquids is carried on board ship:—It should be packed in iron vessels which have been carefully tested up to a pressure of 675 lb. per square inch, and should be stored in a part of the ship beyond the influence of any heat from boilers or furnaces, and remote from the living quarters.

### MINERAL PRODUCTION OF NEW SOUTH WALES.

*Eng. and Mining Journal, September 14th*, 1895, 244.

| — | | 1893. | | 1894. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| | | | £ | | £ |
| Gold | Oz. | 179,288 | 651,286 | 324,787 | 1,156,717 |
| Coal | Tons | 3,278,328 | 1,171,722 | 3,672,976 | 1,155,573 |
| Shale | „ | 55,660 | 101,221 | 21,171 | 31,781 |
| Copper and regulus | „ | 2,067 | 58,426 | 2,137 | 73,481 |
| Tin and ore | „ | 2,785 | 229,743 | 2,801 | 187,197 |
| Silver | Oz. | 531,972 | 78,131 | 846,822 | 94,150 |
| Silver-lead and ore | Tons | 214,260 | 2,953,589 | 180,327 | 2,195,339 |
| Iron | „ | 2,191 | 14,786 | 2,368 | 17,170 |
| Antimony and ore | „ | 1,774 | 25,092 | 1,250 | 18,744 |
| Oxide of iron | „ | 1,260 | 1,526 | 433 | 670 |
| Lead (pig) | „ | 426 | 4,205 | 31 | 260 |
| Limestone (flux) | „ | 130,635 | 111,041 | 89,990 | 69,289 |
| Opal | Lb. | 419 | 12,315 | 198 | 5,684 |
| Manganese | Tons | .. | .. | 14 | 44 |
| Cobalt | „ | 26 | 305 | 3 | 10 |
| Coke | „ | 17,858 | 20,[illegible]33 | 34,458 | 33,209 |
| Alunite | „ | 821 | 3,284 | 862 | 3,448 |
| Fireclay | „ | 21 | 46 | 24 | 60 |
| Marble | Pkg. | .. | .. | 8 | 80 |
| Stone (building) | No. | 850 | 855 | .. | .. |
| Stone (ballast) | Tons | 132 | 166 | .. | .. |
| Grindstones | No. | 2 | 3 | .. | .. |
| Chrome ore | Tons | .. | .. | 3,034 | 12,336 |
| Sundry minerals | „ | 67 | 557 | .. | 892 |
| Total values | | .. | 5,438,532 | .. | 5,056,136 |

## BOARD OF TRADE RETURNS.

### SUMMARY OF IMPORTS.

| Articles. | Month ending 31st August. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,559,209 | 1,579,276 |
| Chemicals and dyestuffs | 399,972 | 514,841 |
| Oils | 652,372 | 679,032 |
| Raw materials for non-textile industries. | 4,512,360 | 5,080,190 |
| Total value of all imports | 31,638,521 | 34,611,305 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 31st August. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,278,711 | 2,417,504 |
| Chemicals and medicines | 659,722 | 659,762 |
| Miscellaneous articles | 2,280,435 | 2,595,064 |
| Total value of all exports | 18,581,240 | 20,181,495 |

### IMPORTS OF METALS FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper :— | | | | |
| Ore ............ Tons | 6,012 | 11,401 | 35,615 | 47,825 |
| Regulus ........ „ | 7,192 | 6,401 | 160,120 | 133,023 |
| Unwrought..... „ | 4,240 | 2,654 | 169,599 | 121,405 |
| Iron :— | | | | |
| Ore............. „ | 387,338 | 439,765 | 269,279 | 308,973 |
| Bolt, bar, &c. ... „ | 5,820 | 8,110 | 57,857 | 63,693 |
| Steel, unwrought.. „ | 324 | 910 | 8,428 | 7,277 |
| Lead, pig and sheet „ | 11,835 | 15,744 | 107,956 | 164,296 |
| Pyrites ........... „ | 54,578 | 48,182 | 93,737 | 85,430 |
| Quicksilver ....... Lb. | 55,938 | 101,510 | 4,540 | 9,872 |
| Silver ore....... Value £ | .. | .. | 151,153 | 151,047 |
| Tin ............... Cwt. | 73,105 | 68,678 | 253,833 | 218,151 |
| Zinc .............. Tons | 4,525 | 4,415 | 76,637 | 68,947 |
| Other articles ...Value £ | .. | .. | 181,155 | 199.337 |
| Total value of metals | .. | .. | 1,559,209 | 1,579,276 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 6,036 | 1.487 | 10,817 | 4,110 |
| Bristles.......... Lb. | 327,139 | 342,429 | 42,043 | 48,413 |
| Caoutchouc ...... Cwt. | 16,571 | 28,584 | 156,061 | 281,769 |
| Gum :— | | | | |
| Arabic......... „ | 4,224 | 5,226 | 8,954 | 13,539 |
| Lac, &c......... „ | 5.796 | 6,150 | 30,862 | 36,047 |
| Gutta-percha .... „ | 3,749 | 3,579 | 33,021 | 31,884 |
| Hides, raw :— | | | | |
| Dry............ „ | 33,086 | 52,959 | 80,978 | 119,953 |
| Wet ........... „ | 74 363 | 86,466 | 153,922 | 208,740 |
| Ivory......... .. „ | 543 | 1,419 | 23,693 | 68,156 |
| Manure :— | | | | |
| Guano ......... Tons | 2,155 | 3,493 | 11,768 | 27,422 |
| Bones ......... „ | 5,109 | 5,305 | 23,963 | 22,559 |
| Nitrate of soda... „ | 3,208 | 3,384 | 28,917 | 26,542 |
| Phosphate of lime „ | 46,732 | 52,603 | 92,510 | 87,763 |
| Paraffin.......... Cwt. | 34,116 | 42,985 | 37,941 | 46,115 |
| Linen rags....... Tons | 1,853 | 1,891 | 16,535 | 16,495 |
| Esparto.......... „ | 13,025 | 21,893 | 53,403 | 89,708 |
| Pulp of wood .... „ | 24,464 | 24,371 | 118,205 | 138,084 |
| Rosin............ Cwt. | 145,469 | 126,103 | 38,654 | 29,005 |
| Tallow and stearin „ | 187,776 | 245,995 | 239,327 | 285,847 |
| Tar ..............Barrels | 34,423 | 37,281 | 20,835 | 26,955 |
| Wood :— | | | | |
| Hewn ......... Loads | 270,285 | 268,785 | 515,301 | 505,691 |
| Sawn .......... „ | 858,428 | 847,275 | 1,864,233 | 1,745,597 |
| Staves......... „ | 16,912 | 18,104 | 61,234 | 72,681 |
| Mahogany ... . Tons | 3,332 | 1,671 | 25,787 | 12,690 |
| Other articles....Value £ | .. | .. | 823,391 | 1,134,427 |
| Total value ....... | .. | .. | 4,512,360 | 5,080,190 |

Besides the above, drugs to the value of 145,807*l.* were imported, as against 63,061*l.* in August 1894.

### IMPORTS OF OILS FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut......... Cwt. | 36,844 | 1,929 | 44,105 | 2.182 |
| Olive.............. Tuns | 2,282 | 839 | 71,395 | 31,074 |
| Palm .............. Cwt. | 110,319 | 136.731 | 116,949 | 142,345 |
| Petroleum ........ Gall. | 13,360.521 | 11,808,438 | 191,429 | 235,632 |
| Seed .............. Tons | 2,137 | 1,838 | 45,259 | 39,048 |
| Train, &c.......... Tuns | 3,272 | 2,976 | 54,502 | 50,388 |
| Turpentine ....... Cwt. | 50,931 | 105,204 | 55,357 | 105,810 |
| Other articles .. Value £ | .. | .. | 73,376 | 72,553 |
| Total value of oils... | .. | .. | 652,372 | 679,032 |

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 7,619 | 24,318 | 6.322 | 9,910 |
| Bark (tanners', &c.) „ | 47,752 | 62,603 | 19,881 | 24,194 |
| Brimstone ........ „ | 79,368 | 53,214 | 15,178 | 10,421 |
| Chemicals...... Value £ | .. | .. | 93,877 | 104,349 |
| Cochineal ......... Cwt. | 274 | 353 | 1,628 | 2,416 |
| Cutch and gambier Tons | 1,933 | 2,458 | 43,347 | 52,762 |
| Dyes :— | | | | |
| Anilin and other Value £ | .. | .. | 30,931 | 36,372 |
| Alizarin ....... „ | .. | .. | 17,924 | 28,274 |
| Indigo ........... Cwt. | 1,698 | 2,765 | 22,958 | 33,297 |
| Nitrate of potash . „ | 25,435 | 22,267 | 22.935 | 20,577 |
| Valonia .......... Tons | 2,317 | 3,108 | 27,317 | 37,267 |
| Other articles... Value £ | .. | .. | 97,674 | 155,002 |
| Total value of chemicals | .. | .. | 399,972 | 514,841 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass........... Cwt. | 7,742 | 8,559 | 29,146 | 33,711 |
| Copper :— | | | | |
| Unwrought ..... „ | 43,537 | 57,242 | 91,601 | 128,085 |
| Wrought ....... „ | 26,600 | 18,890 | 69,935 | 54,109 |
| Mixed metal.... „ | 23,844 | 16,192 | 50,292 | 35,017 |
| Hardware ...... Value £ | .. | .. | 153,178 | 160,427 |
| Implements ...... „ | .. | .. | 92,964 | 101,278 |
| Iron and steel..... Tons | 240,977 | 259,414 | 1,572,183 | 1,708,721 |
| Lead ............. „ | 3,164 | 2,645 | 33,866 | 3[illegible],459 |
| Plated wares... Value £ | .. | .. | 23,022 | 29,727 |
| Telegraph wires .. | .. | .. | 67,550 | 29,488 |
| Tin .............. Cwt. | 9,966 | 7,608 | 35,581 | 25,993 |
| Zinc ............. „ | 12,142 | 17,570 | 8,374 | 12,074 |
| Other articles .. Value £ | .. | .. | 51,019 | 67,415 |
| Total value ......... | .. | .. | 2,278,711 | 2,417,504 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST AUGUST.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 911,400 | 826,400 | 24,973 | 20,605 |
| Military stores.. Value £ | .. | .. | 113,933 | 134,595 |
| Candles.......... Lb. | 1,495,200 | 1,917,300 | 25,675 | 30,972 |
| Caoutchouc ..... Value £ | .. | .. | 96,274 | 103,704 |
| Cement.......... Tons | 38,526 | 40,638 | 65,920 | 65,452 |
| Products of coal Value £ | .. | .. | 77,330 | 89,763 |
| Earthenware ... „ | .. | .. | 144,569 | 173,198 |
| Stoneware ...... „ | .. | .. | 9,982 | 11,591 |
| Glass :— | | | | |
| Plate........... Sq. Ft. | 119,065 | 140,267 | 6.647 | 7,098 |
| Flint........... Cwt. | 7,039 | 8,767 | 15,804 | 19,945 |
| Bottles......... „ | 42,845 | 59,473 | 20,561 | 29,512 |
| Other kinds.... „ | 16,984 | 23,138 | 11,798 | 16,391 |
| Leather :— | | | | |
| Unwrought .... „ | 12,066 | 14,140 | 105,891 | 132,559 |
| Wrought ..... Value £ | .. | .. | 33,691 | 38,054 |
| Seed oil.......... Tons | 3,862 | 3,673 | 81,355 | 74,304 |
| Floorcloth ..... Sq. Yds. | 1,629,500 | 1,709,000 | 66,821 | 71,198 |
| Painters' materials Val. £ | .. | .. | 110,969 | 126,356 |
| Paper ........... Cwt. | 69,405 | 63,987 | 110,119 | 100,931 |
| Rags............. Tons | 4,442 | 4,642 | 22,872 | 26,193 |
| Soap ............ Cwt. | 46,579 | 68,692 | 49,335 | 68,744 |
| Total value .......... | .. | .. | 2,280,435 | 2,595,064 |

### Exports of Drugs and Chemicals for Month ending 31st August.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 389,574 | 479,220 | 110,978 | 124.852 |
| Bleaching materials „ | 91.538 | 111,664 | 35,603 | 39,579 |
| Chemical manures. Tons | 49,162 | 46,632 | 218,698 | 171,640 |
| Medicines....... Value £ | .. | .. | 83,738 | 83,127 |
| Other articles.. „ | .. | .. | 210,705 | 240,564 |
| Total value .......... | .. | .. | 659,722 | 659,762 |

## Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

### I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

#### Applications.

15,565. F. W. Saatmann. Improvements in drying and absorbing apparatus. August 19.

15,581. D. Richards. Improvements in filtering material. August 19.

15,765. H. H. Lake.—From E. de Moerloose. An improved process of chemical decortication and apparatus for use therein, applicable for the treatment of grain and other substances. August 21.

15,835. E. E. Dulier. Improvements in apparatus for removing impurities from smoke. August 22.

15,958. L. M. H. R. Baudoin and P. E. L. Schribaux. A process and apparatus for concentrating liquids. August 24.

16,052. F. D. Cummer. Drying apparatus. Complete Specification. August 27.

16,058. H. C. Michell. Improvements in the manufacture of flake mica for boiler coverings and other uses. Filed August 27. Date applied for March 16, 1895, being date of application in United States.

16,137. J. G. Calvert. New or improved means and apparatus for bringing into intimate contact with each other liquids of different densities. August 28.

16,297. A. M. Hewlett. Improvements in furnaces. Complete Specification. Filed August 30. Date applied for April 8, 1895, being date of application in United States.

16,302. J. Cobeldick. Improvements in apparatus for treating pulverulent or granular materials with fluids. August 30.

16,693. W. J. Lomax and C. J. Lomax. Improvements in the filtration of liquids. September 6.

17,169. H. Whittaker. Improvements in filters for treating sewage and waste water. September 14.

#### Complete Specifications Accepted.*

1894.

16,973. J. C. Sewell. New or improved apparatus for manufacturing heat-non-conducting material. September 4.

17,374. G. Fonchard. Filters. September 11.

17,666. S. Trivick, P. A. J. Head, and J. Elsner. Improvements in furnaces for metallurgical and other purposes. September 18.

1895.

13,160. A. L. G. Dehne. Filter-presses. August 28.

13,486. K. Zimmermann. Improvements in the means for preventing and removing incrustations in or from steam generators. August 21.

13,622. G. C. Dymond.—From T. B. Myers. Improvements in or relating to spraying apparatus. August 21.

15,211. J. M. Davidson. Improvements in and relating to filters. September 18.

### II.—FUEL, GAS, AND LIGHT.

#### Applications.

15,659. The Economical Gas Apparatus Construction Co., Lim., and L. L. Merrifield. Improvements in apparatus for the manufacture of carburetted water-gas. August 20.

15,794. R. Walther. Improvements in incandescence filaments and other similar bodies for use in incandescence electric lamps. Complete Specification. August 22.

15,795. R. Walther. Improvements in incandescence filaments and other similar bodies for use in incandescence gas or vapour lamps. Complete Specification. August 22.

15,890. E. Rohrbeck. Gasifying and increasing the heating power of the gases of easily inflammable liquids. Complete Specification. August 23.

15,990. W. S. Hazelton. An improved method of and firebox for consuming fuel, so as to prevent the formation of smoke. Complete Specification. August 26.

16,110. F. G. Vivian. Improved carburetted water-gas plant. August 28.

16,129. J. Pointon. An improved method of making illuminating gas, applicable also to the production of hydrocarbon-oil and ammonia, and apparatus therefor. August 28.

16,139. J. Laycock. Improvements in apparatus for washing and scrubbing gas. August 28.

16,272. A. Perlich. Lamp for the production of spirit gas incandescent light with lighting and extinguishing contrivance. August 30.

15,344. J. Steiger. Improvements in the manufacture of artificial fuel. August 31.

16,431. J. Chagot. Improvements in and relating to machines for compressing coal-dust and the like mixture into fuel cakes. September 3.

16,458. W. Minshall. Improvements in means for consuming smoke. September 3.

16,471. T. J. Walder. Improvements in the manufacture of water- and coal-gas. September 3.

16,479. J. P. Suche. Improved petroleum firing apparatus. September 3.

16,502. E. Ducretet and L. Lejeune. Improvements in apparatus for use in the production and utilisation of acetylene. September 3.

16,539. W. Young. Improvements in the production of illuminating gas from liquid hydrocarbons and in apparatus therefor. September 1.

16,577. H. H. Leigh.—From G. W. Reye and Söhne and E. Grube. Improvements in burners for liquid fuel. September 4.

16,691. R. Campe. An improved generator for acetylene gas lamps. Complete Specification. September 6.

16,716. W. Darby, I. Darby, and J. H. Punchard. Method and means of burning liquid hydrocarbons in conjunction with an incandescent hood or mantle to produce an incandescent oil-burner. September 6.

16,728. C. Eastwood and C. J. McEwen. Improvements in or relating to apparatus for charging gas retorts. September 6.

16,741. W. Fox. The improvement of coal-gas or other illuminating gases. September 7.

16,769. V. Jacques. A system of producing light and heat. September 7.

16,846. J. E. Campbell. Improvements in the manufacture or preparation of materials for the purification of gas or the like. September 9.

16,927. O. N. Guldlin. Improvements in oil atomising and carburetting apparatus for gas generators. Complete Specification. September 10.

17,152. A. H. Wormald and J. A. Wormald. Improvements in means for increasing the illuminating power of gas. September 14.

17,207. W. Werek. Improved apparatus for filtering gas produced from liquid fuel. September 14.

17,212. F. Forst. Improvements in furnaces and furnace-feeding apparatus for utilising small coal and the like as fuel. Complete Specification. September 14.

### Complete Specifications Accepted.

### 1894.

17,759. W. B. Hartridge. An improvement in artificial fuel. September 18.

17,771A. W. Felton. Apparatus for producing and burning gas to heat furnaces, and generating steam. September 18.

18,445. B. H. Thwaite. Improvements in gas-generating plant. August 28.

20,066. W. E. Price. Apparatus for carburetting coal-gas or other gaseous fluid. August 28.

22,615. L. Denayrouze. Method of and apparatus for illumination by means of combustible gas with forced supply produced by electrical energy. September 18.

23,278. J. M. Bosselaar and J. F. M. van den Elshout. Manufacture of gas and apparatus therefor. September 18.

### 1895.

8680. G. H. Hirst, J. Hirst, A. Hirst, and A. Beaumont. A new means or method of generating heat by the use of spent gases arising from furnaces. August 21.

11,015. A. Dauber. Improvements in continuous working recuperative gas furnaces. September 4.

13,230. F. Mayer. Improvements in apparatus for the manufacture of oil-gas. August 21.

13,959. H. L. A. Lapointe. Improvements in and connected with the manufacture of oxygen. September 4.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Complete Specification Accepted.

### 1895.

12,527. F. J. Bergmann. A process for the extraction of distillation products from sawdust, wood waste, and the like. August 28.

## IV.—COLOURING MATTERS and DYES.

### Applications.

15,720. A. Bang.—From G. A. Dahl. The production of azo-dyestuffs. August 21.

15,836. A. Welter. Process for producing the salts of aniline and its alkyl-derivatives, and of all its homologues. August 22.

16,217. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of colouring matters of the rosinduline series. August 29.

16,301. C. D. Abel.—From J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran. Manufacture of a new leuco-compound of the gallocyanine group. Complete Specification. August 30.

16,407. H. Loesner. Process for the utilisation of the sulphides and sulphydrates of alkaline earths and the production of anilin, toluidine, or amidobenzaldehydes by the treatment of the said substances with nitro bodies. Complete Specification. September 2.

17,072. A. T. Armstrong and W. M. Wood. Improvements in printing or dyeing azo-colours. September 12.

17,160. W. Majert. Process for obtaining pyrocatechin monacetic acid. September 14.

### Complete Specifications Accepted.

### 1894.

19,712. G. W. Johnson.—From The Chemische Fabrik Goldenberg. A process for obtaining lactyl compounds derived from methylaniline, ethylaniline, *p*-anisidine, and *p*-phenetidine. August 21.

21,227. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of stable diazo-compounds in concentrated liquid or solid form. September 11.

21,786. A. G. Green and R. Jansen. Production of dehydrothioaniline sulphonic acid, and of colouring matters therefrom. September 18.

21,787. A. G. Green and R. Jansen. Production of a new basic yellow colouring matter. September 18.

21,788. A. G. Green and R. Jansen. Improvements in the manufacture of red direct cotton colouring matters. September 18.

22,174. H. S. Wilkinson. Improved dyewood extractor. September 18.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

16,143. S. W. Wilkinson and The Grove Co., Lim. An improved method of and apparatus for removing tar, pitch, oil, grease, and similar matter from wool, fur, and the like. August 28.

16,246. H. H. Leigh.—From C. B. Schneider. An improved process to render paper, cellulose, textiles, or any other material fireproof and non-inflammable. August 29.

16,267. G. Atherton and A. Ashworth. Improvements in the method of and apparatus for recovering volatile solvents from fabrics and tissues. August 30.

16,399. E. Nelson. Improvements in the manufacture of fibrous bituminous felt. September 2.

16,766. W. Fairweather.—From E. Balatsch, C. Herold, and A. Bayer. Process for cleaning by chemical means combings and other wool and hair waste stained with pitch, tar, and other colouring material. Complete Specification. September 7.

16,889. E. Maertens. Improvements in process and apparatus for treating raw wool and similar animal fibres with solvents. Complete Specification. September 10.

17,028. A. Hitchon. Improvements in apparatus for breaking-up or opening cotton and other textile materials. September 12.

### Complete Specifications Accepted.

### 1894.

15,815. J. V. Eves. Apparatus for use in the wet-spinning of flax. August 28.

17,911. L. Wilson. Improvements in apparatus for drying and otherwise treating yarn in cop or other similar compact form. August 21.

18,469. J. Ingleby. Manufacture of linoleum and cork carpets, and apparatus therefor. August 28.

20,033. J. L. Byron and B. F. Byron. Manufacture of yarns made from wool and other fibre or fibres combined, and apparatus therefor.

### 1895.

13,232. O. Duckworth and H. Pettit. Apparatus for drying yarn. August 21.

13,370. W. Jackson. A new or improved textile fabric. September 4.

15,152. C. Ris-Kummer. An improvement in raw silk. September 18.

15,171. O. Duckworth and E. M. Tucke. Improvements in method of and apparatus for drying and oxidising stockings. September 18.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

16,002. E. Weldon. Improvements in dyeing-machines. Complete Specification. August 26.

21,287. J. A. O'Loughlin. Producing patterns on indigo-dyed cotton fabrics. September 11.

### Complete Specification Accepted.

1895.

14,415. D. Stewart. Improvements in apparatus for oxidising indigo-dyed fabrics. September 4.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

15,626. R. Addie. Method of extracting cyanide salts from aqueous solutions. August 20.

15,807. J. W. Stevens. Improvements in or relating to the treatment or utilisation of kelp liquors. August 22.

15,813. F. M. Lyte. Improvements in and connected with the production of chlorine. August 22.

15,922. M. N. d'Andria. Improvements in the manufacture of magnesia. August 24.

15,991. H. Gabe. Improvements in automatical apparatus for decomposing carbide of calcium. Complete Specification. August 26.

16,257. J. Hargreaves. Improvements in the manufacture of chlorates, and in means and appliances therefor. August 30.

16,563. J. B. Torres. Improvements in and connected with the preparation of carbides, their compounds, and other metalloid compounds. September 4.

16,778. T. A. de Wolf and W. A. Harper. Improvements in the manufacture of zinc oxides. September 7.

17,066. M. Goldschmidt. Improvements in the preparation or manufacture of formates and nitrites. September 12.

17,142. C. Hoepfner. Improvements relating to the utilisation of ferriferous solutions. September 13.

### Complete Specifications Accepted.

1894.

15,886. S. A. Saddler and R. H. Wilson. Improvements in process and apparatus for the manufacture of chlorine. August 21.

16,227. P. R. J. Krause. New or improved process and apparatus for the production of chlorine from gaseous hydrochloric acid. September 4.

20,168. W. L. Wise.—From Deutsche Solvay-Werke Actien Gesellschaft. Manufacture or production of chromates. August 28.

21,732. H. Y. Castner. Manufacture of alkali cyanides. September 18.

1895.

12,316. J. D. Darling. Process for utilising nitre-cake and other acid sulphates. September 4.

14,050. O. Imray.—From D. H. Chambers. Improvement in method of refining kaolin and other earths. August 28.

15,040. W. Schulte and F. A. Sapp. Improvements in the production of cyanide of potassium and in furnaces for producing cyanide of ammonium. September 18.

## VIII.—GLASS, POTTERY, and ENAMELS.

### Application.

16,289. H. Muller-Hickler. Improvements in or relating to glass-decorations. Complete Specification. August 30.

### Complete Specifications Accepted.

1894.

17,318. R. Stanley and G. Beck. Improvements in or relating to machinery employed in the manufacture of earthenware and like sanitary pipes. September 4.

20,138. E. A. Shaw. Manufacture of pottery or like ware. August 28.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, and CEMENTS.

### Applications.

15,561. C. Brand. Improvements in the manufacture of scoria or slag blocks, and moulds therefor. Complete Specification. August 19.

15,838. J. Walker. An improved cement. August 23.

16,422. V. Kjeldsen. Improvements in or connected with building blocks or bricks. Complete Specification. September 2.

16,573. E. Robbins. An improved cement and means and methods of producing the same and architectural and other works thereof. September 4.

16,661. J. Thomlinson. Improvements in the manufacture of plaster, cement, mortar, and the like from chalk. September 5.

16,829. T. H. Lewis. An improved paving and flooring block. September 9.

16,962. A. Patrick. Improvements in the manufacture of finely-pulverised substances for use in the production of Portland cement, pigments, and the like. September 11.

17,054. G. Bellamy, F. Rolleston, and S. W. Jewell. An improved manufacture of bricks or blocks for building and paving. September 12.

17,136. L. M. J. Herard. Improvements in artificial mosaic. September 13.

### Complete Specifications Accepted.

1894.

15,460. J. Sheppard and F. Dashwood. A combined fireproof floor and ceiling. August 21.

17,486. J. Matthews. A composition for preserving wood, also applicable to other uses. September 18.

19,325. T. R. W. Mossman. Construction of fireproof floors and roofs. August 21.

19,580. C. Williams. The manufacture of improved fireproof and weatherproof materials or products. August 28.

20,869. G. F. Bowman. Improvements in or relating to fireproof doors, screens, and partitions for buildings and other structures. September 4.

21,173. J. Sheppard and F. Dashwood. Improved fire- and heat-resisting and ventilating floors, ceilings, and other structures. September 11.

## X.—METALLURGY, MINING, Etc.

### Applications.

15,656. W. H. James. An improved process for the extraction of precious metals from their ores and compounds. August 20.

15,925. J. B. Torres. Improvements in and connected with the reduction, refining, dephosphorisation and desulphuration of ores, slags, iron, steel, and of any kind of ores, metals, and alloys. August 24.

15,926. J. B. Torres. Improvements in metallurgical furnaces for the reduction, refining, and manufacturing of iron and steel, and of any kind of ores, metals, and alloys. August 24.

15,954. W. P. Thompson.—From La Société pour l'extraction integrale et economique de l'or, Procede de Rigaud. Improvements in gold-extracting processes and apparatus therefor. August 24.

15,959. W. L. Wise.—From The Aluminium-Industrie-Actien Gesellschaft. Manufacture or production of granulated aluminium and magnesium. August 24.

15,987. E. L. Oppermann and E. Fischer. A new and improved method of amalgamating and extracting gold from ore by the use of mercury fumes or vapour. August 26.

16,303. J. Cobeldick. Improvements in the treatment of slimes or tailings for the extraction of gold or silver therefrom by means of solvents, and apparatus for that purpose August 30.

16,312. J. Taylor and G. A. Warburton. Improvements in the extraction of metals from their ores, and in means or apparatus employed therein. August 31.

16,631. J. S. MacArthur. Improvements in obtaining precious metals from solutions. September 5.

16,732. F. G. Treharne. Treating metalliferous compounds for metallurgical reduction. September 6.

16,754. I. Copley. An improved appliance for facilitating the charging of pig iron or other heavy material into steel open-hearth furnaces. September 7.

16,842. T. Parker and J. Pullman. Improvements in extracting zinc from mixed sulphide ores and the like. September 9.

16,843. T. Parker and J. Pullman. Improvements in the extraction of gold and other metals from refractory ores. September 9.

16,874. A. Crooke. An improved method of calcining the ore or stone in the blast furnace. September 10.

16,920. B. C. Hinman. Improved process and apparatus for extracting gold from ores and other auriferous substances. Complete Specification. September 10.

16,932. J. E. Chaster. Improvements in extracting gold and platinum from ores or substances containing the same. September 10.

17,041. R. Howarth. An improved flux for use in the melting of copper, brass, bronze, or like metals. September 12.

17,044. J. B. Torres. Improvements in extracting gold, silver, and other metals from ores and the like. September 12.

17,115. J. P. van der Ploeg. Improvements in or relating to the extraction of gold and other precious metals from their ores or other compounds, and the recovery of the solvents used in the process. September 13.

17,143. E. Smith. Improved process or method of producing brilliant effects upon bright metallic surfaces. September 13.

17,190. H. R. Lewis and C. Gelstharp. Improvements relating to the separation or extraction of copper, zinc, lead, silver, gold, and other metals from ores or compounds containing the same, and to the recovery of chlorine used in the treatment of such ores or compounds. September 14.

### Complete Specifications Accepted.

1894.

10,827. M. Body. An improved process for the chemical disaggregation of pyrites of complex composition with a view to rapid extraction of the metals contained therein, such as gold, silver, arsenic, antimony, and tellurium. September 11.

17,340. G. Love. Improved treatment of molten iron or steel. August 28.

17,666. S. Trivick, P. A. J. Head, and J. Elsner. *See* Class I.

18,003. H. L. Sulman. Improvements in or relating to the obtaining of precious metals from their solutions. August 21.

18,146. H. L. Sulman. Recovery of precious metals from their ores. August 21.

18,592. H. L. Sulman and F. L. Teed. Extracting precious metals from their ores. August 28.

20,067. F. Stubbs. A method of carburetting the surfaces of armour plates. August 28.

20,365. W. S. Rawson and R. Heathfield. A process for recovery of zinc from scrap galvanised iron and from hard spelter and other zinc alloys. September 4.

20,636. A. Ryrie. Improvements for the protection from corrosion and preservation of iron, steel, and other metallic surfaces. August 28.

21,060. P. Rogers and J. Player. Improvements in machinery or apparatus for coating metal plates or sheets with tin, lead, or other metals or alloys. September 11.

21,213. P. Huth. Casting metals. September 4.

22,023. H. Moissan. Manufacture of alloys. September 4.

24,092. E. Meyer. Improved process for facilitating the disintegrating of Thomas-slag. August 21.

1895.

3073. H. Moissan. Manufacture or production of tintanium and carbide thereof. September 11.

14,402. A. von Siemens. An improved method or process for the extraction of precious metals from their ores. September 4.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

11,728A. W. Shaw. An improvement in voltaic batteries. Complete Specification. Filed September 6. Date claimed June 17, 1895.

15,563. L. Epstein. Improvements in the formation of the electrodes for use in primary and secondary batteries. August 19

15,886. C. J. Wollaston. Improvements in or connected with electric batteries. Complete Specification. August 23.

16,022. E. Burnet and F. F. Smith. An improved form of cell for primary or secondary electric batteries. August 27.

16,350. A. J. Boult.—From E. A. Wunderlich. Improvements in or relating to electric batteries. August 31.

16,557. E. Andreoli. Electro-deposition of gold and silver. Complete Specification. September 4.

16,569. L. Epstein. Improvements in the manufacture of electrodes for voltaic batteries. September 4.

16,582. F. N. Tilton. Improvements in storage battery plate. September 4.

16,702. P. Vandersmissen. An element for secondary voltaic batteries. Complete Specification. September 6.

16,736. J. Pfleger. Improvements in or connected with apparatus for extracting gold and silver from cyanide solutions by electricity. September 6.

16,737. J. Pfleger. Improvements in or connected with electrical apparatus for extracting gold and silver from cyanide solutions. September 6.

16,826. E. Andreoli. Improvements in the electrolysis of saline solutions. September 9.

17,063. T. L. Willson. Improvements in electric smelting. Filed September 12. Date applied for February 20, 1895, being date of application in United States.

### Complete Specifications Accepted.

1894.

12,045. A. Schanschieff. Secondary batteries. August 28.

16,105. R. Heathfield and W. S. Rawson. Improvements connected with the electrical deposition of zinc and other metals. August 21.

21,555. I. A. Timmis. Secondary batteries. September 18.

21,822. J. C. Mewburn.—From F. Hornig and W. Porchers. A vessel for the electrolytic separation and alloying of metals in the molten state. September 18.

1895.

11,864. P. Ribbe. An improved plate for electric accumulators or storage batteries. September 11.

13,434. Siemens Bros. and Co.—From Siemens and Halske. Electrolytical production of zinc from its ores and apparatus therefor. September 4.

14,801. C. Luckow. Improvements in the electrolytic production of oxides and salts which are insoluble, or practically insoluble, in the electrolyte. September 18.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

15,887. T. Shepherd. Improvements relating to soap. August 23.

16,951. F. Davis. Improvements in treating cod-liver and castor oils to render the same palatable and medicinal. September 10.

### Complete Specifications Accepted.

1894.

15,780. G. Stecken. Manufacture of soap. August 28.

18,207. A. J. Inston. Improvements in recovering grease from waste suds which have been used in washing wool, hair, or other fibre. September 4.

18,891. R. Armstrong. Improvements in detergent compounds. September 18.

22,205. J. Wigglesworth and C. H. Simpson. An improved soap tablet. September 4.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

15,647. A. D. Lord. Improvements in or relating to the treatment of waste india-rubber. August 20.

15,721. D. C. Davies. Improvements in the method of and means for compressing vulcanised india-rubber. August 21.

15,956. A. Kenyon. Improved blue or colouring material for laundry purposes. August 24.

16,312. J. D. Ross and A. Heiron. Improvements in paint and the like. August 30.

16,398. K. Deneys. Improvements in and connected with pigments or lakes suitable for the manufacture of wall-papers. Complete Specification. September 2.

16,615. J. B. Torres. Improvements in bleaching india-rubber, gutta-percha, rosins, tobacco, and other organic bodies or materials. September 5.

16,656. J. D. Ross and A. Heiron. Improvements in paint and the like. September 5.

16,778. T. A. de Wolf and W. A. Harper. Improvements in the manufacture of zinc oxides. September 7.

16,962. A. Patrick. *See* Class IX.

17,025. H. C. Longsdon. Improved mechanism for pressing and rolling plastic substances, the same being specially applicable for use in the treatment of crude india-rubber. September 12.

17,108. J. F. Cobbledick. Improvements in enamels, viz., an elastic jet enamel for use on metal, wood, stone, or other substances. September 13.

17,178. H. S. Schurr. Improvements in the preparation of sealing-wax. September 14.

### Complete Specifications Accepted.

1895.

3356. G. J. Atkins. Manufacture of mineral and enamel colours for use in the production of ceramic and other photographs. August 21.

11,331. F. G. Kleinsteuber. Process of manufacturing a substance or product as a substitute for vulcanite or for other purposes to which it may be applicable. September 4.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

16,493. R. Haddan.—From J. Scholl. Improvements in the manufacture of marbled leather. Complete Specification. September 3.

16,865. H. Riches and W. Riches. A novel and quick process in preparing skins and hides and making them into buff or oil leather in less than 24 hours. September 10.

### Complete Specifications Accepted.

1895.

13,698. S. Frohwein. Improvements relating to the production of albumen and raw materials for certain purposes, and in apparatus or appliances in connection therewith. August 21.

## XV.—AGRICULTURE and MANURES, Etc.

### Application.

15,566. F. W. Saatmann. Improvements in the manufacture of manures. August 19.

### Complete Specification Accepted.

1894.

24,092. E. Meyer. *See* Class X.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

16,216. C. F. Cross. Improvement in treatment of starch for production of sulpho-carbonates and compounds thereof. August 29.

16,342. L. Fuchs. Improved device for promoting the crystallisation of sugar out of sugar solutions or massecuite. Complete Specification. August 31.

16,485. J. D. Scott and A. Smith. Improvements in the purification and decolorisation of sugar liquids and syrups. September 3.

21,344. S. Briggs. — From H. Vuylsteke. Improved means and apparatus for treating cereals and amylaceous substances. September 11.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

15,531. R. D. Bailey. The utilisation of brewers' and distillers' mash tun "draff" or spent grains. August 19.

15,660. A. R. Elliott, J. Harper, and M. Lumley. Improvements in apparatus for pasteurising or heating liquids, applicable to fruit juices, cider, perry, beers, wines, decoctions, and other liquids. August 20.

### Complete Specifications Accepted.

1894.

14,919. L. Prochazka. An improved process and appliances for mashing and brewing in breweries. September 11.

17,964. A. Kinder. Improvements in malt kilns. August 28.

20,087. F. N. Mackay. Apparatus for cooling wort. August 21.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

15,553. T. O. Kent. An improved coffee extract. August 19.

15,760. C. D. Abel.—From La Compagnie Générale pour la Production du Froid and E. de Stopanni. Apparatus for producing pure water free from air, suitable for the manufacture of clear ice, by means of exhaust or waste steam. August 21.

15,852. W. C. Kaufmann. Carbonated milk. August 23.

15,885. E. Kressel. The manufacture of a new alimentary extract. August 23.

16,115. W. P. Thompson. — From E. Hilberg. An improved process and apparatus for the treatment of milk, bouillon, or the like, to produce an entirely germ-free and transportable alimentary product. Complete Specification. August 28.

16,906. H. L. de Caux. Improvements in preserving milk. September 10.

17,060. S. D. Rowland. Improvements in preserving alimentary and pharmaceutical substances. September 12.

17,061. S. D. Rowland. Improvements in concentrating alimentary or pharmaceutical liquids or other substances, and in apparatus therefor. September 12.

#### *B.—Sanitary Chemistry.*

15,591. H. B. Arnold. Improvements in and relating to a process of disposing of city garbage. August 19.

16,308. N. V. Sleen and A. Schneller. Improvements in apparatus for the sterilisation and purification of water. August 30.

16,401. J. J. Hartnett. An improved apparatus for disinfecting and purifying air. September 2.

16,504. S. de Petroff. A new or improved method for the treatment of town sewage, refuse, and the like. September 3.

### *C.—Disinfectants.*

16,009. A. Lenhardsson. A new or improved antiseptic and preservative preparation. Complete Specification. August 26.

17,121. F. Inchiostri and A. Inchiostri. An improved powder for destroying insects, and a method of manufacturing same. September 13.

### Complete Specifications Accepted.

### *A.—Chemistry of Foods.*

1894.

14,675. B. F. McIntyre. Improvements in process of and apparatus for condensing and preserving milk. September 4.

20,428. F. Guilleaume and E. Golstein. Apparatus for sterilising milk. August 28.

22,018. J. H. Theberath and A. de Kunwald. Manufacture of margarine and apparatus therefor. September 11.

22,437. J. H. Payne. A preparation of herbal solutions, sauces, and similar dietetic materials, in tablet or block form. September 18.

1895.

7695. T. R. Mason and G. V. Alsing. Improvements in and connected with the sterilisation and preservation of milk, cream, and other fluids. August 21.

12,759. P. A. Bachelerie. An improved process for preserving organic and more particularly alimentary substances and apparatus therefor. September 11.

### *B.—Sanitary Chemistry.*

1894.

17,372. W. Lawrence. Improvements in treating, purifying, and sterilising water or contaminated liquids, and in apparatus therefor. September 18.

20,790. C. D. Abel.—From A. Schlumberger. Improved compounds for filtering and purifying liquids. September 4.

21,635. W. E. Adeny and W. K. Parry. Precipitation of sewage and waste liquids, and the utilisation of the products. September 11.

### *C.—Disinfectants.*

1894.

16,422. R. England. Improvements in or connected with the manufacture of disinfectants. August 28.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

15,754. C. Thiébaut. An improved process for the production of ornamental and other effects or designs upon paper and other substances. August 21.

15,783. The Kellner Partington Paper Pulp Co., Lim.—From N. Pedersen. Improvements in the method of and means for separating knots and other matters from wood fibre in the manufacture of wood pulp. August 22.

16,246. H. H. Leigh.—From C. B. Schneider. *See* Class V.

16,498. G. J. Burns. Improvements in coating and drying machines for use in the manufacture of paper. Complete Specification. September 3.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

15,552. J. E. T. Woods. Improvements in the manufacture of substitutes for camphor, and the purification of the same. August 19.

15,553. T. O. Kent. *See* Class XVIII., A.

15,592. M. Ekenberg. Improvement in method of manufacturing aromatic fluids with relieved intensity of smell, simultaneously rendering them more comfortable for use. Complete Specification. Filed August 19. Date applied for April 1, 1895, being date of application in France.

15,762. C. D. Abel.—From The Fabriques de Produits Chimiques de Thann et de Mulhouse. Improvements in the manufacture of artificial musk. August 21.

16,286. J. B. Bouyoud and A. Velluet. Extract of watercress. August 30.

17,060. S. D. Rowland. *See* Class XVIII., A.

17,061. S. D. Rowland. *See* Class XVIII., A.

### Complete Specifications Accepted.

1894.

20,521. C. D. Abel.—From The Fabriques de Produits Chimiques de Thann et Mulhouse. Improvements in the manufacture of artificial musk. September 4.

1895.

11,288. I. Roos. Manufacture of citrates, tartrates, and mandelates of para-anisidine and para-phenetidine. September 11.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Applications.

15,935. A. Hill and A. A. Barratt. Improved means of obtaining photographs in true relief, in gold, silver, and other metals. August 24.

16,045. J. W. Collings. Improvements in and connected with photographic dry (or wet) plates and films. August 27.

16,516. H. S. Fearon. Improvements in the production of coloured photographs. September 3.

16,548. F. W. Lanchester. Photography in colours. September 4.

16,810. C. P. Douglas. Photographic enamel. September 9.

### Complete Specifications Accepted.

1894.

16,693. E. de Coninck. Manufacture of coloured dry plates for photography. August 28.

1895.

13,562. H. de Grousilliers. A process and apparatus for recovering volatile solvents from collodion coatings of paper. August 21.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

15,551. S. J. Mackie. Improvements in the manufacture of gunpowder. August 19.

15,574. P. Fowler and A. W. F. de Courcy Bower. Improvements in lucifer matches. August 19.

16,834. L. W. Buse. An improved manufacture of explosives. Complete Specification. August 22.

16,311. H. Maxim. Improvements in the manufacture of smokeless explosives. August 30.

16,386. R. Wolffenstein. Process of producing a new explosive (Cyclo-aceton-superoxyd). September 2.

16,629. A. Gillingham and J. J. W. Rowland. Smokeless cartridges or gunpowder. September 5.

16,861. H. Maxim. Improvements in the manufacture of explosives. September 9.

16,862. H. Maxim. Improvements in the manufacture of explosives and in apparatus therefor. September 9.

17,005. J. W. Swan. Improvements in or connected with the manufacture of nitro-cellulose or gun-cotton. September 11.

### Complete Specifications Accepted.

1894.

23,260. C. P. du Buit. Improvements relating to the preparation of smokeless powders for use in firearms and for other purposes. September 18.

1895.

14,775. M. Wagner. Manufacture of a safety explosive. September 18.

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THE JOURNAL

OF THE

# Society of Chemical Industry:

A MONTHLY RECORD

FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 10.—Vol. XIV.] OCTOBER 31, 1895. [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form to be hereafter provided | 5*s.* |
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Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed. The circulation of the Journal is now more than 3,000 per month.

Foreign and Colonial Members are reminded that the subscription of 25*s.* for 1896, payable on January 1st next, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1896.

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SESSION 1895-96.

November 4th.—Mr. W. J. Dibdin. "Filtration of Sewage Effluent."

December 2nd:—

Mr. J. Hargreaves. "Alkali Manufacture by the Hargreaves-Bird System of Electrolysis."

Dr. S. Rideal and Mr. S. Rosenbaum. "The Analysis of Chrome Iron Ore, Ferrochrome, and Chrome Steel."

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SESSION 1895-96.

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SESSION 1895-96.

November 1st.—Chairman's Address. "A Quarter of a Century in the Heavy Chemicals Trade."

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SESSION 1895-96.

November 6th.—Chairman's Address.

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SESSION 1895-96.

November 4th.—Mr. W. McD. Mackey. "On the Spontaneous Combustion of Oils spread on Cotton." Part II.

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SESSION 1895-96.

November 5th.—Chairman's Address.

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*Meeting held at the College of Pharmacy,*
*Monday, October 7th, 1895.*

MR. A. H. MASON IN THE CHAIR.

### CHAIRMAN'S ADDRESS.

The CHAIRMAN said: We meet this evening to inaugurate the second session of the New York Section of the Society of Chemical Industry, and we do so under unusual circumstances, in that we have with us Mr. Thos. Tyrer, President of our Society, as well as Prof. Austen, Chairman of the New York Section of the American Chemical Society, and Dr. Hart, Chairman of its Lehigh Valley Section. In your name I heartily welcome these gentlemen. Mr. Tyrer feels it to be the duty of a president, when practicable, to visit the various sections of the Society during his term of office, and our Section is privileged in being the first to welcome him.

A copy of our first annual report has been furnished to the members of the Section, together with a directory of all members of the Society residing in the United States. Your committee felt that thus we should get to know each other better, and the result so far is a considerable accession of members to the Local Section.

The report of the council of the parent Society for 1895 (See this Journal, No. 8, Vol. XIV., page 715) contains the following item:—

"No new section has been formed during the year, but several of those already existing, notably that in New York, show greater activity."

As we are barely out of our swaddling clothes, where does the "greater" activity come in? Gentlemen, we were born full of vigour, and we have kept it up, and intend to continue doing so. The United States furnished 69 members last session, and we have already sent in 34 names towards this year's record, so that the hon. treasurer may find that "the Society has not reached its maximum of members" so far as the United States is concerned.

The list of papers promised is also encouraging. I infer from the remarks of the ex-President that they already feel the press of matter for the Journal, and although the able editor has pruned our communications in some instances, still, if we provide good matter, no doubt room will be found for it.

A collective index from the beginning of the Journal to the close of the current year is being compiled, and I call your attention to a notice appearing on the second page of the Journal, giving the terms on which the index may be obtained in 1896.

In an address which I had the honour to deliver last year, I called the attention of the readers of our Journal to the natural resources of this country for the development of chemical industries; what had then been accomplished so far as I could gather the information; and finally where we hoped to stand in the future. I have given some further attention to the subject in the interval, but find that, so far as public records go, there is little to add thereto. From general sources it seems to be impossible to obtain more complete statistics as to what is being manufactured in this country and the location of the various industries. Such information would be of great value and importance. If this Section could form a bureau for receiving such information, I offer to do my best to compile a record of it, and I respectfully invite the voluntary assistance of chemical manufacturers and the proprietors of chemical industries by sending in the necessary particulars.

I reported on the importations of certain chemicals entered for consumption in the United States up to the 30th June 1893.

I am able to furnish further particulars for 1894–95 to the schedule; they have not been published, so may be useful to some of our readers.

The study of the ultimate history of all industries will show that as they grow they make claims upon different branches of education, and in our case the demand is ever growing for the combination of chemical and engineering knowledge in the same person; this was patent to the founders of our Society. I understand that when its formation was first discussed it was proposed to call it the Society of Chemical Engineers, the tendency of development at that time being more in the direction of the improvement of plant, and success clearly more due to the progress of the science of engineering than that of chemistry; but better councils prevailed. The progress of chemical manufactures must be based on chemistry, so we have a most comprehensive society, embracing all chemical industries. Nevertheless, were it not for the science of engineering, whereby the great sources of *power* in nature are utilised for the use of the manufacturer, we should to-day be in a sorry plight.

Political economy is the science of wealth, but engineering is its producer by utilising such forces as wind, running water, the fuel of the forests, coal, natural gas, and oil wells.

One example of this is the utilisation of the power of Niagara for the development of certain chemical industries.

From general reports, the chemical industries of this country continue to grow steadily in all directions in importance, value, and extent. Progress has been made in two most important branches—the production of alkalis by electrolytic processes and the manufacture of sulphuric acid.

With all the favourable circumstances of large and growing demand, inexhaustible supplies of raw material of various kinds, and cheap power, there is no doubt that recent developments are bound to culminate rapidly and reach very great proportions, and that we shall achieve results of most permanent and enduring quality. What position are we going to take on this onward march? It is possible for each one of us to do something; to put even one stone in the structure which is being erected, unknown to others—may-be even to ourselves; but it is the duty of this Section, individually and collectively, to do all we can to study and develop the chemical industries of this country. Knowledge has no country—belongs to no class; but such knowledge as we develop is mighty, and it is mightier for what each one of us may do towards its development.

The Chairman then requested the President to assume the chair.

The President said: Your Chairman has alluded to me in terms which arise from his long and intimate friendship with me, but they are sufficient to afford me the opportunity of making a few remarks upon our Society and its general policy. I do think that a President should, wherever practicable, see the Sections. It is not always easy to make that intimate acquaintance with the Officers of the Society who are *ex-officio* Members of the Council, and whom distance prevents from attending in London. This certainly is the case in the New York Section of our Society.

The first annual report of the Section, to which your Chairman refers, merits the favourable notice of the other Sections, but its publication or issue is a purely sectional matter. With regard to the comparative activity of the New York Section referred to in the Report of Council at the General Meeting, it was probably the great vigour and usefulness of this Section that prompted the use of the comparative degree: for an infant, your Section undoubtedly is vigorous. Much good will doubtless result from the visit of our ex-President, Mr. Ludwig Mond, who, we are told, will deliver his opinions of the chemical industries of this country at your next meeting. With regard, however, to the contributions of the New York Section to the Journal of the Society, I think you need have no fear of rejection if the right matter is sent forward. The remarks of the ex-President, Dr. T. E. Thorpe, were intended to warn us that the expenditure was getting too near the receipts. We have a considerable reserve fund, for which in due time an outlet may be found, but it is extremely undesirable that the ordinary expenses of the Society should be permitted to trench upon that; and I hope the further remarks of the ex-President will be read in the connection referred to by your Chairman. One of the chief objects of the very earnest and often prolonged meetings of the Committee of Publication on the 23rd of each month is to prune, condense, and even delete matter which in its opinion is not desirable. Each Section has the power, which, I believe, in England is exercised, of appointing its own revision committee, to revise papers before they are read. I believe that many papers are not subjected to this previous revision, but are revised in most cases after reading. This practice is one which I commend to your Committees' notice. The ex-President's remark upon the narrow margin of *£ s. d.* was undoubtedly prompted by considerations regarding the Collective Index, which is in a forward state of preparation, and will probably be ready for the Annual General Meeting of the Society, in London, in July 1896, which I hope that as many as possible of our American friends will make arrangements for attending. The London Section will, I am sure, do its very best to reciprocate the kindness which you have shown, not only to me, as your President, but to the other gentlemen who at this time are visiting your country, and who, as members of our great federation (a term I delight to use in this connection), attend this meeting. I venture to say that the Collective Index will prove worthy of your possession, and believe that no chemist can afford to be without it. It will rank high in the list of bibliographies.

There is an observation in your Chairman's remarks to which I may refer, viz., the formation of a bureau for collecting and receiving information as to the chemical industries of your great country. In Germany there is at least one society, which has a name only slightly different from ours, viz., a society for the protection of chemical industries. Doubtless general needs prompted its formation, but I believe it is a society which collects statistics as to capital, profits, dividends, and other particulars from the manufacturing concerns represented upon it. It is a factor which the Government of Germany does not ignore, but rather troubles to consult and even conciliate. A reference to some of the statistics published by this German society will be found in the trade report of the February number of our Journal, and I refer your attention to that, so that inquiry may be made as to the constitution of the German society, and so make it one of the features of your New York Section to contribute annually as part of its quota to the Journal. I do not think that we can widen the already broad basis of our Society sufficiently to make it, in the same sense as the German one, a "protective" Society.

I notice in the New York Herald of a day or two ago a full notice of the death of Pasteur. Doubtless an obituary of the great savant will appear in due course. Science and true research have lost a great example; and the younger men whom I see here in this admirably arranged School of Pharmacy cannot do better than use fully the faculty of observation which he and every discoverer have found their choicest instrument.

Reference has been made to the presence of Mr. Mond in America. That is a coincidence which is as grateful to me as anything can possibly be, and I am glad to observe that the fame of his good services to science in the opening and founding of the Schorlemmer Laboratory for the exclusive teaching of organic chemical research at the Owens College, Manchester (see this Journal, 1895, 552), and the establishment of the Davy-Faraday Laboratory for research in physics and chemistry in connection with the Royal Institution of London, have preceded him.

I cannot resume the chair without heartily and sincerely thanking you for the cordial and warm reception you have accorded to me. I am not a contributor worthy of the name to technical chemistry, being but a manufacturing chemist; and the honour done to me is a compliment paid to those who have done the drudgery and detail work of this Society.

## NOTE ON THE MANUFACTURE OF PHENYLAMIDOAZOBENZENE AND SOME DERIVATIVES.

BY T. LYNTON BRIGGS.

In the year 1879 Otto N. Witt described some of the properties of phenylamido-azobenzene (Ber. 12, 259, *et seq.*), and gave a method for preparing it, by combining diazobenzene with diphenylamine in alcoholic solution—a method which is not suitable for work on the large scale, and is somewhat troublesome to carry out in the manner described. At that time, however, there was no commercial use for phenylamido-azobenzene itself, but Tropæoline, which is the potassium salt of phenylamido-azobenzene sulphonic acid O O, was introduced then as a new dyestuff. The technical process devised by Witt, and used by Williams, Thomas, and Dower, was as follows:—Alcohol as solvent for the diphenylamine was obviously inadmissible, for such a process a solvent was yet required which would not enter into combination with the reagents and could be easily removed by washing with water. Pure commercial carbolic acid was found to fulfil these requirements, for whilst it it will combine with diazotised sulphanilic acid, forming the colouring matter known as Tropæoline Y, it only does so in neutral or alkaline solutions, and not in the presence of strong acids. Into a steam-jacketed pan 31 lb. of diphenylamine, and 25 lb. of carbolic crystals, were melted together, and then cooled to 30° to 40° C. A cold solution of diazobenzene sodium sulphonate was at the same time prepared in a wooden vessel by combining $11\frac{1}{4}$ lb. of commercial nitrate of soda with 35 lb. of sulphanilic acid in the presence of ice and sufficient water to measure at the end about 35 to 40 galls. Into a covered wooden box, 3 ft. deep and 2 ft. square, provided with wooden agitators and mechanism for very powerfully moving them at any desired speed, was placed 25 lb. of hydrochloric acid of 20° B. cooled with ice and diluted with about one and a half times its bulk of water. The cooled diphenylamine solution was next run into the box, and mixed gently with the acid and water, so as not to cause crystallisation to take place. Thereupon the cold solution of diazobenzene sodium sulphonate was run into the mixture, the agitators being still kept in gentle motion. The addition of the ice-cold solution was so regulated that the oily mass was not allowed to solidify. When all the solution of the diazo compound was added, the box was covered tightly, and the mixture observed through a suitable hole in the cover. As soon as the oily mass showed signs of breaking up into powder the hole was closed; the agitators were driven at high speed so as to finely divide the oily mass and disseminate it throughout the solution. This churning was kept up until no oil was left. More ice was then added as required, and the mixture was slowly stirred for about one hour, then run off into a tub, and left there for a few hours longer. The supernatant liquor was run off for use in other ways, and the granular black powder of phenylamidoazobenzene sulphonic acid was run on to filters, washed with cold water, and finally converted into the potassium salt by boiling in a wooden tub with an amount of carbonate of potash solution slightly in excess of the theoretical and sufficient water. After cooling and crystallising, the product was filter-pressed, dried, ground, and standardised for the market.

Some years later, having need of considerable quantities of the nonsulphonated phenylamidoazobenzene, I adapted the above process to its production, instead of using the alcohol method advocated by Witt, and with very satisfactory results. I dissolved 34 parts of diphenylamine in 70 parts of phenol, and, after cooling as much as possible without causing the solution to crystallise, added the mixture to an ice-cold solution of diazobenzene chloride, resulting from the interaction of 20 parts of aniline, $14\frac{1}{2}$ parts nitrate of soda, and 44 parts of hydrochloric acid of 20° B. The mixture was made in apparatus similar to that above described, and was violently agitated until the finely-divided oily particles became solidified, after which stirring was kept up slowly for a few hours, or until no more or very little uncombined diazobenzene chloride could be found on testing with a solution of phenylenediamine. The crude granular, often shot-like, phenylamidoazobenzene thus obtained was washed with water mixed with excess of strong caustic soda solution, and fused by adding boiling water to the mixture, and the oil well stirred up with the alkaline solution. After settling and cooling down the alkaline liquor was drawn off, and the solid cake of phenylamidoazobenzene broken up and washed with cold water to remove the adherent alkaline solution. The advantages of using the phenol in this case are that it is not only a solvent for the diphenylamine, but also for diazobenzene hydrochloride, which it extracts from the aqueous solution, and thus brings the two substances into condition most suitable for their interaction, whilst owing to the acidity of the solution it is not itself acted upon by the diazobenzene hydrochloride. The yield obtained was about 50 to 52 parts of crude phenylamidoazobenzene.

The process as above described can be readily carried out in the laboratory with ordinary flasks and agitation by hand, and with much greater ease and in less time than by the method originally devised by Witt.

The phenylamidoazobenzene produced by this process was quite pure enough for the purpose required, viz., the production of a very green shade of induline sold at an earlier period under the name of Induline G O, and later as "True Blue." This induline was made by heating 50 lb. of phenylamidoazobenzene with 100 lb. of aniline and 60 lb. of aniline hydrochloride; the temperature was at first raised slowly to 100°—130° C., at which it is kept for a few hours, after which it is heated to 160°—180° C. for 15 to 21 hours longer. An enamelled cast-iron was used, and this was heated in an air or oil bath. The melt, while hot, was run into a quantity of water or aniline liquors from the aniline recovery stills and well stirred up to remove aniline or other salts, leaving the excess of aniline and the colouring matters in a fluid state. The mass was drained on filters, and subjected to hydraulic pressure; the aniline filtrate containing a low grade induline was treated according to the usual methods adopted for the recovery of aniline, and the colour separated and worked up. The hard press-cakes of the induline of green shade were boiled with hydrochloric acid and water, drained on filters, washed, and dried. This induline was very easily sulphonated by treatment with only twice its weight of 98 per cent. of sulphuric acid at 80° to 100° C. until it was soluble in dilute ammonia. The sulphonate produced was very soluble in water, and so the melt was thrown on to as small an amount of ice as sufficed to cool and dilute but not dissolve it. The acid magma was filtered off, submitted to hydraulic pressure or hydro-extracted, and dissolved in water and ammonia, and the solution, after settling, dried down on steam-jackets as usual. The product was then ground and adjusted to standard for market.

If instead of heating the phenylamidoazobenzene with so much aniline hydrochloride, a less quantity, say 5 lb., be taken and the heating kept at 50° C. or under for 24 hours, large quantities of azophenine are formed. Indeed, by using this method phenylamidoazobenzene forms a very convenient substance from which to prepare azophenine in the laboratory.

## ADULTERATION AND SUBSTITUTION OF DRUGS.

BY H. SCHWEITZER.

When a year ago it was decided to protect the patent rights for phenacetine against numerous infringers, the chemical investigations involved were placed in my charge.

Besides searching in some directions which are of no interest from a chemical point of view, I ascertained the character of the adulterants, and the extent to which adulteration and substitution of phenacetine take place. It is the object of this paper to show the character of these adulterations and substitutions.

Regarding the composition of the sophisticated powders, I found that in several cases acetanilide was substituted for phenacetine, and 21 specimens contained sugar mixed with acetanilide; 12 samples proved to be a mixture of acetanilide and bicarbonate of soda, and one powder contained acetanilide and bismuth; 35 specimens of phenacetine were adulterated with acetanilide, 2 with sugar, 1 with borax, and 2 with acetanilide and sugar. One powder put forward as phenacetine was sulphate of quinine, and one was antipyrine.

Everybody will admit that the substitution of acetanilide for phenacetine is reprehensible in the highest degree.

My method of examination was as follows:—It commenced with the determination of the melting point. In accordance with the results of this test the powders were divided into two groups, the one with the correct melting point of phenacetine, 134·5° C., and the other with a different melting point.

The powders of the first group were then subjected to tests for solubility in cold and boiling water, alcohol, ether, and chloroform, and finally they were ignited. All the powders melting at 134·5° C. behaved in all these determinations like pure phenacetine, and were pronounced to be unsophisticated.

Powders with a melting point below or above 134·5° C. were subdivided into three groups, namely: one with constant melting point indicating a pure chemical individual; the other with unconstant melting point, &c., mixtures of organic bodies; and the third showing the presence of unmelted substances at 155° C.

To the first group belong the powders consisting of pure acetanilide, antipyrine, and also sulphate of quinine, which melted in its own water of crystallisation.

Acetanilide is identified by its melting point of 113°—115° C., the larger crystals fusing at a somewhat lower temperature than the finely powdered substance. Again, the powders were subjected to tests for solubility in water, ether, alcohol, chloroform. They were then ignited; finally the carbylamine reaction was carried out by heating 0·10 grm. of the powder with 1 c.c. of NaOH (15 per cent. NaOH) and three drops of chloroform, whereupon the offensive smell of phenyl-isocyanide was given off.

All powders giving the last reaction, melting at 113°—115° C., and corresponding to the tests of solubility for acetanilide, were considered to be pure.

Another powder melting at 113° C. possessed an intensely bitter taste and was very easily soluble in water, alcohol, fusel oil and chloroform, but insoluble in petroleum-ether. The qualitative test for the constitutent elements showed the presence of nitrogen and the absence of sulphur. A solution of 9·30 grm. of the powder treated with 0·10 grm. of nitrite of sodium in 2·5 c.c. of water turned greenish-blue on the addition of 10 drops of acetic acid (1·06 sp. gr.), and in the course of an hour green crystals appeared in the fluid. By these tests the powder was recognised as antipyrine.

For the identification of the powder consisting of sulphate of quinine, we tender the following determinations. The powder, forming long silky-white needles, melted in its own water of crystallisation when carefully heated in a glass tube over the open flame. If the warmed mass was allowed to cool and was then heated with alcohol, it became carmine red. The taste of the crystals was intensely bitter, and they were soluble with great difficulty in the ordinary solvents, alcohol, ether, chloroform, cold and boiling water. Both nitrogen and sulphur were found to be present.

The powders with unconstant melting points fused below 134·5° C., and were recognised to be mixtures of phenacetine and acetanilide. We observed the strange fact that all of these mixtures began to melt at 92° C. and became perfectly clear at temperatures up to 132° C. The regularity of the temperature at which these mixtures began to melt was so striking that it was considered important to inquire further.

For this purpose we compounded mixtures of finely powdered and intimately mixed acetanilide and phenacetine in varying proportions and determined their melting points, heating very slowly and noting the beginning of the melting point and the temperature at which the mass became perfectly clear.

The result is given in the following table, each test being several times repeated:—

| No. | Mixture consisting of | | Begins to Melt at | Completely Transparent at |
|---|---|---|---|---|
| | Phenacetine. | Acetanilide. | | |
| | Per Cent. | Per Cent. | ° C. | ° C. |
| 1 | 89 | 1 | 92 | 134·0 |
| 2 | 95 | 5 | 92 | 133·0 |
| 3 | 85 | 15 | 92 | 128·0 |
| 4 | 66⅔ | 33⅓ | 92 | 126·0 |
| 5 | 60 | 40 | 92 | 125·0 |
| 6 | 50 | 50 | 92 | 122·0 |
| 7 | 40 | 60 | 92 | 118·0 |
| 8 | 33⅓ | 66⅔ | 92 | 114·0 |
| 9 | 15 | 85 | 92 | 110·0 |
| 10 | 5 | 95 | 92 | 106·0 |
| 11 | 100 | 0 | 133 | 134·5 |
| 12 | 0 | 100 | 112 | 114·0 |

From this table it appears that all the mixtures begin to fuse at 92° C., whereas pure phenacetine and acetanilide do not show the least change at this temperature.

According to our experience this test is such a positive indication for a mixture of phenacetine and acetanilide that it is not necessary to carry out any of the more complicated reactions described for the recognition of such a mixture. (This Journal, 1895, 77.)

For the identification of the mixture it is sufficient to state that the substance begins to melt at 92° C. and becomes completely transparent below 134° C. It is soluble in water, alcohol, ether, and chloroform. On heating 0·10 grm. of powder with 1 c.c. of caustic soda (15 per cent. NaOH) and three drops of chloroform, the offensive smell of phenyl-isocyanide is observed. The qualitative test for the constituent elements establishes the presence of nitrogen and the absence of sulphur.

Finally, the examination of the last group of powders, showing the presence of a substance which does not fuse at 155° C., will be described.

These powders were first ignited, then classified into two groups, the one consisting only of organic substances and the other containing mineral matter.

On ignition all the powders containing only organic bodies gave off a smell like carbohydrates, such as starch or sugar, and the powders themselves had a sweet taste. We therefore extracted the powder with ether and examined the portion soluble in ether, as above, establishing the presence of acetanilide and phenacetine, or mixtures of the same. The portion insoluble in ether was identified as cane sugar by the sweet taste, the smell on ignition, and the reaction with Fehling solution before and after inversion by means of dilute acid.

The powders containing an admixture of inorganic substances were likewise extracted with ether and the residue from the ether solution examined as above, and only acetanilide or phenacetine was found to be present. The portion insoluble in ether was subjected to the ordinary methods of inorganic analysis. In case of the presence of bicarbonate of soda we observed during the determination of the melting point, a liberation of gas at about 125°—130° C., and we find that this generation of gas is a sure indication of the presence of bicarbonate of soda.

### Discussion.

The President said that the author had pointed out some singular facts with regard to the constancy of melting points of mixtures, which should be the subject of further investigation. The methods of examination which he had described would doubtless prove useful and interesting to a very considerable number of our members.

## Obituary.

### LOUIS PASTEUR.

The late Professor Huxley, when defending the expenditure of the London School Board, said that it might possibly cost a million sterling to catch a genius, but that the money was well expended when once the genius was caught. The life of Pasteur furnishes a remarkable verification of this statement. Louis Pasteur was born at Dole, December 27th, 1822, and two years later his parents moved to Arbois. He was but a peasant boy when his father, a tanner by trade, entered him at the Communal School of Arbois. Here he manifested a distinct taste for drawing, beyond which no specially predominant faculty had yet appeared. At this time he was about 13 years of age. Later on he became more studious, and soon began to evince a strong predilection for chemistry. In 1843 he became a pupil of the École Normale in Paris, and here he was fully able to satisfy this predilection. He attended the lectures of M. Dumas and M. Balard, and became much attached to M. Delafosse, a lecturer of the École, who had paid much attention to the science of crystallography. About this time Mitscherlich discovered that the double racemate of ammonium and sodium and the corresponding salt of tartaric acid have the same composition and molecular structure, the same crystalline form, and were apparently in every other respect identical, but behaved differently with regard to polarised light, the double racemate being inert whilst the tartrate rotated the ray to the right. Pasteur, however, was inclined to believe that some difference in crystalline form must exist, hitherto overlooked, and as the result of a careful preparation of the two salts, followed by a close examination, he was able to detect certain small facets on the crystals of the tartrate which rendered them unsymmetrical, and a remarkable case of physical isomerism was thus established, which soon led to others even more so. By means of further observations, and under the light of a remarkable process of reasoning by analogy, these investigations in physical isomerism became connected with others on the still higher platform of the science of fermentation, one in which physical and chemical laws play their parts and become connected with the mystery of life and the functions of living organisms. A German manufacturer of tartaric acid had observed that when tartrate of lime containing organic impurities was allowed to remain under water in hot weather it entered into a state of fermentation. Pasteur investigated this phenomenon. One of the results was the discovery that this peculiar fermentation was caused by a living organism. He now cultivated this organism in a solution of racemate of ammonium and found that only one-half of the salt fermented away, and, what was more surprising, that the solution containing the unfermented portion strongly rotated the polarised ray to the left. The organism was thus able to attack and ferment the right-hand acid, but could not cope with the left-hand one. This was the first known instance of what is now called selective fermentation, which has since been found to be a phenomenon of general occurrence. Fischer has since formed the opinion, based upon much research, that the enzymes, like the sugars, possess asymmetric carbon atoms, and that there must be some relation between the configuration of the particular enzyme and that of the sugar which it is able to act upon; "to use a rough analogy, the enzyme and the sugar should, as it were, fit one another as a key does a lock," to quote Dr. W. J. Sykes. The next important question with regard to ferments was that connected with the fact that all ferments, hitherto considered by the majority of observers to be composed of dead organised matter, are living organisms. It had been surmised by many previous observers that yeast was a living organism, and not a purely chemical substance, the great Liebig heading the opposition against the physiological view. The discovery of the fact that the fermentation of calcium tartrate was caused by a living organism led Pasteur next to the belief that this could not be an isolated phenomenon—that there must be some general law, and he subsequently commenced a series of observations on lactic fermentation, with results no less surprising or useful than those already referred to. Thus, the organism now known as *bacterium aceti* was discovered, which is that concerned in acetous fermentation, and can only perform its functions when freely supplied with oxygen.

Pasteur's great statement, at the Sorbonne, based upon quiet but strenuous research, and which laid to rest the chimera of spontaneous generation, may next be quoted. "There is not one circumstance known at the present day which justifies the assertion that microscopic organisms come into the world without germs or without parents like themselves. Those who maintain the contrary have been the dupes of illusions and of ill-conducted experiments, tainted with errors which they did not either know how to perceive or to avoid. Spontaneous generation is a chimera."

Later on, with the growth of experience and knowledge, Pasteur was able to associate in the case of beer, as in that of wine, each special form of deterioration with a particular organism, a number of which he described and pictured. Wines, especially those of low alcoholic strength, are apt to undergo very objectionable changes on keeping: to turn sour, to become turbid, or become bitter. Pasteur found that all such changes or diseases were due to special organisms, and to render wine stable the process now known as "Pasteurisation" was proposed; this consists in heating the wine slowly, when bottled off, to a temperature of 140° F., and then allowing it to cool.

The investigation of the much more complex question of rabies was commenced by Pasteur in 1880 in collaboration with M. Roux. It resulted in the establishment of a system of inoculation which has certainly achieved some marked successes, and so indicates that even if some results have not been good, a right way must nevertheless exist, which has occasionally been missed in the cases of non-success.

Pasteur's method of combating the disease of silk-worms is still rigorously followed wherever the silk-worm is cultivated. Perhaps his greatest discovery, if measured by the alleviation of suffering and distress, and by the warding off the encroachments of terrible disease, was that of the organism of anthrax. Pasteur established the fact that the small filiform corpuscles found in the blood of animals killed by anthrax consisted of a terrible parasite capable of killing sheep, cattle, or men. He found that this organism buried with the carcases of its victims, might attack the very earth-worms, these forming vehicles of the disease, which might thus perform a kind of evil resurrection in the bodies of the earth-worms, the germs becoming then scattered over the fields and forming a constant source of contagion for sheep and cattle.

Such were some of the principal labours of the great savant, who passed away on the 28th September at 5.30 p.m. His life was a quiet one "in the serene peace of laboratories and libraries." He was successively assistant in physical science and demonstrator in chemistry at the École Normale, and was eventually created a Doctor of Science. A few years later he became Professor in

Strassburg and then Dean of the Scientific Faculty of Lille. He was recalled from this city in 1857 to Paris to become Director of Scientific Studies at the École Normale, then Professor of Geology, Physics, and Chemistry at the Beaux Arts; finally, to be Professor of Chemistry at the Sorbonne. In 1874 he was voted a life annuity of 12,000 fr., which the following year was increased by 6,000 fr., and he was in 1878 made a Grand Officer of the Legion of Honour. On the 27th December 1892, on the motion of the Academy of Sciences, the 70th anniversary of Pasteur's birth was celebrated in the old Sorbonne, when the President of the Republic, the Ministers, the Members of Parliament, the Corps Diplomatique, the Scientific Societies of France, and delegates from all the Universities and Colleges in the world, came to present to Pasteur the tribute of their admiration and gratitude.—W. S.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Improvements in Apparatus for Heating and Cooling Liquids.* A. Lawrence, Brentford, Middlesex, and Bennett, Sons, and Shears, Limited, London. Eng. Pat. 14,554, July 28, 1894.

This invention relates to "horizontal refrigerators or heating apparatus constructed of or with corrugated metal surfaces or of tubes, which may be rocked vertically, horizontally, or at any convenient angle." The refrigerator (or heater) is supported at the ends by means of hollow trunnions, which enables a rocking motion to be given to the vessel for the purpose of more evenly distributing the liquor to be cooled (or heated); the hollow trunnions also acting as inlet and outlet tubes for the liquor. The refrigerator is also supported at its centre on a ball-and-socket joint, by means of which, when the trunnions are disconnected, the vessel can be moved in any direction to facilitate cleaning. There are also a number of minor improvements claimed in the form of the refrigerator, &c.—L. T. T.

*An Improved Method for Hermetically Closing Preserve Jars and the like.* W. P. Thompson, Liverpool. From The Conserven-Fabrik, Mombach-Mainz, Germany. Eng. Pat. 21,050, November 2, 1894.

Instead of employing ordinary india-rubber washers which may not fit evenly, and require pressure, the inventors use a variety of india-rubber which becomes adhesive when warm, and paint over the surfaces of the receptacle and its lid with a solution of rosin in spirit; an air-tight cover is thus obtained.—F. H. L.

*Improvements in Filter-Presses.* A. L. G. Dehne, Halle-on-the-Saale, Germany. Eng. Pat. 13,160, July 8, 1895.

In filter-presses provided with means for washing the cakes formed in the filter-press, the inlet and outlet passages for the washing-out water are provided with cocks for the purpose of cutting out any particular chamber, either whilst filtering or washing out.—E. G. C.

*Improvements relating to Safety Devices for the Openings of Receptacles for containing Explosive Fluids.* A. J. A. Elvers, Wendorf, Prussia. Eng. Pat. 13,386, July 11, 1895.

This invention has special reference to liquids such as petroleum spirit, benzoline, &c., and consists in "a safety device for the openings of reservoirs, receptacles, or holders for explosive fluids, characterised by the arrangement of fine metal wire gauze in all the openings leading to the interior of the receptacle so that the fluids, as well as any gases generated therefrom, can only pass in or out of the said receptacle through the wire gauze, in order to render impossible explosions of the contents of the said receptacle by adjacent flames," &c.—W. M.

## II.—FUEL, GAS, AND LIGHT.

*Calcium Carbide.* W. Borchers. Zeits. f. Elektrotechnik. u. Elektrochem. 1895, **2**, 163—167.

At the annual meeting of the German Electro-Chemical Society, Dr. Borchers exhibited an apparatus by which he not only succeeded, nearly 10 years ago, in preparing calcium carbide, but also showed that all the oxides which were regarded as irreducible could easily be reduced by the action of carbon. It consists of a small chamber or furnace of fire-brick, through the walls of which pass thick carbon rods 40 mm. in diameter. Inside the chamber these are connected by a thinner carbon rod, 4 mm. in diameter and 40 mm. long. The furnace is fed with a mixture of lime and carbon. The action is not electrolytic: the effect of the current being simply to heat the lime to a temperature at which it is reduced by the carbon. An E.M.F. of 12 volts and a current of 90 ampères is used. The current may be either direct or alternating; and by diminishing the length of the thinner rod calcium carbide can be produced with an E.M.F. of only 1 volt, so that electrolysis is out of the question. The reactions which take place are:—(1) $CaO + C = Ca + CO$; (2) $Ca + C_2 = CaC_2$.

The above reactions are supposed to have been discovered by Moissan and Wilson, but the author refers to publications by Wöhler (1862) and himself (1891).

It was at first thought that alcohol and potassium cyanide might be manufactured cheaply from calcium carbide, but at present there seems little likelihood of these expectations being realised.—D. E. J.

*Physical Properties of Acetylene and of Acetylene Hydrate.* P. Villard. Comptes rend. 1895, **120**, 1262—1265.

The acetylene was prepared from calcium carbide, and was obtained in a state of great purity. Determinations of vapour tension gave the following results:—

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[*] Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

| Temperature. | Pressure in Atmospheres. | Temperature. | Pressure in Atmospheres. |
|---|---|---|---|
| ° C. | | ° C. | |
| −90 (solid) | 0·69 | −23·8 (liquid) | 13·2 |
| −85 " | 1·00 | 0·0 " | 26·0 |
| −81 (m.p.) | 1·25 | + 5·8 " | 30·3 |
| −70 (tiquid) | 2·22 | +11·5 " | 34·8 |
| −60 " | 3·55 | +15·0 " | 37·9 |
| −50 " | 5·3 | +20·2 " | 42·8 |
| −40 " | 7·7 | | |

These are rather higher than those obtained by Ansdell (Proc. Roy. Soc. **29**, 209), who probably worked with a less pure material. As the boiling point at atmospheric pressure is below the melting point, acetylene resembles carbonic anhydride in solidifying during the spontaneous evaporation of the liquid at atmospheric pressure. The crystals of solid acetylene are without action on polarised light. The coefficient of solubility of gaseous acetylene at 0° and under a pressure of 4·65 atms. is 1·6.

Under pressure liquid acetylene combines with water to form a crystalline hydrate, $C_2H_2$, $6H_2O$. These crystals are denser than water, do not affect polarised light, and do not sensibly decompose below −0·5° C. At 1° C. the tension of decomposition is 5 atms. Determinations of the heat of combination showed that 1 grm. of water in forming the hydrates evolved 0·143 cal., which is equivalent to 15 cals. for a gramme-molecule of the hydrate. This is almost identically the same as the heat of combination of the hydrate of nitrous oxide.—L. T. T.

*Gas- and Petroleum-Engines at the Antwerp Exhibition of* 1894. G. Lambotte, Revue Universelle des Mines, 30 May 1895, 128; Proc. Inst. Civil Eng. 1895, **122**, 59—60.

Based on conditions prevailing in Brussels, and taking into account interest on first cost, maintenance and working expenses, the results given in the following table are arrived at, showing that up to 10 h.p. the petroleum-motor is the most economical; that at that power the cost of gas, oil, and steam is about the same; and that above it steam is the cheapest for continuous work of any duration:—

| Power. | Cost in Pence per I.H.P. per Hour. | | |
|---|---|---|---|
| | Gas. | Petroleum. | Steam. |
| 2 I.H.P. .................... | 2·93 | 1·74 | 2·91 |
| 10 " .................... | 1·06 | 0·97 | 1·06 |
| 50 " .................... | 0·49* | .. | 0·49 |

* Generator gas.

For 50 h.p. the daily cost is the same for coke, gas, and steam, but in the neighbourhood of anthracite mines the advantage lies with the gas-engine, which would only require 1·33 lb. of anthracite per h.p. per hour, whilst the steam-engine would consume 3·33 lb. of coal.

The remark is made that when the gas-engine shall have been perfected by improvements in the cycle and generator, the solution of the problem of large power gas-motors may be expected; reference being then made to the 320 h.p. engine at Pantin, which consumes 50 per cent. less coal than a good steam-engine of the same power.

## PATENTS.

*Improvements in the Manufacture of Gas.* T. G. McEwen, Leytonstone, Essex. Eng. Pat. 8974, May 5, 1894.

The retort, shaped like an ordinary gas retort, has a door which is made hollow, and, when hot, is supplied with water and oil from reservoirs. The steam and oil vapour thus generated, pass into the retort through a zig-zag, perforated pipe, running the whole length of the retort and fitting into a conical seat in the upper part of the door. The permanent gas passes from the retort through an ordinary ascension pipe.—A. G. B.

*Improvements in the Manufacture of Heating and Illuminating Gas.* E. Daus, Schöneberg, Berlin, Germany. Eng. Pat. 13,114, July 6, 1894.

In order to produce a hot flame, either for heating or for lighting in connection with a "glow" attachment, the gas to be burned is mixed with a definite quantity of air. This is effected by a rotating suction apparatus, driven by a gas-motor, which draws in the proper quantity of air and mixes it with the gas after the latter has passed through the meter.—R. B. P.

*Improvements in or connected with Apparatus for making Gas from Coal.* J. H. R. Dinsmore, Liverpool. Eng. Pat. 17,555, September 15, 1894.

In order to obtain a large quantity of gas of high illuminating power by means of a relatively small plant, an automatic feeding mechanism is used. By this, coal is fed into the retorts, either continuously or intermittently, without the necessity of opening them, and with the advantage that air is excluded. The mechanism comprises a plunger with reciprocating motion working in connection with a hopper containing the material. As the plunger rises, the coal sinks in the hopper towards a chamber below, and as it descends, it forces the coal downwards, so that it falls into the chamber, and so passes into the retort. A valve is placed on the lower part of the hopper, which at once closes so soon as the charge of coal is forced through. —R. B. P.

*Improvements in or appertaining to Hydrocarbon or Vapour Burners for Lighting or Heating Purposes.* J. Watts, Warrington, Lancaster. Eng. Pat. 17,587, September 15, 1894.

In hydrocarbon burners for producing light and heat, the tubes or generators in which the oil is vaporised are made to surround the flame in such a manner that they are exposed to its full heat, whereby the tubes will be heated and the oil supplied thereto converted into gas or vapour to feed the flame—A. G. B.

*Improvements in or connected with Furnaces.* J. J. Meldrum, T. F. Meldrum, and J. W. Meldrum, Manchester. Eng. Pat. 17,869, September 20, 1894.

The furnaces referred to may be destructor furnaces, furnaces for certain metallurgical operations, or for certain kinds of steam generators. Separate fire-places are so arranged that the gases from one or more of them pass over another or others and mix together. In the illustrated example given, there are four fire-places arranged in a line, with a dead plate between each pair, and between the fire bars and walls. Each fire-place has a firing door, an ash-pit with door, and a steam jet-blower beneath the bars. The gases pass from the first, over the second, third, and fourth; from the second, over the third and fourth; and from the third, over the fourth. The gases from all the fire-places, already partly mixed, next pass together into a chamber having vertical brickwork pillars arranged so that each transverse row breaks line with its neighbours, where they are thoroughly mixed together, and thence to a flue, a steam generator, and a chimney; or directly from the flue to the chimney. Internally projecting walls or partitions may be arranged between the doors within the fire-places to protect the firemen when cleaning out; and a flue common to all the fire places may be arranged to run at the back of them. The fire places should be worked in rotation and at regular intervals.—R. S.

*Improvements in Apparatus for Washing or Scrubbing Gas.* S. Hersey and Kirkham, Hulett, and Chandler, Ltd., all of Westminster. Eng. Pat. 18,440, September 28, 1894.

The object of this invention is to obtain a large amount of wetted surface for scrubbing gas, and to attain it, the inventors construct discs of segmental bundles of laths, which are placed one above the other edge-wise, and become gradually shorter in length as they approach the centre of the disc.

The laths, with distance-pieces between them, are strung on bolts in rows, and the several rows making up a segment are connected by end plates and a bolt.—R. B. P.

*Improvements in Apparatus for Condensing and Washing Gas.* Kirkham, Hulett, and Chandler, Ltd., Westminster. Eng. Pat. 18,441, September 28, 1894.

The invention relates to an improved construction of battery condensers. The apparatus consists of a rectangular casing enclosing a number of parallel straight cooling pipes. These are fitted into sockets cast in the end walls, in which are also cast passages for the water as it circulates through the cooling pipes. The water enters by one of the lowest pipes and leaves by one of the top ones. The gas enters the casing at the top, and, after passing round the outside of the cooling pipes, leaves through a hooded exit at the bottom. Over the top set of cooling pipes are situated troughs with notched edges, which deliver a number of fine streams of water on to the outside of the cooling pipes; this washes off all tar or other impurities deposited on the pipes from the gas.—R. B. P.

*Improvements in Gas generating Plant.* B. H. Thwaite, London. Eng. Pat. 18,445, September 29, 1894.

Water-gas is produced in a vertical gas generator, at the base of which an inverted conical casting supports a series of bars, which dip into the water of the hydraulic seal and support the fuel in a nearly vertical position. The heated air is forced beneath the water in the seal, and rises up through the fuel in the generator. The latter is lined with fireclay pipes and the space between these and the casing is filled with fireclay grouting, which becomes baked during use, whilst special curved tiles or fireclay blocks are placed on the top of the lining. A portion of the generator may have a jacket, through which the air is passed before it enters the base of the vessel. A second similar vessel is connected to the generator near the top by a lined conduit, and serves as a scrubber, as well as to arrest tar, dust, and dirt. It is filled with coal or coke, and the inclined bars dip into water through which the purified gas has to pass before it leaves the apparatus. The air employed is heated by means of the exhaust gases of the gas engine used, by passing the air and exhaust gases through a vertical column containing a nest of copper or other metallic tubes, the air passing through, and the gases around the tubes, or *vice versâ*.—R. S.

*Improvements in and connected with Incandescence Gas Burners.* G. F. Redfern, London. From La Compagnie Parisienne du Bec Deselle-Gillet, Paris, France. Eng. Pat. 20,093, October 20, 1894.

The mantle is carried on a separate cap which can be placed on the burner without removing the latter. From the centre of the cap rises a metal rod, preferably protected by asbestos, on to the top of which the nickel stirrup carrying the mantle is fastened by means of a set screw. The use of two concentric mantles is claimed; in this way more light can be obtained, or the light can be modified in colour by making one of the mantles from oxides which incandesce with the preferred tint. The specification also includes novel arrangements of the pilot jet and bye-pass, and a claim is made for the application of platinum-black or palladium-black for rendering the burner capable of automatic ignition.—A. G. B.

*Improvements in or relating to Oil-fired Furnaces and the Feed-Apparatus thereof.* C. H. Bachy, Sirault, Belgium. Eng. Pat. 6154, March 25, 1895.

These oil-fired furnaces, suitable for glass-making, stationary boilers, marine boilers, locomotives, metallurgical industries, &c.; each consists essentially of a horizontal quadrangular basin, having a channel all round, into which the oil is delivered, and a number of parallel longitudinal grooves connecting the two end channels. Above the basin is placed a sheet of felt or flexible asbestos ("amianth"), through and up which the oil passes by capillary attraction, and above which it is lighted. The amount of flame is regulated by a cover or air-slide, having at its forward end a roller or cylinder of uninflammable and refractory material, covering the entire width, limiting the area of the flame as desired, and providing a means for extinguishing it. The cover may be hollow, the space being divided by parallel partitions into a number of air tubes or tuyères, all connected to one transverse channel, to which a flexible tube from an air compressor, &c., is attached, whereby a current of hot air may be forced above the flames to increase the heating effect. The oil may be delivered to the furnace from a safety-feed apparatus.—R. S.

*Improvements in Continuous-working Recuperative Gas-Furnaces.* A. Dauber, Westphalia, Germany. Eng. Pat. 11,015, June 4, 1895.

An arrangement of flues whereby the air alone, or both the air and the gas, may be heated by the products of combustion, the latter flowing in a direction either with or against that of the air or air and gas. The flues may be arranged at the side of or above the furnace, but are shown in the drawings below the furnace, where a vertically arranged zigzag flue is formed, through which the products of combustion pass on their way from the furnace to the stack, and in this are placed parallel ranges of fireclay pipes, through which the gas or gas and air separately pass to the furnace. Where arrangements are made for heating the air, valves are employed so that the air may, when desired, be sent direct to the furnace without pre-heating. The air and gas in all cases mix in a tuyère just before entering the furnace, into which they pass through baffle plates. The outlet for the products of combustion from the furnace is smaller than the flue into which it leads, so that the pressure in the furnace is raised somewhat, and the gases are retained longer in the furnace. When the flow of the products of combustion and of the air or air and gas are in the same direction, the former pass directly to the flue, but where the directions are opposite, the products of combustion pass first through an intermediate chamber and through tubes so that they enter the flue at a point near the place where the air and gas mix.—R. S.

*Improvements in Apparatus for the Manufacture of Oil-Gas.* F. Mayer, Baltimore, U.S.A. Eng. Pat. 13,230, July 9, 1895.

In apparatus for carburetting water-gas, the patentee sets the retorts vertically in a chamber situated above a furnace and separated therefrom by a perforated arch. The retorts are entirely enveloped by the hot products of combustion from the furnace, which are caused to ascend the centre of the chamber and to descend at the sides. In the rear of the furnace is a system of circuitous flues which serve for the regenerative heating of the primary and secondary air (supplied to the furnace and retort chamber) by means of the products of combustion; the products subsequently pass up a vaporising chamber situated above these flues. In this chamber is set a series of vaporising pipes which traverse the chamber from side to side in zigzag fashion. The oil is fed into the upper ends of these pipes, and during its passage down them is vaporised by the heat of the products of combustion. The lower ends of the pipes open into a main pipe, up which the vapour passes into the upper ends of the retorts; here the vapour is fixed, and the permanent gas produced passes through ascension pipes from the lower ends of the retorts into an hydraulic main, where it is mixed with the water-gas. The claims comprise various combinations of the portions of the above system of apparatus.—A. G. B.

*Improvements in Furnaces and in Steam Boilers formed in combination therewith.* G. Hesse, London. Eng. Pat. 13,391, July 11, 1895.

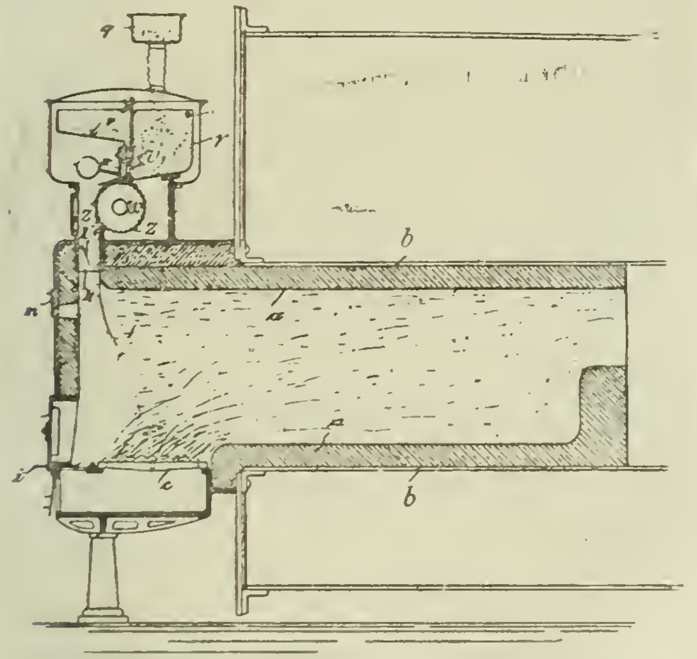
The improvements are in Cornish boilers with one fire or flue tube, and consist of arrangements to obtain perfect combustion with small fuel and dust or a mixture of both. The fuel is charged through a tapered feeding hopper provided with a sliding plate or damper and built in the upper part of the boiler. Immediately beneath the hopper is arranged a grate upon which the coarser or coked part of the fuel which is not carried away into the fire-place arranged for the dust, is fully consumed as on an ordinary fire-grate.—R. S.

*Improved Incandescent Petroleum Burner.* H. Rint, Vienna, Austria. Eng. Pat. 13,935, July 22, 1895.

The construction of the burner is such that only a small flame from the inner edge of the protruding end of the wick is maintained, that from the remaining part of the wick being extinguished by the current of air drawn into the burner; consequently the vapour from this part of the wick escapes combustion until after it has mixed with the air, which is supplied in two currents, one through the centre of the tubular wick and the other around the outside of the wick. This mixture of vapour and air burns with a blue flame and heats the mantle.—A. G. B.

*Improvements in Boiler and like Furnaces, and in Self-acting Stokers therefor.* G. Unger, Magdeburg. Eng. Pat. 14,132, July 24, 1895.

The improvements are for furnaces burning coal-dust or disintegrated fuel. A Lancashire boiler is here shown, having a furnace tube *b* and a fire chamber *a* of fire-proof material. An ordinary grate *c* is employed for burning ordinary fuel for starting the fire. The disintegrated fuel is fed, in the example shown, from a feed channel *q* to a pivoted receptacle *r*, which is caused to rock by projections *z* on a rotating feed roller *w*, so that the contents are uniformly delivered on to the grooved or roughened surface of the feed roller, and then delivered down the feed channel *h*. To regulate the admission of air, slides or dampers *n i* are provided, whilst the rate of feed of the dust, &c. is regulated by a slide *v*. The dust, &c. is directed by an adjustable flap *l*. By these arrangements the fuel is delivered as a thin veil or cloud, all risk of explosion is avoided, and perfect combustion takes place.—R. S.



Boiler Furnace with Self-acting Stoker.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Coal-Tar Bases.* F. B. Ahrens. Ber. 28, 795—798.

The material forming the subject of the present investigation was obtained by subjecting the light oil distilled from 10,000 kilos. of coal-tar to the action of dilute sulphuric acid. In this manner 5 kilos. of bases were obtained. The lower fractions boiling below 160° consisted of pyridine, picoline, and lutidine; the next fraction, 400 c.c. in quantity, boiling at 160°—220° and having a sp. gr. of 0·990 at 15°. This latter was freed from aniline by oxidation with potassium bichromate, the aniline being converted into aniline black. This was separated by filtration and the filtrate rendered alkaline and distilled with steam. The bases thus obtained (100 c.c.) were fractionated into seven distillates, that boiling below 160° consisting of picoline and lutidine. Of the other fractions the following were more closely examined:—

I. Fraction boiling at 165°—170° consisted mainly of *α-γ*-dimethylpyridine, together with a small amount of symmetrical trimethylpyridine and an unknown collidine. They were separated by fractional crystallisation of the mercuric chloride double salt from acid, neutral, aqueous, and alcoholic solutions. From the latter solvents (water and alcohol) colourless crystals were obtained, which yielded, on treatment with potash and distillation with steam, an oil possessing an agreeable odour. It forms a non-deliquescent *hydrochloride* crystallising in needles.

II. Fraction boiling at 170°—180° is mainly composed of symmetrical trimethylpyridine, identified by analysis and a comparison of the properties of the auro- and platino-chlorides.

III. Fraction boiling at 220°—230° gave when re-distilled a fraction boiling at 227°—230°. This consisted of parvoline and appears to be identical with the base obtained by Williams in 1854, by the destructive distillation of the oil from Dorsetshire bituminous shale, and that isolated by Thenius in 1861 from coal-tar oil. The author's substance consisted of a colourless liquid, slightly soluble in water, boiling at 232°—234°.

The base is shown to be tetramethylpyridine, its constitution being represented by the formula—

$$C_5HN(CH_3)_4(N\ 1, 2, 3, 4, 5).$$

It was recognised by its convertibility into the tetracarboxylic acid when oxidised with potassium permanganate. From this the author infers that the base obtained by the action of propaldehyde-ammonia on propaldehyde (this Journal, 1890, 820) must have another constitution.—D. B.

*Occurrence of Hexanaphthene in Caucasian Naphtha.* W. Markownikoff. Ber. 1895, 28, 577—578.

It is shown that the substance boiling at 69°—71°, prepared by the author in conjunction with Spadi and Kijner a few years ago, is not pure hexanaphthene. Baeyer having found that synthetical hexamethylene boils at 79°, the author has now succeeded in isolating hexanaphthene from Caucasian naphtha. A fraction boiling at 78°—80° was obtained free from aromatic hydrocarbons, and having a sp. gr. of 0·756 at $\frac{15^\circ}{15^\circ}$. This was subjected to nitration according to the method described by Konowaloff, and the portion soluble in potash reduced, an amido-compound being obtained which is identical with the substance prepared by Baeyer. It boils at 132°—134°.

The *hydrochloride* melts at 204°, and is readily soluble in water and alcohol.—D. B.

*Estimation of Thiophen in Benzene.* G. Denigès. Bull. Soc. Chim. 1895, 13, 537.

*See under* XXIII., *page* 893.

### PATENT.

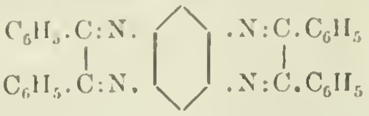
*A Process for the Extraction of Distillation Products from Sawdust, Wood-Waste, and the like.* F. J. Bergmann, Neheim, Germany. Eng. Pat. 12,527, June 28, 1895.

In order to obtain the products of distillation of wood, particularly acetic acid, in a more concentrated form from wood-waste and sawdust, these materials are made into briquettes, by subjecting them to a pressure, such as 300 atmospheres, sufficient to impart to them a specific gravity double that of natural wood. Much heat is developed during the compression, and water is expelled as steam. The briquettes are distilled as usual.—A. G. B.

## IV.—COLOURING MATTERS AND DYES.

*Fluorindines.* R. Nietzki. Ber. 28, 1357—1360.

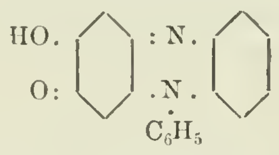
Replying to certain criticisms of O. Fischer and Hepp (Ber. 28, 293; this Journal, 1895, 565) as to the author's views on the fluorindine formulæ, the author points out that he had already obtained condensation-products from tetramidobenzene (Ber. 22, 444; this Journal, 1889, 385), and that this substance readily condenses with 2 molecules of an *o*-diketone to form di-*o*-diazines. Thus, from tetramidobenzene and benzil there results the compound—



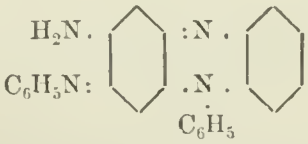
When reduced in hot acetic acid solution with stannous chloride or zinc dust, the yellow colour changes to a greenish-blue, and the hydrochloride of the colouring matter so obtained can be isolated in a crystalline form. As it does not fluoresce, the substance is not a fluorindine, but the first hydro-product of the diazine, for on oxidation it is reconverted into the original azine, and must have the constitution which Fischer and Hepp give to the corresponding fluorindine, and the fluorindines must have a different constitution from that assigned to them (*l.c.*), since these compounds, on oxidation, do not yield azines. In the latter part of the paper the author replies to several critical remarks of Fischer and Hepp with regard to the properties and constitution of the fluorindines, and also criticises the nomenclature employed for the lowest homologue of the fluorindine group.—T. A. L.

### *Relations of the Indulines to the Safranines.* F. Kehrmann. Ber. 28, 1709—1717.

O. Fischer and Hepp (Annalen, **286**, 187; this Journal, 1895, 797), as a result of their work, conclude that the indulines and safranines are representatives of two different series, which, by the action of certain reagents, can be transformed into one another. On the other hand, the author is of opinion that the non-oxygenated induline bases and the indones are *p*-quinonoid anhydrides of amido- or hydroxy-azonium bases, whilst their salts and hydrates are *o*-quinonoid derivatives. The safranines being amido-azonium bases, the induline bases appear as *p*-quinonoid anhydrides of those safranines which contain at least one amido group para to the non-alkylated nitrogen, and these safranines only form one series of salts, which have the *o*-quinonoid azonium formula. The author, in repeating some of Fischer and Hepp's work, describes first, the action of aniline on aposafranine chloride. This produces anilido safranine, which, on heating with acetic and hydrochloric acids to 160°—170° C., gives off aniline and yields hydroxybenzene indone identical with the product obtained by condensing dihydroxyquinone with *o*-phenylene diamine, from which it must have the constitution—



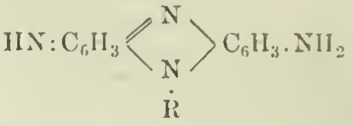
The substance has the same properties as already described by Fischer and Hepp for their benzene indone hydrate. By heating anilido-aposafranine with alcoholic baryta to 140°—145° C., or by boiling aposafranine with very dilute caustic soda, benzene indone is produced, from which it follows that aposafranine stands to benzene indone in the same relation that rosinduline does to rosindone. Anilido-aposafranine is isomeric, and not identical with the oxidation product of *o*-amidodiphenylamine. This latter substance, on heating with acetic and hydrochloric acids, gives the same hydroxy-benzene indone as that obtained from anilido-aposafranine, and must therefore have the following constitution:—



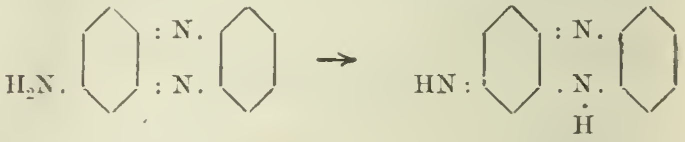
The corresponding *p*-tolyl derivative to anilido-aposafranine, can be produced by heating aposafranine chloride with *p*-toluidine, and the compound obtained yields *p*-toluidine, hydroxy-benzene indone, and ammonia on heating with hydrochloric acid.—T. A. L.

### *Relations of the Safranines to the Mauveïnes and Indulines.* G. F. Jaubert. Ber. 28, 1578—1585.

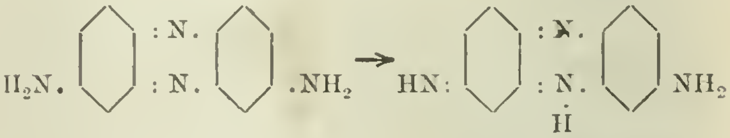
In reply to Nietzki (Ber. 28, 1354, see following abstract) the author admits that the synthesis of safranines from meta substituted diphenylamines (this Journal, 1895, 564) is no proof of their symmetrical constitution, although he considers that Nietzki's explanation as to the formation of an unsymmetrical safranine is not very probable. If Nietzki's view of the mechanism of the reaction were correct, no safranine could be obtained from methyl-*m*-tolylene diamine and *p*-phenylene diamine, but the author shows that a safranine is formed under these conditions. He therefore still considers that the symmetrical formula for the safranines—



is correct. Hitherto in the safranine molecule it has been assumed that the presence of a phenylchlorammonium group suffices to account for the strong basic nature of the colouring matter and for the presence of water in the base. The latter appears to be an error, pure safranine base being anhydrous. It is said to be a powerful base, since it is not precipitated from aqueous solutions by alkalis, and, moreover, di-acetylsafranine and di-acetylsafranol are stated to be soluble in mineral acids. The non-precipitation of the safranine salts by alkalis is due to the solubility of the base both in water and alkalis, whilst several cases are known of compounds which possess no basic properties and yet give compounds with acids. Such, for example, are the quinonoid fluoresceïn derivatives, and substances such as aurin, hæmateïn, and brazileïn. Experiments on the electrical conductivity of phenosafranine hydrochloride also point to its being a strong base, which is dissociated in an aqueous solution in a normal manner. The formula for safranine readily admits of a diacetyl derivative, but, in the case of safranol, only a monacetyl compound can be formed, which is in fact the case, the substance being insoluble in alkalis. The amido group in safranine can be readily titrated with sodium nitrite. In conclusion, the author points out that the safranines and mauveïnes, being obtained in a similar manner and having similar properties, belong to the same class of colouring matters. As regards the indulines, for instance, Fischer and Hepp's so-called simplest induline, $C_{18}H_{13}N_3$, ought to be identical with safranide, but this is not the case; in fact, rosinduline and induline scarlet stand in a much closer relationship to safranide than safranide does to induline. Since safranide has undoubtedly the formula $C_{18}H_{13}N_3$, this so-called simplest induline must have a different one, possibly doubled, but even Fischer and Hepp have not been able to determine its molecular weight. It is probable that the simplest induline and safranine are tautomeric forms of the simplest eurhodine and phenylene red—



Eurhodine. Induline.



Phenylene Red. Safranine (Mauveïne).

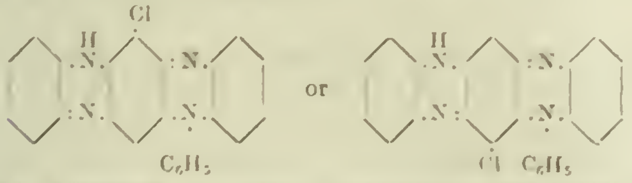
although it will probably not be possible to obtain these derivatives, since when the H attached to the azine nitrogen is unreplaced, the compound will always tend to revert from the *p*-quinone form (induline or safranine) to that of the *o*-quinone (eurhodine or phenylene red).—T. A. L.

### *Constitution of the Safranines.* R. Nietzki. Ber. 28, 1354—1357.

According to Jaubert (Ber. 28, 270 and 508; this Journal, 1895, 564) the safranines have a symmetrical constitution, since the *m*-amido- and hydroxyl derivatives of diphenylamine yield safranines when oxidised with *p*-diamines. The author, however, points out that these substances will also condense to a body having an unsymmetrical constitution, and in order to decide the question, an attempt was made to prepare a safranine of which the constitution was undoubtedly asymmetrical. For this purpose a *p*-diamine is required in which all the hydrogens are replaced. These conditions are satisfied in diamido-durene, which the author has oxidised, together with *m*-amidoditolylamine obtained from *m*-tolylene-diamine and *p*-toluidine (Eng. Pat. 9610 of 1894; this Journal, 1895, 478). The colouring matter obtained is, however, not a true safranine, but a safraninone which can only have an unsymmetrical constitution. The nitrate $C_{21}H_{23}N_3OHNO_3\frac{1}{2}H_2O$ is sparingly soluble in water. It would appear probable from the existence of this compound, closely allied to the safranines, that these latter also have an unsymmetrical constitution, but further experiments are being made on the subject. If the safranines have a symmetrical constitution the same compound should be obtained from dimethyl-*m*-amido-diphenylamine and *p*-phenylene diamine as from *m*-amido-diphenylamine and dimethyl-*p*-phenylene diamine, whilst different substances should result if their constitution is unsymmetrical. The compound prepared from dimethyl-*p*-phenylene diamine and aniline is different from that obtained from *p*-phenylenediamine and dimethylaniline, analyses of the latter product agreeing better with a monomethylsafranine, although dimethylaniline free from the mono-derivative, was employed. Experiments have been made with a view of obtaining dimethyl-*m*-amido-diphenylamine and *m*-amidodiphenylamine itself, since the formation of safranine from these compounds throws some light on the constitution of the mauveïnes and indazine. The simplest mauveïne is obtained by the action of nitroso-aniline on diphenyl-*m*-phenylene diamine, whilst indazine is produced by the action of nitroso-dimethylaniline on the same compound, and according to their formation both these substances ought to be true safranines. Fischer and Hepp at present consider them to be indulines, and it is possible that ultimately these two groups may prove to be identical.—T. A. L.

### *Constitution of the Fluorindines.* F. Kehrmann. Ber. 28, 1543—1546.

In reply to Nietzki's criticism (Ber. 28, 1359; *v. supra*) of the formula for the fluorindines (Ber. 23, 2789), the author gives details of two compounds of this class which he prepared. *Chlorophenylfluorindine* is obtained by heating together the condensation product from phenyl-*o*-phenylene diamine and chlorodihydroxyquinone with *o*-phenylene diamine hydrochloride in presence of an excess of benzoic acid. The melt is extracted with alcohol and a trace of hydrochloric acid, the hydrochloride obtained being subsequently basified in alcoholic solution by ammonia. The base forms a bronzy crystalline powder having the formula $C_{21}H_{15}N_4Cl$ and the constitution—



An analogous compound, *methylphenylfluorindine*, is obtained by substituting dihydroxytoluquinone for the chlorodihydroxyquinone in the above example, and the same formula will represent the constitution, chlorine being replaced by the methyl group. The author considers that these syntheses confirm Fischer and Hepp's fluorindine formula, and is of opinion that Nietzki's blue colouring matter obtained by reducing the azine from benzil and tetramidobenzene is not a fluorindine, but has another constitution. For the lowest homologue of the series, which is obtained by oxidising *o*-phenylenediamine, the name phenofluorindine is suggested.—T. A. L.

### *Constitutions of the Fuchsines.* M. Tortelli. Ber. 28, 1702—1707.

Miolati (Ber. 26, 1788; this Journal, 1894, 143), in electrolysing *p*-fuchsine in aqueous solution, has found that it decomposes normally like a salt, whilst Fischer and Jennings (Ber. 26, 2221; this Journal, 1894, 142) have pointed out the complete difference between *p*-fuchsine and hydrocyan-*p*-rosaniline, which, according to Rosenstiehl, have an analogous constitution—

| $Cl.C \vdots (C_6H_4.NH_2)_3$ | $NC.C \vdots (C_6H_4.NH_2)_3$ |
|---|---|
| *p*-Fuchsine. | Hydrocyanrosaniline. |

In order to obtain further evidence that the fuchsines are true salts from a purely chemical standpoint, the author has treated several salts of the various triphenylmethane derivatives with silver nitrate and barium chloride under different conditions, and in all cases has obtained the theoretical amount of silver haloid and barium sulphate. By the action of potassium cyanide on *p*-rosaniline salts, H. Müller obtained hydrocyan-*p*-rosaniline, which differs considerably from other fuchsines, since it is colourless and insoluble. Attempts to isolate a *p*-rosaniline hydrocyanate, which had similar properties to the ordinary *p*-rosaniline salts, were unsuccessful, although the author found that a complete series of double salts of the compound could be obtained. Thus if R represent the *p*-rosaniline radicle, then, starting from the mercuric chloride double salt, each atom of chlorine can be successively replaced by cyanogen—

$$[HgCl_3]R,\ [HgCl_2CN]R,\ [HgCl(CN)_2]R,\ Hg(CN)_3R.$$

The properties of all these salts, both when solid and in solution, are similar to those of the simple *p*-rosaniline salts, and the author concludes that the other formula for the rosaniline salts cannot be accepted, but only one which represents fuchsine as a salt.—T. A. L.

### *Investigation of Certain Triphenylmethane Colouring Matters by Means of the Boiling Point Method.* A. Haller and P. T. Muller. Comptes Rend. 120, 410—413.

The method employed was the determination of the boiling point of the solutions of certain triphenylmethane colouring matters, with a view of ascertaining whether this would throw any light on their constitution. Certain investigators ascribe their dyeing properties to a quinonoid structure and the presence of chromophoric groups, whilst Rosenstiehl inclines to the view that these properties are due to the position of the amido group para to the methane carbon and also to the radicle attached to the methane carbon being opposite in function to the substituents in the benzene rings. Hence, Rosenstiehl's formula does not assume the presence of pentavalent nitrogens, and in view of the behaviour of the triphenylmethane derivatives described in the paper, his formula appears to possess most probability. With respect to the method described in the paper, of which only the results are given, the rise in boiling point $e$, if no dissociation take place, and $n$ be the number of molecules of the substance in 1 litre of water, is $e = 0{\cdot}52\ n$. If, however, dissociation take place, $e$ will be much greater than $0{\cdot}52\ n$. In the case of ammonium chloride and similarly constituted compounds it has been shown that for $n = 0{\cdot}1$ and $0{\cdot}2$ at least 50 per cent. is dissociated. The following derivatives were investigated:—Crystal Violet, Parafuchsine, and Rhodamine in the forms of their hydrochlorides, and the conclusion arrived at from this preliminary investigation is that the hydrochlorides of the amidotriphenylmethane colouring matters are not dissociated on boiling with water, whilst this is the case with ammonium chloride and with the hydrochloride of nitrosodimethylaniline.—T. A. L.

### *Hexamethyltriamidotriphenylmethane Ammonium Bases.* A. Rosenstiehl. Comptes Rend. 120, 740—743.

The author, in a previous paper (Comptes Rend. 120, 194; this Journal, 1895, 474), has already alluded to the action of sodium hydroxide and silver oxide on the ammonium iodide derivatives of hexamethyltriamidotriphenylmethane. In continuation of this work, he finds that the bases, although they cannot be isolated in a form suitable for analysis, can be estimated volumetrically. The action of caustic soda is to substitute hydroxyl for iodine, but the substitution is not complete, as an inverse reaction sets in, so that the liquid contains a mixture of the iodide and base. On the other hand, silver oxide decomposes the iodide completely, the base $(\mathrm{ICH_3A})_3 \vdots \mathrm{C.OH.3H_2O}$ yielding $(\mathrm{HO.CH_3A})_3 \vdots \mathrm{C.OH.3H_2O}$, where A represents the group $\mathrm{C_6H_4.N(CH_3)_2}$ (see this Journal, 1895, 359 *et seq.*). By working with weighed quantities it is possible to determine acidimetrically the amount of base, and from this to fix its molecular weight at 893, and to prove the presence of $3\mathrm{H_2O}$. The method also furnishes a means of determining the proportion of hydriodide to ammonium iodide in a substance of this class. In alkalinity, these bases can be compared with tetra-ethyl-ammonium hydrate, and, like it, they displace ammonia and various oxides from their salts in the cold. They dissolve freshly-precipitated alumina, but not zinc hydrate, whilst solutions of the fuchsines are decolorised, and the carbinols, when these are insoluble, are precipitated. As regards their basicity, the three bases (1) $\mathrm{HO.C} \vdots \mathrm{A_2.(ACH_3OH)}$, (2) $\mathrm{HO.C} \vdots \mathrm{(ACH_3OH)_3}$, and (3) $\mathrm{H.C} \vdots \mathrm{(ACH_3OH)_3}$ have practically the same properties, for all of them decolorise fuchsines, although only the base (3) precipitates magnesium sulphate in the cold, whilst the base (1) only reacts on boiling, or very slowly in the cold. The difference is, however, more marked in considering their basic functions and their behaviour to acids. For instance, in (3) only the ammoniacal function is present, whilst in (2) three of the hydroxyls are ammoniacal and one is alcoholic. Only the former react with acids, whilst the latter reacts with alcohols to form mixed ethers. Finally, the base (1) contains two hydroxyls with different functions, and has also three different basic functions, owing to the presence of the group $\mathrm{C_6H_4N(CH_3)_2}$. The substance is simultaneously a monobasic base, a monovalent alcohol, and also contains two amido groups. Experiment shows that the first action of an acid is to form the carbinol $\mathrm{HO.C} \vdots \mathrm{A_2.(ACH_3Cl)}$. The second molecule of acid added in the cold does not react immediately on the hydroxyl of the carbinol, but attaches itself to one of the tertiary nitrogens in the group A. The change takes place slowly in the cold, more rapidly on heating, and there finally results the green $\mathrm{Cl.C} \vdots \mathrm{A_2(ACH_3Cl)}$, which, in presence of an excess of acid, turns yellow, forming the acid salt $\mathrm{Cl.C} \vdots \mathrm{(AHCl)_2(ACH_3Cl)}$, which, like all magenta salts, is decomposed by water. In conclusion, the alcoholic function of the phenolic carbinol is modified according as to whether the para substituent is an amido or an ammonium group.—T. A. L.

### *Nitro- and Amido-Derivatives of Paraditolylamine.* G. F. Jaubert. Ber. 28, 1647—1650.

By nitrating *p*-ditolylamine in sulphuric acid solution and reducing the nitro product, the author has obtained the amido-tolylamine—

$$[1.2.4]\mathrm{CH_3(NH_2)C_6H_3.NH.C_6H_4.CH_3}[1.4]$$

which has also been obtained by heating *m*-tolylene diamine hydrochloride with *p*-toluidine (Eng. Pat. 9610 of 1894; this Journal, 1895, 478). The base, which melts at 71° C. (corr.), is colourless, insoluble in water, and slightly soluble in petroleum ether, but very easily soluble in benzene, alcohol, or ether. It is diazotisable, and gives a red colouring matter with R salt. On condensation with quinone-dichloro-imide it gives an isomeride of safranine T (Ber. 28, 272; this Journal, 1895, 564). If *p*-ditolylamine be nitrated in acetic acid solution with twice its weight of nitric acid (sp. gr. 1·53), a trinitro-*p*-ditolylamine is obtained. This product is insoluble in water, sparingly soluble in alcohol and acetic acid, but can be crystallised from chloroform in prisms, which melt at 268° C.—T. A. L.

### *The Fuchsines and their Sulphonic Acids.* M. Prud'homme. Bull. Soc. Chim. 1895, 13, 581.

The author disputes the parallelism between the rosanilines and their sulphonic acids, which *Rosenstiehl* has endeavoured to maintain. The decolorising action of soda upon acid fuchsines may be explained on the supposition that the OH is converted into ONa. For example, $\mathrm{HO.C} \vdots \mathrm{(C_6H_3.SO_3Na.NH_2)_3}$ is coloured; by treating with soda $\mathrm{NaO.C} \vdots \mathrm{(C_6H_3.SO_3Na.NH_2)_3}$ may be formed, which is not coloured. Conversely, by treating the latter with acid, we should get the former.

The action of the acids and bases therefore does not prove the parallelism of constitution between the fuchsines and their sulphonic derivatives, since it can be explained otherwise than as by Rosenstiehl. In support of his view the author advances the cases of the action of carbonic acid, ammonium chloride, and ammonium carbonate on a solution of acid fuchsine decolorised by soda, and the action of ammonia on acid fuchsine.

The neutral salts of the sulphonated fuchsines of commerce are coloured, owing to the absorption of carbonic acid from the air in concentrating and drying. The same sulphonated carbinols form salts which are capable of decomposing ammonium salts, removing the stronger bases, as MgO, ZnO, PbO, &c., and behave thus as powerful bases, more powerful indeed than the non-sulphonated carbinols.
—H. M.

### *Constitution of Fluoresceïn.* R. Meyer. Ber. 28, 1576—1577.

With regard to the constitution of fluoresceïn, G. Heller (Ber. 28, 312) has recently shown that at least one of the hydroxyl groups is para to the phthalic acid nucleus. A method has now been devised by which the position of the second hydroxyl is also fixed. By the decomposition of eosine with alkali, Heller obtained dibromodihydroxybenzoylbenzoic acid—

$$\mathrm{HO_2C.C_6H_4.CO.C_6H(OH)_2Br_2}[1.2.4.3.5].$$

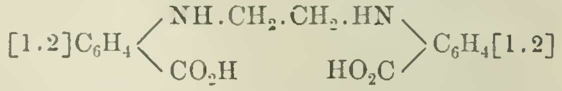
When this product is heated above its melting point it decomposes into phthalic anhydride and eosine. The brominated colouring matter has thus a symmetrical constitution, the second hydroxyl also being in the para position, and therefore in fluoresceïn as well.—T. A. L.

### *Synthetical Production of Alizarin from Hemipic Acid.* K. Lagodzinski. Ber. 28, 1427—1429.

The author, in extending his work on the synthesis of quinizarin and hystazarin from phthalic anhydride and the ethers of quinol and pyrocatechol, has also investigated the behaviour of substituted phthalic acids when subjected to the Friedel and Craft's reaction. Hemipic acid (dimethoxyphthalic acid), obtained by oxidising opianic acid with potassium permanganate, is converted into its anhydride when heated to its melting point, 180° C. On heating this in pure benzene in presence of aluminium chloride, it is converted into an acid having the formula $\mathrm{C_{15}H_{12}O_5H_2O}$, to which the name oxymethoxybenzoylbenzoic acid has been given. When this is heated in sulphuric acid solution to 100° C. for some time, and the melt is poured into water, an orange-yellow precipitate of alizarin monomethyl ether is obtained, which, after crystallisation from acetic acid, melts at 201° C. On boiling with hydriodic acid of boiling point 127° C. for a short time, hydrolysis takes place, alizarin being formed.—T. A. L.

### *Preparation of Indigo from Ethylene Dianthranilic Acid.* J. Fränkel and K. Spiro. Ber. 28, 1685—1688.

When anthranilic acid and ethylene are heated together in an oil-bath to the melting point of the former, a small quantity of ethylene dianthranilic acid is produced. A better yield is obtained by ethylating anthranilic acid and heating the ether with ethylene bromide to about 150° C., the resulting ethylene dianthranilic ether melting at 117° C. and giving ethylene dianthranilic acid on saponification with alcoholic potash. This substance, having the formula—



$$[1.2]\mathrm{C_6H_4}\left\langle\begin{matrix}\mathrm{NH.CH_2.CH_2.HN}\\ \mathrm{CO_2H}\qquad\quad \mathrm{HO_2C}\end{matrix}\right\rangle\mathrm{C_6H_4}[1.2]$$

is sparingly soluble in all solvents, but separates from nitrobenzene in crystals melting at 213°—214° C. On heating with 2—3 times its weight of caustic potash to 260°—300° C., out of contact with the air, the melt turns yellowish-red, with the formation of a leuco base, which on dissolving in water is rapidly oxidised by the atmospheric oxygen to indigo, although only a small yield is obtained. It was not proved directly whether indoxyl was formed as an intermediate product, although this probably was the case.—T. A. L.

*New Method of Estimating Indigotin.* J. Schneider. Zeits. anal. Chem. 1895, **34**, [3], 347.

*See under* XXIII., *page* 893.

*Detection of Artificial and Natural Colouring Matters on the Fibre.* A. Lehne and A. Rusterholz. Färber Zeit. 1891, *et seq.*

*See under* XXIII., *page* 891.

## PATENTS.

*Improvements in the Manufacture of Alkyl-Ethers from Acetyl and Similar Derivatives of Para-amidophenols.* J. Y. Johnson, London. From C. F. Böhringer and Sons, Waldhof, Germany. Eng. Pat. 19,187, October 9, 1894.

In preparing alkyl compounds from acetyl- and similar derivatives of *p*-amidophenol, it is usual to commence with the alkyl-*p*-amidophenol, and introduce into it the acid remnant. It is here claimed as advantageous to reverse the operations, and, starting with *p*-amidophenol, introduce first the acid remnant, *e.g.*, by treatment with acetic or lactic acid in the presence of nitrogen. The acetyl- or lactyl-*p*-amidophenol thus formed is dissolved in alcohol and heated with caustic soda and ethyl bromide at 100°—110° C. for several hours. The alcohol is distilled off, and the residue, after boiling with water containing carbon, yields on crystallisation acetyl- or lactyl-*p*-phenetidine. The advantage claimed is that the introduction of the acid remnant (in the course of which a quantity of colouring matter is always formed) takes place at an early stage of the process, which circumstance facilitates the purification of the final product.—R. B. B.

*An Improved Process for the Manufacture of Lactyl-p-Phenetidine.* J. Y. Johnson, London. From C. F. Böhringer and Sons, Waldhof, Germany. Eng. Pat. 19,188, October 9, 1894.

Benzylidine-*p*-phenetidine is heated together with lactic acid in an open vessel or chamber (in connection with a downward condenser) for a sufficiently long period to enable benzaldehyde to be distilled off. The mixture is then treated with steam to remove the whole of the benzaldehyde it contains, and extraction is completed by boiling the solution with carbon. On filtering, lactyl-*p*-phenetidine is obtained in the form of colourless prisms or crystals.

—R. B. B.

*Manufacture of a Colouring Matter to Dye Cotton without Mordant.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 19,120, October 12, 1894.

The specification describes the preparation of an azo colouring matter by combining the tetrazo compound of *p*-amidobenzene-azo-amido-*p*-cresol ether with two molecular proportions of γ-amidonaphthol sodium sulphonate. The base referred to is prepared by combining *p*-nitrodiazobenzene with *p*-amidocresol methyl ether, and reducing the resulting azo compound with alkaline sulphides. It forms a brownish-yellow powder melting at 115° C., soluble in alcohol and benzene with a yellow, and in hydrochloric acid with a deep red colour. In order to convert it into a colouring matter, 26·5 kilos. are dissolved in water and 60 kilos. of hydrochloric acid and diazotised with 14 kilos. of sodium nitrite. The brownish solution obtained is added to a solution containing 50 kilos. of γ-amidonaphthol sulphonic acid and 60 kilos. of sodium carbonate, when a black precipitate of the colouring matter separates, which, after slowly heating for some time, is filter-pressed and dried. It forms a dark brown powder sparingly soluble in cold, more easily in hot water to an indigo-blue solution. Dilute caustic soda produces no change, whilst an excess gives a deep blue precipitate. Mineral acids precipitate the free acid directly, whilst acetic acid does so more slowly. The colouring matter is insoluble in alcohol and ether, whilst it dissolves in concentrated sulphuric acid with a blackish-blue colour which becomes indigo blue and finally violet, depositing a precipitate of the colouring matter on adding water.

—T. A. L.

*A Process for Obtaining Lactyl Compounds derived from Methylaniline, Ethylaniline, p-Anisidine, and p-Phenetidine.* G. W. Johnson, London. From The Chemische Fabrik, late Goldenberg, Geromont, and Co. Winkel a/Rhein, Germany. Eng. Pat. 19,712, October 16, 1894.

This is an improvement referring to Eng. Pat. 12,166 of 1892 (this Journal, 1893, 596). Instead of employing lactic acid, lactic anhydride, lactide, or lactic acid esters, as therein specified, the amide of lactic acid is used. For example, lactamide is heated with *p*-phenetidine to 150° C. until the mixture ceases to evolve ammonia. It is allowed to cool down to 100° C. and poured into hot dilute hydrochloric acid. On cooling, lactylparaphenetidine will crystallise out.

—R. B. B.

*Manufacture of Colouring Matters of the Induline Series.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation." Eng. Pat. 19,885, October 18, 1894.

The unsymmetrically alkylated *p*-phenylene- or -tolylene diamines on oxidation with secondary amines, such as diphenylamine, form indamines which on further oxidation in presence of primary amines, yield violet to blue colouring matters easily soluble in water. For instance, 19·2 kilos. of nitrosodimethylaniline hydrochloride are suspended in 750 litres of alcohol and reduced with 20 kilos. of zinc dust and 55 kilos. of hydrochloric acid. When the reduction is complete, 17 kilos. of diphenylamine and 4 kilos. of hydrochloric acid are added, and the cold solution is oxidised by adding 20 kilos. of sodium bichromate in 100 litres of water. After agitating for an hour and heating to 70° C., a concentrated solution of 19 kilos. of aniline chloride and 11 kilos. of hydrochloric acid (20° B.) is added. The whole is then oxidised with 20 kilos. of sodium bichromate in 150 litres of water, the blue product obtained being poured into an equal volume of water and precipitated with salt. After filtering off the colouring matter and chromium oxide, the former is dissolved out with water, the solution filtered, and the colouring matter precipitated with salt. The dyestuff, easily soluble in water, gives bright bluish-violet shades on tannined cotton, fast to acids, alkalis, and light.—T. A. L.

*Manufacture of Direct Dyeing Colouring Matter.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 19,970, October 19, 1894.

The dyestuff referred to is obtained by combining equimolecular proportions of the tetrazo compound of *p*-amido-benzene-azo-amido-*p*-cresol methyl ether (see foregoing) with 1.3′- or 1.2′- naphthylamine sulphonic acid in presence of an excess of sodium acetate and combining the intermediate compound so obtained with one molecular proportion of γ-amidonaphthol sulphonic acid. The colouring matter dyes violet-grey to deep violet-black shades on unmordanted cotton. It may be diazotised on the fibre and combined with tolylene diamine or amidonaphthol ether, giving fast blue-black shades. The reactions of the dry colouring matter are almost identical with those of the colouring matter already referred to in Eng. Pat. 19,120 of 1894. (See foregoing.)—T. A. L.

*Manufacture of Direct Dyeing Colouring Matter.* C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 19,971, October 19, 1894.

For colouring matters dyeing unmordanted cotton grey to black shades fast to acid, alkali, and light, in place of the 1.3′-naphthylamine sulphonic acid referred to in the preceding specification, the patentees substitute salicylic acid. It may be diazotised on the fibre and combined with tolylene diamine, naphthol or amidonaphthol ether, and the like, but it has not much affinity for wool or silk. When dry it forms a brownish-black powder readily soluble in hot water with a dark reddish-violet colour, which, on adding caustic soda-lye turns lighter, an excess producing a dark blue-black precipitate. Insoluble in ether, the colouring matter is slightly soluble in alcohol with a dark violet-red colour. The aqueous solution is precipitated by mineral acids or by acetic acid, giving dark greenish-blue flakes. Concentrated sulphuric acid dissolves the dry colour, giving a dark blue solution which, on dilution with water, turns greenish-blue, and on further dilution gives a brownish-violet precipitate of the free colour acid. —T. A. L.

*Manufacture of Direct Dyeing Colouring Matter.* [*Blue Cotton Dye.*] C. D. Abel, London. From "The Actien Gesellschaft für Anilin Fabrikation," Berlin, Germany. Eng. Pat. 19,972, October 19, 1894.

The blue cotton dye referred to is obtained by combining one molecular proportion of the tetrazo compound from *p*-amidobenzene-azo-amido-*p*-cresol methyl ether with two molecular proportions of $\gamma$-amidonaphthol sulphonic acid in presence of an excess of sodium acetate. It forms a blackish-brown powder, which dissolves with a violet-blue colour unaltered by dilute caustic soda, but precipitated by an excess. The solution in concentrated sulphuric acid is bluish-black, which on dilution with water turns first violet and afterwards gives a blackish-violet precipitate.—T. A. L.

*Improvements in the Manufacture of Colouring Matters.* [*Aniline Greys and Blacks.*] J. Weller and W. Brauns, Quedlinburg am Harz, Germany. Eng. Pat. 13,291, July 10, 1895.

For the production of grey and black dyestuffs, the patentees heat together a mixture containing 130 kilos. of aniline hydrochloride, 77 kilos. of trinitrophenol, 200 kilos. of aniline, and 0·5 kilo. of ammonium vanadate to 120° C. in a cast-iron vessel provided with an agitator, for 6 hours. The resulting product, which is soluble in alcohol, may be rendered soluble in water by sulphonation with four times its weight of fuming sulphuric acid. The dyestuffs obtained give grey to black shades on cotton wool and silk from an acetic acid bath. Another method of rendering the product soluble is by fusing it with *p*-phenylene diamine in presence of benzoic acid. The melt, consisting of 120 kilos. of the compound soluble in alcohol, 100 kilos. of *p*-phenylene diamine, and 5 kilos. of benzoic acid, is heated to 130°—140° C. so long as ammonia is evolved. The product obtained is poured into dilute hydrochloric acid, and the colouring matter salted out. It dyes cotton, wool, and silk bluish-red to blue in a bath acid with acetic acid. In a similar manner a colouring matter soluble in water can be obtained directly by heating to 120° C., in a cast-iron vessel, 54 kilos. of *p*-phenylene diamine hydrochloride, 23 kilos. of trinitrophenol, 70 kilos. of phenylene diamine, and 0·2 kilo. of ammonium vanadate for about 4 hours. The colouring matter dyes cotton, for which it has a considerable affinity, directly.—T. A. L.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

### PATENT.

*Improvements in Apparatus used in the Manufacture of Paper, Linen, or other Fabrics Coated or Impregnated with Celluloid or Varnish, or the like.* A. Gray, Hampstead. Eng. Pat. 19,175, October 9, 1894.

This patent specially refers to the manufacture of fabrics coated with celluloid solution as described in Eng. Pat. 19,710, 1891; this Journal, 1892, 904. The drying of the film takes place in a closed steam-heated chamber in order that the solvents may be recovered, or the material may be caused to travel round a hollow steam-heated steel cylinder placed therein. The air is drawn away by a pump, and passed through a condenser before being used again. Still greater economy is effected by working the apparatus under slightly diminished pressure; to which end, part of the air on emerging from the condenser is passed through a second smaller one, and then allowed to escape.—F. H. L.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Tinctorial Power of Phenols for Ferric Mordants.* P Sisley. Bull. Soc. Chim. 1895, **13**, 740.

*Monophenols* do not form colours with iron mordants.

*Diphenols.*—Resorcinol and hydroquinone do not form colours, nor do their substitution derivatives. Pyrocatechol forms a greenish-black. Substitutions in the molecule of pyrocatechol modify the shades without destroying the tinctorial power. The introduction of alkyl groups in the OH destroys the tinctorial power. Thus, guaiacol, vanillic acid, &c., do not colour iron mordants.

*Trihydroxybenzenes.*—Hydroxyhydroquinone, pyrogallol, and their derivatives give colours; phloroglucinol and its derivatives do not. Derivatives in which at least two hydroxyl groups become alkylated, no longer colour iron mordants. The conclusion drawn is that the two groups, $C_6H_4(OH)_2 2.3$ and $C_6H_3(OH)_3 1.2.6$ and their derivatives form true colours on fibres mordanted with ferric salts.

The introduction of the chromophoric group $NO_2$ into the simpler orthodihydroxy derivatives of benzene, as pyrocatechol and pyrogallol, confers upon these colours the power of dyeing upon mordants of chromium, iron, aluminium, nickel, tin, uranium, &c. The orthodiphenols, which do not contain a chromophoric group, but have the power of dyeing upon iron mordants, have the peculiarity that they will not dye upon any other mordants (manganese excepted).

From a practical point of view, the iron lakes obtained in this way are so sensitive towards acids that there is not much prospect of their being used in dyeing, although certain acid phenols give very beautiful shades. The monobromopyrogallocarbonic acid, $C_6Br.H.COOH(OH)_3.H_2O$, for instance, gives a very fine navy blue shade. The reactions of the orthodiphenols may nevertheless be found useful for analytical purposes.—H. M.

### PATENTS.

*Improvements in and relating to the Printing and Mercerising of Cotton Fabrics.* W. E. Kay and The Thornliebank Co., Ltd., Glasgow. Eng. Pat. 20,308, October 24, 1894.

This invention relates to the production of printed cotton fabrics with white or coloured, crimped or crinkled patterns on dyed or printed grounds. Prints on aniline black and indigo blue grounds are mentioned as typical examples.

In the case of the former of these colours, the fabric is treated with a solution of the compounds requisite for the production of the colour. It is then dried and printed with a thickening of preferably highly-calcined gum or gum Gedda admixed with a reagent to resist the development of the black in the printed parts, and, if a coloured pattern be desired, with a colouring matter or suitable colour mixture, such as is, for instance, employed in the process described in Eng. Pat. 713 of 1893 (this Journal, 1893, 1027). The fabric is next aged or steamed to develop the black in the unprinted parts, and it is then passed, preferably by means of a padding mangle, through a solution of caustic soda at 70° Tw., or of other alkali of appropriate concentration to contract the unprinted parts of it. A short time is allowed to elapse for the alkali to complete its action and then the fabric is washed and dried.

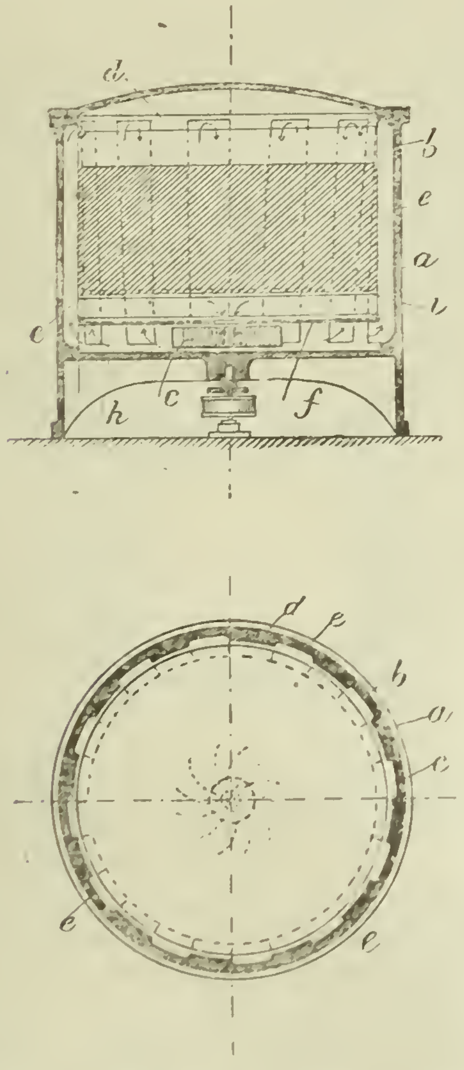
The effects are obtained on indigo blue grounds by printing a gum resist, containing reagents which will discharge the blue on steaming, on cloth which has previously been dyed indigo blue. Colouring matters, with, if necessary, appropriate mordants, may, in this case also be added to the resist-discharge to obtain coloured patterns. After the indigo has been discharged in the printed places, the cloth is passed through caustic alkali to mercerise the unprinted parts.

Similarly, colours other than indigo may be discharged; and besides those which have been printed or dyed entirely over the surface of the fabric, those which have been printed or dyed in parts of it only may be printed with a suitable resist-discharge.

The effects again may be varied by adding colouring matters to the alkali solution employed for mercerising.
—E. B.

*Improvements in Apparatus for Washing and otherwise Treating Wool and other Fibre.* G. Politz, Barmen, Germany. Eng. Pat. 13,941, July 22, 1895.

The materials to be treated are placed in a cylindrical vessel *b* (see figure) contained in a second vessel or tank *a*. Space is left between the vessels for a number of vertical channels *e*, which are formed by ribs or projections *d* from the outer vessel. The inner vessel has a sieve-bottom *i*, and the outer one a false bottom *f*, with a central hole in it for the admission of liquids from the inner vessel into the space between the false bottom and the bottom *h*. A horizontal fan-wheel *c* revolves in this space and causes the liquids with which the materials are treated to pass upwards through the vertical channels to the top of the materials in vessel *b*, through which they descend to the fan, to be again circulated.



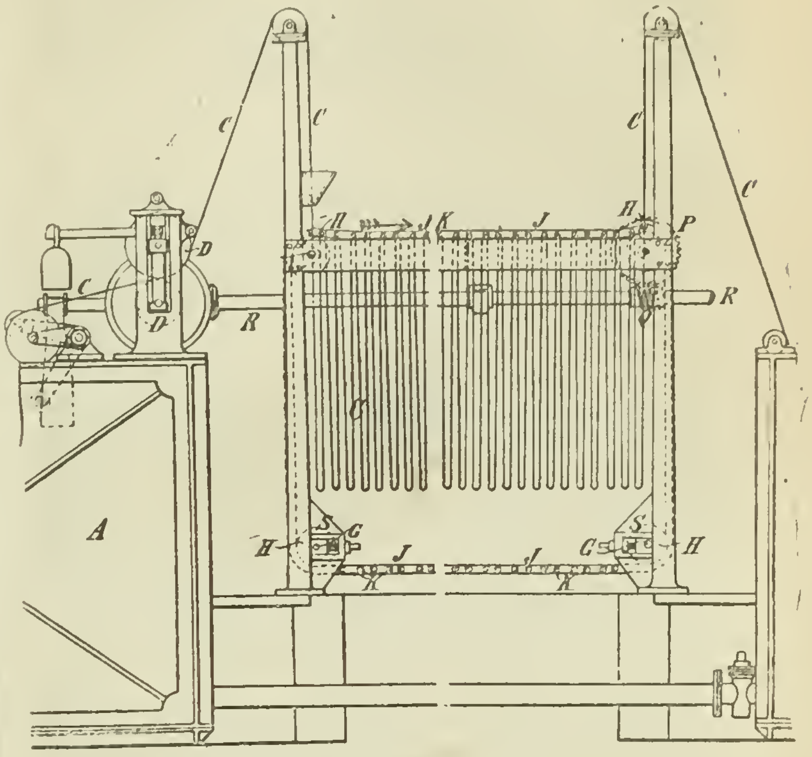
Apparatus for Washing and Treating Wool, &c.

In a second form of apparatus the vertical channels are dispensed with, being replaced by a central vertical pipe, and the holder vessel and tank are of modified construction. The fan-wheel is enclosed in a casing formed by an elongation and expansion of the pipe, with a central aperture in it below for the entrance of the dye or other liquors. A disc is fixed above the fan round which an annular space is left communicating with the pipe. As the fan revolves, the liquors are forced into the pipe and thence over and through the materials.

Another form of apparatus differs from that last described in having a vertical screw conveyor instead of a fan in the central pipe for the circulation of the liquors employed. The screw blades of this are made concave on their upper side to render them more effective in their action.—E. B.

*Improvements in Apparatus for Oxidising Indigo-dyed Fabrics.* D. Stewart, Glasgow. Eng. Pat. 14,415, July 30, 1895.

The object of this invention is to provide improved mechanism for the oxidation of indigo-dyed fabrics during the process of dyeing.



Oxidising Apparatus.

The fabric C (see figure), on leaving the vat A, is caused to fall in loops between rods K, supported on or forming the joints of endless travelling chains J.

Uniformity in the delivery of the fabric to the oxidising apparatus is secured by driving the pulleys H, round which the chains pass, by the same shaft R (by means of the worm Q and worm-wheel P) as turns the squeezing rollers D.

The chains are held taut by means of pulleys or rollers in adjustable bearings S placed at the lower corners of their course.—E. B.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Properties of Solid Carbonic Anhydride.* P. Villard and R. Jarry. Comptes Rend. 1895, **120**, 1413—1416.

The statements regarding the properties of solid carbonic anhydride being very conflicting, the authors have carefully re-investigated the subject.

Solid carbonic anhydride melts at −56·7° C., and the vapour tension is then 5·1 atmospheres. When liquid carbonic acid is cooled solidification begins at −56·7° C., and the temperature remains at that point and the vapour pressure at 5·1 atmospheres, till the whole is solid. When evaporating freely in the air at ordinary pressures the temperature of the solid falls to −79°, where it remains till all has volatilised. The addition of ether does not sensibly alter this temperature, the reduction due to the solution of the solid in ether at −79° being only 1°. On the other hand, the addition of chloride of methyl produces a reduction of temperature to −85°, the solid carbonic acid dissolving rapidly below −65° without the evolution of gas. In a current of dry air solid carbonic anhydride attains a temperature of −90° C. When solid carbonic anhydride is allowed to evaporate freely into a vacuum the reduction of temperature reaches −125°, when the vapour pressure is 5 mm. and evaporation proceeds very slowly. This should render it possible to produce liquid oxygen with the ordinary resources of a laboratory and the help of liquid carbonic anhydride only, a result which the authors hope to obtain. The crystals of carbonic anhydride are without action on polarised light.—L. T. T.

### *Electrolysis of Hydrochloric Acid without a Diaphragm.* F. Oettel. Zeits. f. Electrotech. u. Electrochem. **2**, 1895, 57.

It is well known that on electrolysing hydrochloric acid in a simple cell an explosive mixture of hydrogen and chlorine is obtained. The amount of this mixture falls considerably below the theoretical, owing to some of the dissolved chlorine recombining at the cathode with the liberated hydrogen to re-form hydrochloric acid. This loss can be reduced by increasing the current density, as the following experiment with platinum electrodes and 12 per cent. HCl solution shows :—

| Density per Square Metre. | Current Yield. | E.M.F. |
|---|---|---|
| Ampères. | Per Cent. | Volts. |
| 240 | 41 | 1·4 |
| 600 | 55 | 1·6 |
| 1,200 | 66 | 1·7 |

The author further proves that the yield per ampère is much increased if the chlorine be rendered less soluble in the electrolyte This he effected by the addition of NaCl, $MgCl_2$, and $MgSO_4$, but the best results were obtained by the addition of $H_2SO_4$ to a concentrated salt solution. Such solution consists of HCl, NaCl, and $NaHSO_4$, and dissolves so little chlorine that it is barely coloured.

A solution containing per litre 160 grms. NaCl + 140 grms. $H_2SO_4$ (= 100 grms. HCl) held, after several hours' electrolysis, only 0·61 grm. free chlorine per litre, while the HCl present reached 30·5 grms. per litre.

A current density of 240 ampères gave with the above solution a current yield of 70 per cent., and on increasing the current to 600—700 ampères per sq. m. the yield rose to 92—98 per cent., and only fell when nearly all the free acid was decomposed.

If excess of sulphuric acid be present, oxygen is evolved along with the chlorine towards the end of the electrolysis, until, finally, the solution is practically free from chlorine. Should, on the other hand, the NaCl be in greater amount, the gas evolution at the anode at length almost ceases, and the solution becomes gradually neutral.

The necessary voltage changes as the electrolysis proceeds, for 600 ampères rising gradually from 1·8 volts to 2·9 volts, and then suddenly to 3·7 volts at the point when the solution is nearly neutral and the rapid decrease in yield occurs. These results are shown in a series of curves.

The experiments were made in the absence of sunlight and the current yield calculated partly by absorption of the chlorine in KI solution and partly by a gas analysis method previously described.—J. T. C.

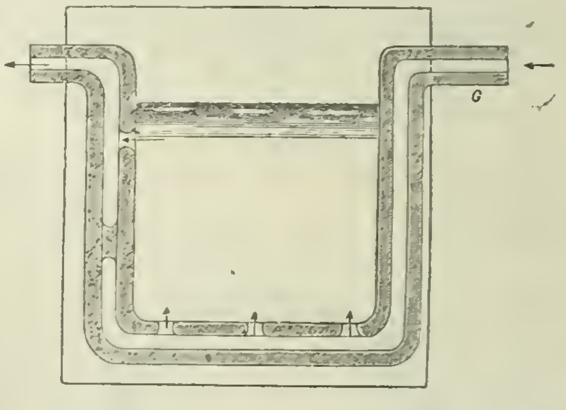
### *Electrolysis of Calcium Chloride Solutions and the Hermite Process.* P. Schoop. Zeits. f. Electrochem. 1895, **2**, [10], 209—214.

The "electrolytic bleaching powder" presents no advantages over the ordinary chemically-obtained article; but the "electrolytic chlorine" is said to have a distinctly stronger bleaching action than a bleaching-powder solution containing an equal amount of available chlorine. A chlorine solution, obtained by electrolysing 5 per cent. calcium chloride solution, and containing 0·015 per cent. available chlorine, was very rapidly acted on by cleaned jute-yarn, so as to be without action on potassium iodide and starch. A larger volume of this solution completely bleached a known weight of the jute-yarn with a smaller expenditure of available chlorine than was needed when bleaching powder was used. To make the action with bleaching powder equally rapid, it is stated that a much stronger solution had to be used. Probably the electrolysed solution contains a compound differing from, and more easily decomposed than, ordinary bleaching powder. The less the current density, and hence the less the percentage of calcium chloride decomposed per second, the more unstable was the bleaching compound produced; part of the bleaching power was lost by merely standing for a day. This is not such a disadvantage to the Hermite process as it seems, for the bleaching substance can be produced in presence of the materials to be bleached.

In the Hermite apparatus a 5 per cent. magnesium chloride solution is electrolysed. A solution of bleaching effect equivalent to 100 kilos. of bleaching powder needs an expenditure of 216 horse-power hours. A current of 1,000 ampères is employed, and the E.M.F. in the electrolyser is about 6 volts. The fluid is agitated by the revolving zinc plates, but in spite of the motion and of the scrapers which work against the zinc plates, crusts of magnesia form, increasing the resistance of the cell and lessening the working surface of the cathode. The time and labour of cleaning away these crusts constitute a notable loss. Another point of uncertainty is the rate at which the platinum anodes are destroyed. These form the chief element of cost, and the want of trustworthy data as to their durability has militated against the adoption of the process.

The author has made experiments on the electrolysis of calcium chloride, a waste product of the ammonia-soda process, and a substance the electrolysis of which is more steady and regular than that of magnesium chloride. He proposed to investigate first the minimum E.M.F. at which the process is practicable, and has found that more than 3 volts are not necessary. This is commercially an important point, for with the same strength of current the yield of bleaching substance is greater with a less current density, while of course the cost of installation increases with greater area of decomposing surfaces. The concentration of the calcium chloride solution, the distance apart of the electrodes, and the addition of other substances to the electrolyte, also need investigation.

The electrolytic cell consists of two metal plates cemented watertight to a glass tube bent and furnished with holes, as in the illustration, which shows how the circulation and fresh supply of the electrolyte are provided for. As cathodes, copper, sheet steel, zinc, and platinum; as anodes, graphite, gas carbon, and platinum, were tried. The platinum anodes were made of thin iridioplatinum soldered to sheet lead. Diffusion experiments showed that platinum leaf thinner than 0·02 mm. was not continuous, but contained cracks and holes which in some cases were visible under the microscope. The iridioplatinum not only resists better than platinum the action of the substances set free at the anode, but is mechanically more durable.



The electrolyte flowed from an upper reservoir through the electrolytic cell into a lower reservoir. The flow was regulated so that 1 litre per hour passed, which with a cell 7 cm. × 4·5 cm. × 1·4 cm. gave a change of contents 20 or 25 times per hour. The current was derived from three accumulators, and a resistance coil in the main circuit allowed the current to be kept at the desired strength. By means of a high-resistance galvanometer the fall of potential along a portion of the circuit of known resistance could be determined, and hence the current strength calculated. The same galvanometer, by an alteration in the connections, could be used to determine the difference of potential between the two plates of the electrolytic cell, or the variations in potential taking place in either plate from time to time.—J. T. D.

### *Detection and Determination of Calcium Chlorate in Bleaching Powder.* R. Fresenius. Zeits. Anal. Chem. **34**, 1895, 434.

*See under* XXIII., *page* 887.

*Calcium Carbide.* W. Borchers. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 163.

*See under* II., *page* 854.

*Estimation of Boric Acid.* H. Jay and Dupasquier. Comptes Rend. **121**, 260–262.

*See under* XXIII., *page* 889.

*Detection of Small Quantities of Potassium Cyanate in Potassium Cyanide.* E. A. Schneider. Ber. 1895, **28**, 1540.

*See under* XXIII., *page* 887.

## PATENTS.

*Improvements in Process and Apparatus for the Manufacture of Chlorine.* S. A. Sadler and R. H. Wilson, Middlesbrough. Eng. Pat. 15,886, August 21, 1894.

Chlorine is obtained by reacting upon hydrochloric acid with nitric acid in the presence of sulphuric acid, the acids being fed into a mixing vessel in successive measured quantities. The hydrochloric and the nitric acids are siphoned from their respective tanks, each into a small vessel, sulphuric acid being supplied to another similar vessel from the concentrator in which the dilute sulphuric acid resulting from the process, is strengthened. A rocking shaft, driven from a shaft the motion of which also actuates other parts of the apparatus, passes through the upper part of the three acid-containing vessels, carrying cups adjusted to lift the required quantities of the acids for delivery into the mixing vessel of earthenware or glass, placed at one end of the decomposer, from which mixer they overflow in cascades into several trays, one below the other. The decomposer is a long, rectangular, closed vessel, built of flags or the like, lined with lead sulphate cement, supplied with cross divisions, and heated by steam or hot air pipes. The hot acid is conducted by a pipe from the decomposer into a vessel provided with a revolving series of cups or arms to raise the acid, so that it may flow into an adjacent evaporating pan, which has cross partitions to prevent the weak acid reaching the hottest part until it is concentrated. The chlorine and other gases evolved in the decomposer, are led to a cooling system, of which the first column is of stone, packed as a dephlegmator, the other parts consisting of ∩ pipes, on to the tops of which water is sprayed; or they may be water-jacketed. Thence the gases pass into a tower fed with sulphuric acid from a cistern, measured by means of a cup actuated by a rocking shaft. The nitrous vitriol flows from the tower into a receiving tank, to be run into a denitrating apparatus. The chlorine is then washed free from acid in a tower fed with measured quantities of water in the manner described, the hydrochloric acid being returned to the decomposer.—E. S.

*A New or Improved Process and Apparatus for the Production of Chlorine from Gaseous Hydrochloric Acid.* P. R. J. Krause, Kadi Kieuy, near Constantinople. Eng. Pat. 16,227, August 25, 1894.

Hot sulphuric acid is run in regulated quantity from an elevated concentrating pan into the top of a tower constructed similarly to a Glover's tower, which also receives in like manner nitric acid through a measuring apparatus. A little below the cover to the tower is a perforated stone diaphragm, so that a chamber is thus formed in which the acids mix. Hydrochloric acid gas enters the upper part of this chamber through a flue, and the quantity of the gas entering in a given time being ascertained, the proportion of nitric acid to be admitted is known by the formula—

$$6HCl + 2HNO_3 = 4Cl + 2NOCl + 4H_2O.$$

The proportion of sulphuric acid to be admitted is regulated according to the density of the acid flowing from the bottom of the tower, which should not be allowed to fall below from 1·45 to 1·50. Superheated steam is passed through tuyères below the diaphragm in such proportion as to maintain the temperature of the sulphuric acid at from 125° to 130° C. The chlorine and nitrosyl chloride gases pass from the bottom of the tower by a pipe. The spent acid flowing from the bottom of the tower is pumped from the receiver into the elevated concentrating pan, to be again used.—E. S.

*Improvements relating to the Separation of Arsenic, Antimony, Bismuth, and other Metals from Spirit of Salt [Hydrochloric Acid], Oil of Vitriol or Sulphuric Acid, and other Acid Solutions, and to Apparatus therefor.* W. Whitehead, Manchester, and C. Gelstharp, Clayton, near Manchester. Eng. Pat. 18,940, October 5, 1894.

Hydrogen sulphide is pumped from a generator through a series of closed vats, containing the impure hydrochloric or other acid, in such a way that the gas, entering the liquid through a J-shaped pipe which delivers it under a bell-mouthed upright tube, carries a little of the liquid with it into the next vat in the series; it is finally discharged through a scrubbing tower in which fresh impure acid is the absorbent. All the vats are connected by a horizontal pipe, so that the level of the acid may be adjusted by means of control cocks. When the precipitation in the first tank is complete, the gas is diverted to the second of the series, the sulphides are allowed to settle (after expelling the excess of hydrogen sulphide by a current of air, if preferred), and the purified acid is run off through a cock at the side, whilst the precipitate is discharged by a sludge-cock beneath, and filtered. An alternative method of introducing the gas is described. Instead of pure hydrogen sulphide, the use is preferred of the mixed sulphur dioxide, hydrogen sulphide, and air, resulting from the decomposition by warm dilute acid of the yellow liquor obtained by the lixiviation of old vat waste.—W. G. M.

*Improvements in the Manufacture of Chlorate of Soda.* T. T. Best and J. Brock, Liverpool. Eng. Pat. 19,189, October 9, 1894.

Chlorine, preferably diluted by inert gases, is passed into a concentrated solution of sodium carbonate to saturation. A series of connected vessels is used, to contain the sodium carbonate, so that any excess of chlorine, as well as the hypochlorous acid evolved in the reaction, may be absorbed in the following vessels. The process is preferably conducted at atmospheric temperature, and the temperature should not rise above 100° F. When the solution in the first vessel is fully saturated, it is emptied, recharged with fresh solution, and placed last in the series. The cleared saturated solution is concentrated to cause sodium chlorate to salt out, and it is then set to crystallise. The sodium chloride obtained may be purified by recrystallisation. As sodium carbonate becomes bicarbonate in the early stage of the process, the latter salt may be used instead of the former when it is convenient. An ordinary pump may be used in forcing the chlorine through the alkaline solution, provided the chlorine be previously dried, which is recommended to be effected as directed in Eng. Pat. 16,151, 1893 (this Journal, 1894, 810).—E. S.

*Improvements in the Manufacture or Production of Chromates.* W. L. Wise, London. From The Deutsche Solvay-werke Actiengesellschaft, Bernburg, Germany. Eng. Pat. 20,168, October 22, 1894.

In this process, ferric oxide, such as results from roasting pyrites, replaces the lime ordinarily used to mix with chrome iron ore for furnacing. The proportions of the materials recommended are: 240 parts chrome iron ore of 50 per cent., 170 parts sodium carbonate, and 150 parts ferric oxide, with addition, if desired, of from 50 to 80 parts of lime. The intimately mixed materials are roasted in the usual way, and the product is lixiviated. The sodium chromate solution is freed from impurities by sulphuric acid or carbon dioxide. The residue left after lixiviation, which contains from 3 to 5 per cent. of chromium oxide, may be used over again with the same materials as before, in certain stated proportions, except that additional ferric oxide is not needed, since that before used reappears in the residue. The action of the ferric oxide on the ore and alkali during the roasting, is stated to be such that a ferrite of the alkali is formed, which becomes converted into a chromate and ferric oxide.—E. S.

*Improvements in the Manufacture of Sulphuric Acid and By-Products, and in Apparatus adapted to such Manufacture.* (Under International Convention.) J. D. Darling, Philadelphia, U.S.A. Eng. Pat. 13,171, January 8, 1895.

The mixture of nitrogen peroxide ($NO_2$) and oxygen, evolved when fused sodium or potassium nitrate is electrolysed, is used as a substitute in this process for the nitric acid ordinarily used. In a sulphuric acid plant arranged in accordance with this invention, the pyrites burners communicate with the dust-chamber by means of a horizontal flue, within which is placed the electrolytic apparatus, and the dust-chamber communicates by a transverse flue with a Glover tower, which thus receives the sulphurous gases from the kilns, as well as, by a separate duct, the nitrogen peroxide and oxygen, generated as described.

The rectangular decomposing vessel for the nitrate is of cast-iron, and is furnished below with a discharge pipe controlled by a cock, and with a removable insulated cover with a pipe for conveying the liberated gases to the Glover tower. A supply pipe extends through the cover to a point near the bottom of the vessel. A series of cast-iron plates depend from the cover, connected to the positive pole of a source of electricity, the vessel itself being connected to the negative pole. The vessel is charged with sodium nitrate to about two-thirds of its height, and the salt is kept in fusion by the heat of the kiln gases. Part of the vertical pipe leading from the decomposing vessel to the duct is constructed of glass, so that it may be known by the colour of the gases passing, whether or not the salt is spent. When the gases cease to pass the current is switched to a second similar apparatus, and the first-used vessel is discharged and refilled. The sodium oxide, or similar residuum from the vessels, is dissolved in water to form a crude caustic soda.—E. S.

*Process for Utilising Nitre-Cake and other Acid Sulphates.* J. D. Darling, Philadelphia, U.S.A. Eng. Pat. 12,316, June 25, 1895.

The process consists in treating acid sulphates electrolytically, in such manner as to decompose an electrolyte containing a similar base to that of the sulphate, with transference of such base to the sulphate.

The invention is described in reference to the treatment of nitre-cake, solution of which is placed in the two outer compartments of a three-compartmented vessel, the partitions to which are in whole or in part porous. The central compartment, which is charged with sodium chloride solution, is closely covered and provided with a feed orifice, for admission of solid sodium chloride, and with a gas outlet for the chlorine produced. It contains a carbon electrode, forming the positive pole. The electrodes in the outer cells, constituting the negative pole, may be of sheet-lead. Sodium chloride is added from time to time to the central cell until the acid sulphate in the outer cells is neutralised, when the neutral salt is drawn off, filtered, and crystallised. The mother-liquor may, with addition of water, be utilised in dissolving a fresh portion of nitre-cake. The chlorine evolved during the electrolysis, is taken to be absorbed by lime, or is otherwise applied.—E. S.

## VIII.—GLASS, POTTERY, ENAMELS.

### PATENTS.

*Improvements in or relating to Kilns for Burning Pottery, Bricks, and the like.* B. Dawson, Malvern Link, Worcester. Eng. Pat. 19,711, October 16, 1894.

When gas-fired kilns have been arranged in groups and worked in succession, the first kiln has usually been supplied with cold air, so that it has to be in action for some hours longer than the succeeding kilns. In the present invention, the air is heated in a regenerator before entering the first kiln, so that the time required for each kiln is the same. By a suitable arrangement of mains and valves, any one or more of the kilns may be started before the others. After one or more kilns have been heated, the products of combustion can be passed into the regenerators, from which a constant supply of hot air can thus be obtained.—V. C.

*Improvements in the Manufacture of Pottery or like Ware.* E. A. Shaw, Buglawton, near Congleton, Chester. Eng. Pat. 20,138, October 22, 1894.

The inventor dispenses with the first, or "biscuit" firing, by impregnating the material with soluble glass, which, after drying, renders the ware sufficiently hard to be handled and decorated. Ten parts by measure of water to 1 part by measure of soluble glass of 66 per cent. strength is a suitable proportion in which to apply the impregnating material.—V. C.

*Improved Adjustable Table for Etching Glass.* S. Puchner, Weiden, Bavaria, and K. Schubert, Amberg, Bavaria. Eng. Pat. 10,741, May 30, 1895.

Hitherto the edges of glass objects intended to be etched have been set in wax, which it is often difficult to remove, and which sometimes fails to protect the edges from the action of the acid. In the present invention a table, adjustable both as to level and as to the shape of the periphery, is provided with a rubber packing, which efficiently protects the edges from the action of the acid. For the purpose of removing the acid, one of the rails of the table is provided with a slot into which the acid is made to run at the end of the operation, by tilting the table by means of an adjusting screw.—V. C.

*An Improved Process and Means for Producing Clear Plate Glass in Cuvette Furnaces.* F. G. Schluder, Deuben, near Dresden, and W. G. Verständig, Dresden-Neustadt, Germany. Eng. Pat. 13,151, July 8, 1895.

In cuvette glass-furnaces comprising a melting and a working cuvette, it has hitherto been difficult to prevent impure glass making its way through the connecting passage. In the present invention, air is admitted at the proper time into the connecting passage, so that the glass then in the passage is cooled and half congealed, which prevents the flow of any impure glass from the melting cuvette into the working cuvette. When the glass in the melting cuvette has become clear, the half-congealed glass in the passage can be remelted by stopping the air holes in the passage.—V. C.

*Improvement in Method of Refining Kaolin and other Earths.* O. Imray, London. From D. H. Chambers, Pittsburg, U.S.A. Eng. Pat. 14,050, July 23, 1895.

Hitherto kaolin has been separated from gritty matter by mixing with water and allowing the gritty particles to settle, which is a slow, expensive, and inefficient method.

In the present invention the material is disintegrated, without, however, grinding down the gritty particles, and is then heated, preferably in a steam-jacketed cylinder, to such temperature, that the kaolin will not absorb moisture during the subsequent treatment. The material is then "screened," which separates the larger gritty particles, and is finally passed through bolting cloth, leaving behind all the finer particles of grit, as well as any surface clays which may have been present.—V. C.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### PATENT.

*The Manufacture of Improved Fireproof and Weatherproof Materials or Products.* C. Williams, London. Eng. Pat. 19,580, October 15, 1894.

The following are examples of the materials, with a statement as to their several uses:—

| —— | I. | II. | III. | IV. |
|---|---|---|---|---|
| | Parts. | Parts. | Parts. | Parts. |
| Alkali-ferro-silicate | 60 | 60 | 100 | .. |
| Magnesián silicate | 40 | 40 | .. | 50 |
| Magnesium oxide | 70 | 75 | 60 | 70 |
| Barium oxide | .. | .. | 20 | .. |
| Ferro-magnesian silicate | .. | .. | .. | 50 |
| Siliceous material | .. | 50 | .. | .. |
| Silica | .. | .. | .. | 50 |
| Magnesium chloride solution | 160 | 175 | 140 | 160 |
| Barium chloride solution | .. | .. | 30 | .. |

After the silicates and oxides have been incorporated, the mass is saturated with the chloride solution, and is subsequently pressed or moulded.

No. I. is suitable for roofing plates or wall linings.

No. II. for the same, or for outside walls of framework houses.

No. III. for use in thin, flexible sheets, the barium compounds making the material capable of taking a better surface finish.

No. IV. may be used in slabs, but is especially suitable for covering purposes, for which water must be added.

—V. C.

## X.—METALLURGY.

### *The Extraction of Zinc from Zinc-Lead Sulphides.* Eng. and Mining J., August 1895, 146.

The process by which it is proposed to utilise the Broken Hill (Australia) sulphide ores, which are said to contain on the average 22 ounces of silver, 25 per cent. of lead, and 26 per cent. of zinc, is as follows:—The ore is roasted in the ordinary furnaces until the zinc is converted into sulphate and oxide, the former of which is leached out with water and the latter with dilute sulphuric acid. The leached ore, which contains the lead and silver, is then smelted in the usual manner. Thus far the process does not differ from those tried in many places in the United States, and in which it was found difficult to render all the zinc soluble in water or dilute acid.

The novelty in the new treatment consists in the cheap recovery of the zinc in a merchantable form from the solution. This, it is said, is secured, after removal of iron, copper, &c., by the Marsh and Storer process, which consists in precipitating the zinc as oxide by means of magnesium oxide at the boiling temperature, from the zinc solution. The magnesium oxide is prepared from magnesite.

Whilst it is claimed that the zinc oxide prepared in this way is even more profitable than spelter, it is counted in the estimates that most of the oxide may be reduced to spelter in the usual manner.

Another proposed method of recovering the zinc from the sulphate solution is the Siemens electrolytic precipitation of metallic zinc, which Messrs. Siemens Brothers and Co. say can be effected, under the conditions proposed, from the solution at a cost of 3*l*. 12*s*. per long ton of zinc, or with royalty on patent 4*l*. 12*s*. per ton.

The proposed smelting works are to be established at Lake Illawarra, near Sydney, N.S.W., and within a few miles of the coal mines. Coal will cost at the works 6*s*. (1·50 dol.) per ton, unscreened, and 3*s*. 6*d*. for small coal. It is stated that it requires fully three tons of coal to treat one ton of ore.

### *Preparation of Pure Zinc.* F. Mylius and O. Fromm. Ber. 28, 1563—1575.

The authors commenced by analysing a number of samples of "commercially pure" metal. 100 grms. were used in the process, and the basis of their analytical method was a preliminary fractional precipitation with ammonium sulphide.

The impurities are chiefly lead, cadmium, and iron, *not* arsenic. The following quantities were estimated in 100,000 parts on eight samples of commercially pure zinc from various sources, seven of them reputed pure zinc from leading manufacturers, and in the table below numbered 1 to 7:—

| —— | Lead. | Cadmium. | Iron. |
|---|---|---|---|
| 1 | 72 | 111 | 15 |
| 2 | 30 | 58 | 11 |
| 3 | 5 | 23 | 2 |
| 4 | 5 | 16 | 1·4 |
| 5 | 10 | 18 | 2 |
| 6 | 21 | 5 | 36 |
| 7 | 11 | 99 | 4 |
| Electrolytic zinc, commercial | 58 | 39 | 17 |

Various processes for the purification of pure zinc were investigated, as follows:—

I. *Dry Processes.*—Recrystallisation of the metal reduced the lead impurity from 0·67 to 0·02 per cent. after five repetitions; the cadmium fell from 1·27 to 0·36 per cent. in four recrystallisations. The iron, on the other hand, increased from 0·92 to 3·2 per cent. in two crystallisations. This process can scarcely be recommended.

II. *Wet Processes* (Electrolytic).—(1) By separating the metal from solutions of purified salts with insoluble anodes; (2) by electrolytic purification by means of soluble anodes of zinc.

In all cases purified zinc sulphate was used. Iron was eliminated by heating the solution with zinc oxide in presence of hydrogen peroxide. After warming and filtering, a solution free from iron is obtained. For the elimination of other impurities the following methods are recommended:—(*a.*) Recrystallisation of the sulphate from solution in dilute alcohol. (*b.*) Decomposition of zinc ethyl with sulphuric acid. (*c.*) Electrolysis of the solution with platinum electrodes and weak currents, keeping the solution neutralised by means of zinc oxide. Pb, Cd, and Fe″ are separated at the cathode; $PbO_2$ and $Fe_2O_3$ at the anode. (*d.*) Treatment of $ZnSO_4$ solution with purified zinc. (*e.*) Treatment of porous zinc (electrolytic) with less than the equivalent of sulphuric acids in dilute solution.

A pure zinc oxide, required in the above treatments, may be prepared from the nitrate by fractional precipitation with ammonium sulphide.

The main issue of the investigation is that the purest zinc is obtained by repeated electrolytic separation of the metal in the spongy form from basic solutions of the sulphate. The impurities do not exceed 1 part per 100,000.

As a final purification (elimination of non metallic elements, dissolved gases, &c.) the authors recommend distillation *in vacuô*.—C. F. C.

### *Preparation and Properties of Pure Cast Molybdenum.* H. Moissan. Comptes Rend. 120, 1320—1326.

Molybdenum can be obtained pure and in the fused state in the electric furnace; it has a density of 9·01, is as malleable as iron, can be filed when cold, and forged when hot. By cementation it forms a steel-like body of greater hardness than the pure metal, and, conversely, this substance, when heated in a mass of oxide, loses its carbon, and re-assumes the properties of pure molybdenum. With excess of carbon in the electric furnace, molybdenum furnishes a crystalline carbide, $Mo_2C$.—D. A. L.

### *Direct Puddling of Iron.* E. Bonehill. Iron and Steel Inst., Autumn Meeting, 1895. The Ironmonger, 1895, 72, 314—318.

Iron from the blast furnace is run into a reservoir capable of holding about 35 tons, which is heated by means of a gas-producer. The reservoir is situated close to a group of four puddling furnaces. The walls of the reservoir contain several openings at different levels, through which the molten metal is run into a ladle, and thus transferred to a puddling furnace on the Siemens system. It is rabbled immediately, and in half an hour the blooms are withdrawn and taken direct to the steam hammer. By thus dispensing with the process of casting into pigs and remelting in the puddling furnace, a great saving in time is effected and the average production of a puddler nearly doubled. Moreover, the loss of metal does not exceed 6 per cent., whilst in ordinary work it amounts to 16 per cent. In the question of economy it is stated there is a saving of 1·9*s.* in labour, 6·2*s.* in fuel, and 3·6*s.* in waste, making a total saving of 11·7*s.* per ton. Other advantages of the process are the smaller space required, and a decrease in superintendence.—A. W.

*Nickel Steel and its Advantages over Ordinary Steel.* H. Wiggin. Iron and Steel Inst., Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 351—358.

After paying a tribute to the work of Mr. James Riley on nickel steel, the author proceeds to advocate its use in many technical branches other than those already adopting it. The nickel steel containing about 3¼ per cent. of nickel is the alloy chiefly produced, as it possesses a tensile strength 30 per cent. higher than ordinary steel, with an increased elastic limit of at least 75 per cent. In its application to boilers an increased pressure of 30 per cent. could be obtained for the same weight of material, and, if experience bore out the early experiments, in respect to corrosion, the nickel steel boiler would possess a longer life. An ordinary steel having an elastic limit equal to nickel steel would be a high carbon one very deficient in elongation and difficult to work. Nickel steel beyond the elastic limit has a sufficient range of increased resistance with fully as large an ultimate elongation as ordinary mild steel. It also gives better results under the drop test; and for this reason, and its greater strength and stiffness, it is used for shafts, piston rods, propellers, &c. The author believes that nickel steel will replace ordinary steel in the same way that the latter has superseded wrought iron.

An important discussion followed this paper. Mr. J. Riley thought that the metal should have more attention than it had yet received, and said that the type of metal for the construction of the hulls of ships should have a tensile strength of 40 tons per square inch as a minimum, an extension of 16 per cent. measured on 8 inches, and should answer the usual bending test of Lloyd's. Mr. Beardmore said that he had cast a cylinder of nickel steel which contained about 64 tons of metal, and which he believed to be one of the best castings ever produced. In making nickel steel ingots the alloy was regular in composition, and there need be no loss of nickel in the slag if the process be properly carried out. Metallic nickel could now be obtained free from sulphur and phosphorus. Mr. Windsor Richards referred to the scale which clung to nickel steel in hot working, and which would not flake off like the scale from ordinary steel. It was probably owing to the rough surface thereby produced that this metal had been so sparingly used for shipbuilding. Mr. R. M. Thompson spoke of some recent German experiments on nickel steels containing from 1 to 25 per cent. of nickel with varying degrees of carbon. With 15 per cent. of nickel an almost new metal has been discovered possessing a tensile strength more than double that referred to above. The increased cost of this metal, with its great advantages, would only amount to 2 per cent. In the United States at the present time, nickel steel is being used for armour plates, small arms barrels, large guns, wire for torpedo netting, and the construction of vessels. In Russia, France, and Germany it is being largely used, and it almost seemed as though England knew how to produce things, but was not quite ready to use them after they were produced. Mr. Milton defended Lloyd's Register against the charge of backwardness in adopting improvements, and spoke of its ready adoption of mild steel. It did not oppose the use of nickel steel at the present moment, but it required that all the good qualities claimed for it should be proved. In the introduction of steel fresh working appliances had to be used; in the same way probably nickel steel would require particular appliances and treatment, and nobody seemed to say anything about this. As regards its use for boilers, unless it was suitable for furnaces it would not be of any advantage. Sir H. Wiggin could not understand why nickel steel had not been adopted by England, since it had been so extensively used in other countries. Mr. Ford took exception to making comparisons as to the saving in weight by the adoption of nickel steel at the expense of ordinary steel; he thought there was room for both. He challenged the superiority of nickel steel in any section up to ⅜ of an inch, as ordinary steel would give quite as good results up to that thickness; but in large masses where there was larger crystallisation there was undoubtedly a field for it.
—A. W.

*Production of Iron by a New Process.* R. A. Hadfield. Iron and Steel Institute, Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 347—350.

This paper describes an entirely new process for producing iron, which as yet has no practical value, but only a scientific interest. The metal is obtained by heating iron oxalate in a basic-lined crucible for about 15 minutes, and then adding aluminium, and a small quantity of lime and fluorspar as a flux, to the ferrous oxide so obtained, and heating to a high temperature. By this means an alloy of iron and aluminium was obtained free from carbon, which was hard enough to scratch glass, and which was non-magnetic. The experiments were continued in this direction, taking, in the first place, ferrous oxide, until a metal was obtained having the following composition:—Iron, 97·50 per cent.; carbon, 0·03; silicon, 1·17; sulphur, 0·17; phosphorus, 0·016; aluminium, 0·02; and copper, 0·81 per cent. Its specific gravity was 7·75. A still purer metal, containing 99·75 per cent. of iron, was also obtained. The experiment was interesting as showing the production of pure iron from its oxide without the aid and introduction of carbon, and provided that aluminium becomes cheaper it may be found of use for the production of pure iron for certain classes of electrical work.—A. W.

*Thermochemistry of the Bessemer Process.* W. N. Hartley. Iron and Steel Institute, Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 324—334.

The author has taken spectra of the Bessemer flame at different periods, and gives the exact measurements of the lines produced, and compares one spectrum with another. It is difficult to give a single spectrum as typical of the Bessemer flame, as it is not only a complex one, but it exhibits differences in constitution during different periods of the blow, and even during different intervals in the same period, such as, for instance, the varying spectra obtained during the boil period. Again, the spectrum differs in different works, the difference being due to the varying temperatures and composition of the metal blown. On the first appearance of the flame there is a continuous spectrum, caused by the burning of the carbon monoxide, and the lines of the alkali metals appear. During the second period of the boil, the flame exhibits a continuous spectrum of bright rays, overlying which is a number of bright bands. Some of these appear to diminish in intensity on the side towards the least refrangible rays, whilst others are bounded by lines or by very narrow bands, possibly by the sharp edges of bands. At the commencement of the boil the bands are not so numerous, nor are the lines so strong as subsequently, excepting the lines of the alkali metals. Certain lines appear only at the commencement of the boil, others do not appear until the end. There is no very great difference between the spectra taken at the close of the boil and the commencement of the third periods or fining stage. Both in the second and third period there are several lines which are short, and seen only at the base of the flame; others are broad at the base of the flame like bands, but towards the tip they attenuate into lines. Such a conversion of band spectra into line spectra is observed when the substances which yield them diminish in quantity in the flame. The greater number of lines are iron lines. The prominent bands of low refrangibility are due to metallic manganese, but they are not quite similar to the bands of that metal, as the bands of carbon overlie them. Lines of great refrangibility have now for the first time been observed, most of them being strong and sharp, forming characteristic groups, which can be identified with iron, as seen in the arc spectrum. No absorption bands are seen, no nitrogen bands, nor bands of calcium or magnesium oxide, nor the lines of these metals. There is no trace of chromium, nickel, cobalt, or copper.

The Bessemer flame is not the result of combustible gases or vapours being mixed with oxygen, and burning within the converter, and thus in a state of combustion issuing into the air, but, on the contrary, it is carbon monoxide mixed with metallic vapours at an exceedingly high temperature, burning outside the converter in a cold atmosphere. That complete combustion takes place in the converter is erroneous. The fact that the lines of manganese do not appear at the commencement and termination of the blow is explained by the quantity of metal volatilised at those periods being insufficient for the production of a spectrum. With a metal containing but little manganese the latter is all converted into silicate during the first period, and the manganese must therefore be vaporised from the slag. This explains the fact that when a converter is being heated with coke after it has been used, but not relined, the spectrum of the Bessemer flame makes its appearance, manifestly from the adhering slag. The disappearance of the manganese spectrum at the third or fining period is primarily due to a reduction of the quantity of carbon monoxide. When the last traces of carbon are gone the blast instantly oxidises any manganese that may be in the converter, and also some of the iron, so that the temperature immediately falls. The entire spectroscopic phenomena of the blow are therefore determined by the chemical composition of the molten iron and of the gases and metallic vapours within the converter, the temperature of the metal and that of the issuing gases.

The author then deals with the temperature of the converter, using the spectrum as an index. When the same substance emits two spectra it is evident that either the rate of vaporisation or the temperatures of the vapour differ; the more complex the spectrum the higher is the temperature. When the spectrum extends through the visible rays into the ultra-violet region, and an increase is observed in the number and intensity of the ultra-violet rays, nothing but an increase of temperature will serve to account for the change. No increase of material in the flame would increase the refrangibility of the rays emitted by its vapour. Hence the study of the ultra-violet spectra has another importance as an indication of temperature. The difficulty of ascertaining the maximum temperature of any flame is pointed out, and is illustrated by the flame of a candle, which although having very small heating effect, contains carbon in a state of vapour, and is capable of melting fine platinum wire. There is one significant fact to be observed in the spectra of the flame photographed during the boil and the finishing stage which bears on the temperature of the metal. When the oxyhydrogen flame spectra of manganese, manganic oxide, iron, and ferric oxide are photographed, the number of the lines and bands in the spectra are not more numerous than with a Bessemer flame spectra of only a half minute's exposure, though the above spectra may have received an exposure of from 30 to 80 minutes. Again, judging by the number of lines and bands belonging to iron and manganese which have been photographed in the spectrum of the Bessemer flame, the temperature must in any case nearly approach that of the oxhydrogen flame, even if it does not very generally exceed it.

Finally, the author calculates that the heat units developed by the combustion in the converter of the impurities of 5 tons of pig-iron of a given composition amount to 1,558,197, and the specific heat of the iron and products of combustion, with also the nitrogen in the air, amounts to 1071·8 kilo. heat units. The theoretical pyrometrical effect, or the temperature attained above that of the molten cast iron, is therefore $\frac{1,558,197}{1071\cdot8} = 1,154^\circ$ C. Allowing that 50 per cent. of the heat is absorbed or conveyed away, the temperature would be 727° C. above that of molten pig-iron. In the case of grey iron, melting at 1,220° C., the metal would acquire a temperature of about 1,947° C., which is very considerably above the melting point of platinum.—A. W.

*The Hardening of Steel.* H. M. Howe. Iron and Steel Institute, Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 331.

In extensively reviewing the work and theories of others to explain the hardening of steel, the author speaks of certain irons which contain a "jog," a term which he uses to indicate the sudden break in a curve, such for instance as the breaking-down point in the stress curve shown in the tensile test of annealed iron or steel as against the same metal which has been cold-worked, and which has a comparatively smooth curve, and is therefore termed "jogless." The subject is divided into four questions, which the author deals with separately, viz.:—

1. Does cold-working induce an allotropic modification? If so, its name by definition is δ-iron.
2. Does hardening by quenching induce an allotropic modification? If so, its name by definition is β-iron.
3. Are β- and δ-iron identical?
4. How far are the effects of hardening by quenching due to the known change which it induces in the carbon condition, and how far to the presence of β- or δ-iron?

The carbon and allotropic theories form the basis of the author's arguments, which are of an exhaustive character. Questioning M. Charpy's results on the hardness of quenched steels and the absence of the "jog" therein, he states that the absence of the jog is not valid evidence of the absence of α-iron, nor when the jog is present is its length a fair measure of the relative proportions of α- and δ-iron present.

That the tenacity of almost carbonless steel can be nearly tripled by quenching, shows, in addition to other evidence, that some change other than the carbon condition enters into the question of hardening by quenching. Carbon plays an important part in the hardening process, and is opposed to the allotropic theory, but it is possible that both theories may have a bearing on the subject. The facts of the case may possibly be better explained by what the author now puts forward as the "carbo-allotropic theory," viz., that hardening is due to the retention, not of β-iron alone, nor of hardening carbon alone, but to a compound of β-iron with hardening carbon, or what may be called a "hardening carbide of β-iron," so that it would be as inaccurate to say that hardening is due rather to β-iron than to hardening carbon as to say that the properties of water are due to its oxygen rather than its hydrogen.

Hardness may be produced by quenching, in the almost complete absence of carbon, by the presence of excess of manganese, or in nickel steel; but in none of these is there any approach to the glass hardness of quenched high carbon steel, nor an increase in hardness proportional to the other effects.

Non-magnetic manganese steel, which is said to owe its hardness to β-iron, which is also non-magnetic, should be much harder than quenched high carbon steel if the hardness was simply due to β-iron, but it is much softer. The carbo-allotropic theory, however, regarding β- and δ-iron as stronger and harder than α-iron, explains why these stronger irons are less hard than high-carbon steel. The theory is put forward as a rival to the existing theories, but the evidence is not considered conclusive.

—A. W.

*Cooling Curves and Tests for Cast Iron.* W. J. Keep. Iron and Steel Institute, Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 363.

In this paper the author deals with the question of shrinkage of cast iron, and the influences which affect it. It appears to vary in proportion to the percentage of carbon in the iron, because the carbon renders the metal more largely crystalline. It also varies in proportion to the silicon present, because this element changes carbon from the combined state into graphite, and thus indirectly affects crystallisation. The size of the casting has a bearing on the shrinkage, as the large ones cool more slowly, and thus become more largely crystalline than the small ones. A number of curves are given bearing upon this subject. From actual tests it is found that an increase of silicon decreases the shrinkage. The shrinkage of $\frac{1}{2}$-in. square bars is due to chemical composition alone, whilst in large bars it is additionally influenced by the slow cooling. These facts may be utilised practically, as from the curves given the composition could be ascertained necessary to produce a casting having a certain shrinkage for a given size. A description is given of the author's autographic apparatus, by which he examines the behaviour of test bars whilst cooling from a liquid state to that of a cold bar.—A. W.

*The Ironworks and Mineral Resources of the South of Russia.* G. Kamensky. Iron and Steel Institute, Autumn Meeting, 1895. The Ironmonger, 1895, **72**, 318.

The ironworks of South Russia are divided into two groups, viz.: (1) those situated nearest the iron-ore deposits of Krivoi-Rog, and at a distance from the coal; and (2) those situated above the coal, but at a distance from the iron ore. Three works in each group are described, and taken in the order from west to east or from the ore to the anthracite coal. The Krivoi-Rog ores contain 91 to 95 per cent. of ferric oxide, about 5 per cent. of silica, and less than 1 per cent. of phosphoric anhydride.

Analyses of the poorer ores of the eastern districts show that they contain slightly over 70 per cent. of ferric oxide, 3 to 8 per cent. of alumina, 8 to 17 per cent. of silica, and varying quantities of phosphoric anhydride up to 1 per cent. At the present time the 12 existing mines yield 800,000 tons of ore per annum.

The coal-seams are of three kinds—anthracite, caking, and gas coal. The majority of coals, however, contain much ash and sulphur, and so require washing previous to coking in the ovens. The ore requires 45 per cent. of flux to smelt it, but there is an abundance of limestone in the district to meet this. There is also some manganese ore in the locality, but of poor quality, which, after washing, &c., contains from 32 to 40 per cent. only of manganese. Fire-clay is plentiful, and each works has its own firebrick factory. The author then gives full details of the process, furnaces, production, &c., in each of the six works previously mentioned.—A. W.

*The Influence of Pickling on Iron and Steel.* Engineer, 1895, 261.

When iron and steel wire, previous to galvanising, is "pickled" with dilute acid, to cleanse it from the oxide formed on annealing, it becomes brittle. W. H. Johnson (Proc. Royal Soc., 1875) found that not only do sulphuric acid and hydrochloric acid act thus, but also caustic soda solution. Nitric acid, whilst attacking iron strongly, does not cause brittleness.

Iron can be made especially brittle by using it as a cathode, with water as the electrolyte. If used as an anode no change occurs.

Iron which has been made brittle, evolves hydrogen gas when immersed in warm water, the evolution of gas ceasing when the iron has lost its brittleness. The iron also loses its brittlenes on heating.

Hughes has shown that iron is the only metal which has this peculiar property, and that the brittleness is more easily acquired when the iron, in contact with zinc, is exposed to the action of an acid.

Iron which is rich in silicon does not become brittle so easily.—A. S.

*Tin Deposits of Durango, Mexico.* W. A. Ingalls. Trans. of the Amer. Inst. of Mining Eng., March 1895; Proc. Inst. Civil Eng. 1895, **122**, 69—70.

A table is given of ten analyses of Mexican tin ores made by the late Dr. Genth, half being from Potrillos and the remainder from Cacária. The former is fairly pure, containing 92 per cent. to 93 per cent. $SnO_2$, 4 per cent. to 6 per cent. $Fe_2O_3$, and 0·7 per cent. to 2·7 per cent. of silver; but the latter is remarkable as containing arsenic in appreciable quantity up to a maximum of 10·34 per cent. of arsenic acid ($As_2O_5$). The Durango tin as shipped to the United States is free from wolfram, but sometimes contains antimony. Two analyses of parcels of about 25 tons total weight were of the following composition:—

| | | |
|---|---|---|
| Tin | 92·6104 | 90·6047 |
| Antimony | 7·3139 | 9·2850 |
| Arsenic | trace | trace |
| Lead | 0·0331 | 0·0555 |
| Bismuth | 0·0255 | 0·0276 |
| Iron | 0·0171 | 0·0270 |
| | 100·0000 | 100·0000 |

*Estimation of Sulphur in Iron and Steel.* L. Campredon. Comptes rend. **120**, 1051.

*See under* XXIII., *page* 889.

*Estimation of Gold and Silver in Copper and in Copper Matte.* E. A. Smith. Chem. News, **72**, 1895, 76.

*See under* XXIII., *page* 890.

## PATENTS.

*Improvements in the Method of Extracting Gold from Gold Ores, Quartz, and Auriferous Alluvials, and Collecting and Retaining Float Gold.* H. C. Barker and R. Pearson, London. Eng. Pat. 13,868, July 18, 1894.

The tank receiving the pulp, crushed ore, &c., has mercury on the bottom, and is provided with a siphon which takes over the residual pulp, gold and float gold, to a lower tank, also with mercury on the bottom, the siphon inlet being near the bottom, and partly in the mercury, whilst a few inches above the mercury a horizontal amalgamated copper plate is attached to three sides of the tank leaving a space of a few inches at the end opposite the inlet. Above this is a similar plate, but with the space at the inlet end having, in addition, small vertical amalgamated plates attached underneath.
—D. A. L.

*Improved Arrangements and Apparatus for the Utilisation of the Waste Heat of Furnaces of the Open Hearth Type.* C. J. Bagley and L. Roberts, Stockton-on-Tees. Eng. Pat. 15,249, August 10, 1894.

In the case of steel melting furnaces of the open hearth type, the waste gases and highly heated products of combustion, the excess heat of which is otherwise lost, are intercepted before they reach the chimney and employed for steam-raising by the adoption of the apparatus and system described.—J. H. C.

*Improved Treatment of Molten Iron or Steel.* G. Love, Durham. Eng. Pat. 17,340, September 12, 1894.

A complete stirring of the molten metal is effected by causing it to pass through a heated revolving tube or cylinder, finely-powdered carbonaceous or flux material being added when necessary.—J. H. C.

*Improvements in or relating to the Obtaining of Precious Metals from their Solutions.* H. L. Sulman, London. Eng. Pat. 18,003, September 21, 1894.

Very finely-divided zinc (for example, zinc fume) or magnesium is added to the cyanide solution of the precious metal, either by sifting it in, or by introducing it in aqueous suspension. The exchange with the precious metal is nearly instantaneous and almost complete, the unnecessary consumption of zinc with its train of attendant evils, resulting from the use of boxes containing a large excess of zinc turnings, being thus obviated.—W. G. M.

*Improvements in or relating to the Recovery of Precious Metals from their Ores.* H. L. Sulman, London. Eng. Pat. 18,146, September 24, 1894.

The ore is treated with cyanide solution, and the precious metal in solution is precipitated by zinc dust or zinc fume, obtained by condensation in the distillation of zinc.
—W. G. M.

*Improvements in or relating to the Extraction of Precious Metals from their Ores.* H. L. Sulman and F. L. Teed, London. Eng. Pat. 18,592, October 1, 1894.

To the alkaline cyanide solution, of suitable strength for treating ore, there is added chloride, bromide, or iodide of cyanogen, either before or during the leaching process; or the cyanogen haloid compound is prepared by passing a sufficient quantity of the elementary halogen into a solution of a cyanide. In this latter way, the solution resulting from the precipitation of the precious metal, by means of zinc, may be revivified and rendered fit for use again, zinc cyanide being a soluble substance.—W. G. M.

*A Method of Carburetting the Surfaces of Armour-Plates.* F. Stubbs, Sheffield. Eng. Pat. 20,067, October 20, 1894.

The plate to be carburetted is subjected, whilst strongly heated, to the action of a layer of fused cast-iron or other metal or alloy containing a considerable proportion of carbon.—J. H. C.

*A Process for Recovery of Zinc from Scrap Galvanised Iron and from Hard Spelter and other Zinc Alloys.* W. S. Rawson and R. Heathfield, London. Eng. Pat. 20,365, October 24, 1894.

The fragments are subjected to the action of caustic potash of about 1·170 sp. gr. in an iron vessel which is kept in motion when necessary and connected to the positive pole of a source of electricity so as to form the anode for electrical deposit of zinc from the solution. When the solution has become so far charged with zinc as to have acquired a sp. gr. of about 1·240 to 1·260, it is operated upon electrolytically, the zinc being deposited upon a revolving cathode in the form of a cylindrical core from which it may be afterwards removed as a sheet. A rubber or burnisher is preferably applied to the zinc during its deposition.—J. H. C.

*Improvements in Casting Metals.* P. Huth. Gelsenkirchen, Germany. Eng. Pat. 21,213, November 5, 1894.

The molten metal or alloy is cast into a rotating mould, by which means it is thrown towards its periphery. A second charge of the same or some other metal or alloy may then be added and similarly rotated, so as to fill the remainder of the mould if required. As an example it is stated that in casting shells, the hard metal will be cast first into the rotating mould, filling the bottom, and thus forming the point of the shell. Some of the liquid metal will, however, be driven upward on the sides of the mould by the centrifugal force. Into the conical cavity in the centre the softer metal will next flow, filling this cavity and the remainder of the mould.—J. H. C.

*Improvements in the Smelting of Ores.* R. Fegan, Blackheath. Eng. Pat. 21,245, November 5, 1894.

The ores and reducing agents in a finely-powdered state are mixed whilst hot with small proportions of naphthalene and of the distillation residues of rosin or paraffin and then formed into blocks or briquettes under pressure and smelted.—J. H. C.

*Improvements in the Manufacture of Alloys.* H. Moissan, Paris. Eng. Pat. 22,023, November 14, 1894.

To facilitate the production of alloys of common metals with those of a refractory nature, such as molybdenum, tungsten, uranium, zirconium, vanadium, cobalt, nickel, manganese, chromium, titanium, silicon, or boron, an alloy of the refractory element with aluminium is added to the fused common metal, and after thoroughly mixing, the aluminium is removed by the introduction of an oxide, or by blowing air through the mixture. The aluminium alloy itself is made by melting aluminium in a basic-lined crucible, and at a temperature between 700 C. and a white heat introducing and gently stirring with it, little by little, an oxide of the refractory metal required. This operation may be conducted after removing the crucible from the fire, as the heat generated by the reaction suffices to keep the alloy melted. The alumina formed by exchange is afterwards stirred into fused alkaline chloride, in order to separate entangled globules of alloy. The aluminium alloy may also be prepared in the electric furnace, by allowing the liquid or gaseous aluminium, as it is produced, to act upon the refractory oxide; but in this case the alloy is liable to contain carbon, which is often an undesirable ingredient. Magnesium may often be substituted for aluminium.—W. G. M.

*Process of Extracting Precious Metals from their Ores.* M. Crawford, Colorado Springs, Col., U.S.A. Eng. Pat. 25,016, December 22, 1894.

The pulverised ore as it comes from the mine, in preference to tailings, is lixiviated with a cyanide solution prepared by any of the three methods hereinafter described; it may then along with the solution be submitted to an amalgamation process. Finally the tailings are separated mechanically and the gold removed from the solution, an electrolytic process being preferred. The solvent solution may consist of a cyanide solution, preferably 1 per cent., mixed with not less than 10 per cent. of a cyanate; or the necessary proportion of cyanate may be generated in the solution by chemical means, avoiding destructive agents; or, by preference, electrolytically, in which case the electrolytic bath may have two compartments separated by a porous diaphragm or may simply have a porous cup inserted in it. The anode of carbon or other material is placed in the larger compartment, the cathode of iron, copper, or other material in the smaller compartment; both compartments are filled with cyanide solution. The current is passed continuously until tests show that the solvent activity of the solution in the anode compartment has increased to the proper degree for its use for lixiviating. Various other alternatives are also stated.—D. A. L.

*Improved Process for the Recovery of Gold and Silver from Solutions.* E. D. Kendall, Sewaren, New Jersey, U.S.A. Eng. Pat. 8536, April 30, 1895.

The cyanide or other solution containing gold and silver is passed through precipitating vessels charged with powdered zinc amalgam; the resulting precipitate is transferred to another vessel, covered with granulated carbon—gas carbon, for instance—and treated with sulphuric or other suitable acid mixed with 10 or 12 parts of water; the precious metals are separated from the residual amalgam in the usual manner.—D. A. L.

*Improvements in and relating to the Extraction of Gold and Silver from their Ores.* J. J. Crooke, New York City, U.S.A. Eng. Pat. 12,290, June 25, 1895.

The ores are treated by chlorination. The pulverised ore, preferably roasted or partially so, is mixed with sodium chloride, and sometimes with manganese dioxide also, and charged into a hot solution containing copper nitrate, common salt, and hydrochloric acid, in a vat, which is then closed gas-tight. The mass is kept agitated for an hour whilst sulphuric acid is added gradually. Then, after maintaining at 100° F. for six hours, the mixture is forced by steam into lixiviating tanks, and hot 2 per cent. sodium chloride, preferably acidified with hydrochloric acid, is also admitted. The solution passes to the precipitation tanks, where the gold, silver, and copper are precipitated on soft iron plates; this precipitate is washed and treated with nitric acid, the gold is collected, whilst the copper (and silver) nitrate solution serves for the treatment of a fresh lot of ore; but from time to time the silver is separated in the ordinary manner. A chlorination apparatus is also described, consisting of an upright wooden vessel, capable of being closed air-tight, and tapering upwards, with a vertical reciprocating agitator, a flexible hood attached gas-tight, a channel, extending down the side, for introducing acid at the bottom of the digester, a sluice door for discharging, and a vent for escape of excess of gas, all internal wooden surfaces being protected by acid-proof material. For lixiviation an air-tight wooden vessel, with filter bed, is described, from which the tailings can be removed by flushing.—D. A. L.

*Improvements in and relating to the Extraction of Silver from its Ores.* J. J. Crooke, New York City, U.S.A. Eng. Pat. 12,291, June 25, 1895.

This is a modification of the Augustin process. The pulverised ore is roasted, preferably in a reverberatory furnace, with sodium chloride: heaped and allowed to cool to 150° F.; then leached with an equal weight of a solution consisting of a mixture of 3,000 galls. of saturated sodium chloride solution with 90 lb. of a 25° B. solution of copper nitrate and 20 lb. of sulphuric acid (this solution allows lead to remain dissolved). Preferably, when used, the temperature of this solution is 170° F., and it should stand on and well cover the charge for an hour. The solution is then run on to a series of strong canvas filters placed one above another and carrying precipitated copper (and a few strips of iron, if the solution contain gold, though the process is not intended for ores rich in gold) in which the silver and gold are deposited; the solution drains through to a tank below, where the copper is precipitated by means of iron. The solution is used over again until it gets surcharged with iron and lead salts, when the latter are recovered. As the upper filters become too heavily charged with silver, they are removed and replaced by the lower ones.—D. A. L.

*Improvements in Treating Molten Metals.* E. A. Uehling, Birmingham. Eng. Pat. 14,029, July 23, 1895.

The molten metal is treated with suitable reagents (" for the purpose of purifying and rendering it more homogeneous or changing its chemical character, and hence its physical properties "), which reagents are compacted into a mass around a core or form suitable for rotating about an axis. This mass is plunged into the metal and caused to revolve. According to the nature of the elements of which the revolved material is composed, these elements are assimilated by the molten metal, the extraneous matters forming a slag which separates.—J. H. C.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### (*A*.)—ELECTRO-CHEMISTRY.

*The Action of Nitrous Acid in the Grove Battery.* Ihle. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 174—176.

If the concentrated nitric acid in a Grove cell be gradually diluted with water, the E.M.F. of the cell remains approximately constant and equal to 1·8 volt until only 38 per cent. of nitric acid is present. A little below this concentration the cell gives an E.M.F. roughly corresponding to that of a Smee cell (0·7 volt), although at first it only exhibits this lower E.M.F. for a short time. When the amount of nitric acid present is reduced to 27—28 per cent., the E.M.F. of the cell remains permanently at the lower value.

This remarkable relation appears to be due to the action of nitrous acid, which is either contained in the nitric acid or formed in it when the circuit is closed. For, if a Grove cell be used which contains less than 28 per cent. of nitric acid, and therefore exhibits permanently the E.M.F. of a Smee cell, and a small quantity of potassium nitrite be added, the E.M.F. instantly rises to that of the Grove cell proper. On removing the nitrous acid, by adding potassium permanganate or urea, the E.M.F. again sinks to that of the Smee cell. And even with more concentrated nitric acid, the depolarising power can be annulled if we remove the nitrous acid by adding urea or potassium permanganate; the E.M.F. then falls to that of a Smee cell. With acid containing over 50 per cent. of $HNO_3$ this can only be done for a short time; but with acid containing 50—38 per cent. the effect is permanent.

Thus depolarisation in the Grove cell appears to take place by a catalytic action of nitrous acid. V. H. Veley first drew attention to similar catalytic actions of nitrous acid, *e.g.*, in the action of nitric acid upon metals (Ber. 1895, 928).—D. E. J.

*Block Accumulator Plates.* J. Zacharias. Zeits. f. Electrotech. u. Electrochem. **2**, 1895, 190.

By "block plates" (*Masseplatten*) is meant plates which throughout the whole of their mass consist of active substance, and are only bound round their rims by a small framework. Unlike plates of the Planté type, they possess no scaffolding, ribs, or plates in the interior of the mass, but are simply held together by the adhesion of the substances used in their manufacture. The preparation of the block plates offers many difficulties, the correct choice of raw materials, the necessary thickness to prevent warping, the obtaining a plate of proper capacity which will not crumble on usage, all require care and experience; and to clear up these points and to show where the plates can be most advantageously used is the object of the author's paper.

The surface of the plates, especially of the negative, is level and smooth, and both sides are covered with very small holes, the positive plate, in addition, containing a larger hole in the interior. The object of these is to allow easy escape to the gases formed during charging and discharging which would, if confined, give rise to blisters and cause disintegration. The conductivity of the plates is high, but somewhat less than that of plates of the gridiron type. On the other hand, the capacity, 55—62 ampère hours per positive electrode kilo., is much higher than that of framework plates, as is also the current density. The absence of a metallic conductor in the mass causes the rate of charging and discharging to be much slower. This is well shown on short circuiting a cell until it appears to be completely run down. On allowing to stand, the cell recovers, the charge in the interior redistributing itself, and so forming a surface charge for further action.

It therefore follows that a plate of 5 mm. thickness gives, in relation to its mass, a much higher current density than one of 8 or 10 mm. of the same size, and for strong discharge from cells of high capacity it is better to increase the number of plates than to increase their size, since, owing to the mechanically necessary greater thickness, the larger plates do not conduct so well.

This peculiarity does not apply to the gridiron plate.

The small amount of self-discharging is a great advantage in the block plates, and renders them particularly suitable in the microphone manufacture, &c.

Microphone cells having plates of 8 mm. × 140 × 100 gave, by the action of some ampères on three plates, only about 30 ampère-hours, whilst by a minimum action in the telephone working, about 90 ampère hours were obtained, the cells remaining in order for $1\frac{1}{4}$ year.

This shows that the capacity is relative, depending on time, temperature, mode of usage, &c.

Working slowly, the capacity per unit of mass is equal for all thicknesses of plates; the introduction of a metallic connection from angle to angle, or side to side, of the frame doubles or trebles the current density. Such a division presents, however, as yet technical difficulties.

A capacity of 88 ampère hours per kilo positive block plates has been reached by the author; theoretically it is somewhat higher than this.

In general, the time of charging lasts 16—20 hours, and that of discharge 14—12 hours; charging and discharging in 4—5 hours, as with other plates, is quite impossible.

The system is largely employed by the German postal authorities and on the longer telegraph lines.

For preparing the active mass one of two methods is employed; the oxide of lead is bound together by a resin or varnish insoluble in acid, or it is converted into an insoluble salt by means of coal tar residues or phenol compounds, as in Böse's process. Many such insoluble compounds exist; the sulphonic acid salts are, however, the most valuable. The resistance must not be made too high, since a too solid and resisting plate possesses only a half or a quarter of the theoretically possible capacity.

The division of the active material by metallic conductors is not to be recommended, without further investigation, since the grating construction sometimes leads to weakness in the plate by affording cavities for gases, thus causing mechanical destruction to occur.—J. T. C.

*A New Accumulator.* von Kowalski. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 171—176.

This accumulator is chiefly intended for motors and for lighting trains. Each plate is encased in an envelope of celluloid. Inside the envelope is placed an electrode of lead and antimony, together with oxides of these metals. The whole is immersed in the electrolyte for a day. The powder absorbs some of the electrolyte with development of heat. It is then taken out and dries to a compact mass of "solid solution of oxides of lead and antimony." After repeated formation with a current of 3 ampères, the electrodes attain a capacity of 20 ampère-hours per kilo. of plate. The accumulator is cheap and is capable of yielding very heavy discharge currents.—D. E. J.

*Resistance of Porous Diaphragms.* F. Kruger. Zeits f. Electrotechnik u. Elektrochem. 1895, **2**, 83.

Strictly speaking, the term "resistance of a diaphragm" is incorrect, for a porous earthenware or porcelain cell is a non-conductor of electricity. But the term is very generally used and indicates the increase of resistance produced by introducing the diaphragm into a given electrolyte. The author has measured the resistance of such diaphragms for various electrolytes. He finds that the resistance increases with that of the electrolyte; it is probably proportionate to the specific resistance of the latter.—D. E. J.

*Electrolysis of Hydrochloric Acid without a Diaphragm.* F. Oettel. Zeits f. Electrotech. u. Electrochem. **2** 1895, 57.

*See under* VII., *page* 864.

*Electrolysis of Calcium Chloride Solutions and the Hermite Process.* Paul Schoop. Zeits. f. Electrochem. 1895, **2**, [10], 209.

*See under* VII., *page* 864.

*Electrical Tanning.* Folsing. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 167.

*See under* XIV., *page* 875.

## PATENTS.

*Improvements in Secondary Batteries.* A. Schanschieff, Upper Norwood, England. Eng. Pat. 12,045, June 21, 1894.

The improved battery consists of hard rubber, or wood coated with some waterproof substance, the top and one side of the box being movable. A plate of lead is fastened to the fixed side of the box. Next to this is placed a layer of minium or litharge made into a paste with treacle or sugar. This layer, which does not extend to the top of the box, is evenly compressed and overlaid with asbestos cloth, perforated celluloid or other insulating and porous substance unaffected by acid. A layer of vegetable or other fibre comes next, and this is overlaid with asbestos cloth or perforated celluloid. Next to this comes a layer of minium paste, then a plate of aluminium, iron, rolled brass or other material covered with lead, then a layer of paste followed by insulating and fibrous materials as before, and so on till the required number of plates have been laid. The removable side, which is faced with a sheet of lead, is then put on and hermetically sealed. The plates are so fixed and secured in position that the cells between them are liquid-tight in order to avoid short-circuiting. A mixture of water and sulphuric acid is then poured in until it reaches just above the active surfaces of the electrodes, and a strip of hard rubber or other suitable material is placed on the top of the plates. A tube for the passage of hydrogen leads from each cell to the space at the top of the box, the tubes passing through the strip. The terminals are then connected and the top of the box is put on and hermetically sealed. The hydrogen evolved collects at the top of the box and produces pressure, which it is stated diminishes polarisation. This construction allows of the employment of materials which give off noxious fumes, as all such fumes are retained within the hermetically sealed cell.—G. H. R.

*Improvements in Electrolytic Cells.* W. L. Wise, London. From E. Solvay, Brussels, Belgium. Eng. Pat. 14,988, August 4, 1894.

In this electrolytic apparatus the electrodes consist of thin strips, threads, or wires of conducting material insulated from each other, all the even numbers being connected to one terminal of a source of electric supply, whilst all the odd strips form a flat or slightly curved surface over which the electrolyte flows in a thin sheet, and this electrolysing table may be provided with a grooved cover so arranged as to separate and collect the gaseous products of electrolysis. The electrolyte may be made to circulate in a thin sheet by mechanical means, or by the action of gravity, with or without the aid of heat. In combination with the table, which supports the electrolyte, a cover may be placed above it, formed with grooves, the sides of which are made of or provided with conducting material arranged to form an inverted electrolysing surface.—G. H. R.

*Improvements in Accumulators or Secondary Batteries.* M. Engl, Vienna, Austria. Eng. Pat. 16,162, August 24, 1894.

The positive plates are composed of finely-ground litharge with the necessary quantity of powdered sulphate of magnesia and well-washed chalk mixed with dilute hydrochloric acid to form a pasty mass which is then pressed into any desired form. These plates are then stood for two or three days in pure water to harden. The negative plates are preferably made of a mixture of litharge and calomel or bisulphate of mercury mixed with liquid ammonia to form a paste which is put at once into lead frames which are placed for some days in water to harden. These plates are not formed in sulphuric acid, but in solutions of salt; in the formed state they resist all solutions of sulphuric acid.—G. H. R.

*Manufacture of Chloride of Lead.* The Chloride Electrical Storage Syndicate, Limited, and J. G. A. Rhodin, Manchester. Eng. Pat. 12,953, July 4, 1895.

Litharge is heated with a slight excess of hydrochloric acid in an autoclave to a temperature of 200° C. under a pressure of 15 atmospheres. The reaction is soon completed. On discharging the cooled contents, the lead chloride formed is separated from the weak acid in any suitable manner. The autoclave is lined with acid-resisting material.—E. S.

## (*B.*)—ELECTRO METALLURGY.

*Annealing of Wire by Electricity.* H. Wedding. Stahl und Eisen, **15**, 1895, 195; Proc. Inst. Civil Eng. 1895, **122**, 95.

The Lagrange and Hoho system of heating metals by the resistance to conductivity offered by an envelope of hydrogen produced by electrolysis of water has been applied to the annealing of hard-drawn iron wire by Messrs. H. A. and W. Dresler, of Creuzthal, in Westphalia. The apparatus consists of an electrolysing tank containing a weak solution of salt in water, with a surface covering of petroleum. A plate of lead is placed near the bottom of the tank and connected with the positive pole forms the cathode, whilst the hard wire is guided through the tank parallel to the cathode by two insulated rollers immersed at about half the depth of the fluid. As it passes downwards it receives the current from the negative pole by a roller contact similar to that of an overhead electric railway, and sets up decomposition in the water with an accumulation of hydrogen around it, so that it immediately becomes red hot through the increased resistance to the current, and is softened without becoming oxidised, as on passing the second roller it is cooled in the upper part of the bath and the protecting cover of petroleum at the top. This arrangement is suitable when the wire is passed through the apparatus at a low rate of speed; but if the motion is rapid, the wire may come out of the water sufficiently hot to fire the petroleum cover. In this case it is better to bring the wire out vertically through a tube filled with the oil, so that a much greater depth of the latter can be used than is possible when it covers the open bath. Wire that is covered with scale, as for instance, that made by rolling, is rendered bright when annealed in this way, the result being due not to the reducing action of the hydrogen envelope, but to the difference in the rate of expansion between the metal and scale when strongly heated, which causes the latter to break off and fall to the bottom of the tank. For this purpose, it is better to place the cathode along one side of the tank, in order to keep it free from the accumulation of scale on the bottom. The tension of current required is about 200 volts. By the adoption of this method, the operations of pickling and washing required when furnace annealing is employed, and the consequent fouling of the streams with waste acid liquors are avoided.

*Frankfort Electrolytic Works for separating Gold and Silver.* Zeits. f. Electrotechnik u. Electrochem. 1895, **2**, 177—178.

These works were inspected by the German Electrochemical Society during its Annual Meeting. The process differs from most other processes of metal refining in that it is not necessary to obtain the metal in coherent plates. Silver can be melted easily and without loss, even if it is separated in the form of powder or mud. The electrolysis is carried out in long pitch-pine troughs, tarred inside. Each trough is divided by partitions into seven divisions, each of which contains three anodes and four cathodes. The cathodes consist of fine silver sheets hanging freely in the bath; the anodes consist of small plates of the metal to be separated, and these are enclosed in linen bags. The electrolyte consists of a weak solution of silver nitrate, which is from time to time acidified with nitric acid. There is a mechanical arrangement for rubbing off the crystals of silver as they form upon the cathode, so as to avoid short-circuits. Under the electrodes are trays covered with linen, on which most of the silver crystals accumulate. Every 24 hours these are removed; the silver mud is washed, pressed, dried, and melted in the usual way. Once or twice a week (according to the percentage of gold in the silver plates) the anode bags are emptied and the gold mud is treated just as the gold residues are treated in the method of parting by sulphuric acid.—D. E. J.

*Electro-deposition of Zinc on Iron.* K. Richter. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 79—82 and 98—103.

The so-called "galvanising" of iron with zinc is almost invariably carried out by pickling the iron objects in weak sulphuric acid and then dipping them in a bath of zinc heated above its melting-point. The method is simple; it does well enough for small objects, but not for large ones. For in the latter case we need to melt a very large quantity of zinc; after the operation is finished, the zinc is allowed to cool and must be melted again for the next operation. When the objects to be coated are thick they cool the bath considerably; unless, indeed, a large excess of zinc be used. And in all cases there is a loss of zinc through its alloying with the material (iron) of the bath.

It is well known that zinc can be deposited electrolytically upon iron in cyanide baths; but for hygienic reasons this method cannot be carried out on the large scale. Attempts have been made to deposit zinc together with tin, aluminium, and even mercury. The results were slow and uncertain; and up to the last two years no satisfactory process of electro-deposition had been discovered. A new and more hopeful stage has been reached by the experiments carried out on a large scale in the works of Messrs. Watson and Laidlaw in Glasgow, according to the Cowper-Coles patent. This last process is very similar to one which the author used in 1893 for depositing zinc upon iron tubes and spirals, and of which an account is given in the present paper.

The bath consisted of a perfectly neutral solution of zinc sulphate of specific gravity 1·2. Wrought-iron tubes 6 metres in length were coated both internally and externally with zinc; so also were spirals which contained as much as 300 metres of tubing and which were often more than 2 metres in diameter. 10 minutes was sufficient time for depositing a layer of zinc 0·05 mm. thick (which, according to Karmarsch, is sufficient). The current-density used was 200—300 ampères per square metre. At this current-density (and up to 700) the deposit was adherent, ductile, and silvery-white in colour. It only becomes spongy and blotchy when the density is allowed to fall too low. In order to secure a satisfactory electro-deposition of zinc two things are essential. In the first place the articles to be coated must beforehand be most carefully cleaned; in the second place the current-density should be as uniform as possible over all parts of the cathode. Grease is removed by dipping the articles in a 10 per cent. solution of caustic soda heated nearly to its boiling-point; after draining they are placed in a pickling bath containing dilute sulphuric acid (7·5° B.) After the grease is removed they should not be touched by the hands; large articles should be moved by means of a crane and smaller ones handled with pincers. Diagrams of convenient mechanical pickling-machines are given; in these the chemical action of the acid is supplemented by a thorough scouring by means of quartz-sand and chopped straw. Depressions and cavities are cleaned out by means of a sand-blast. After pickling, the acid must be removed as quickly and thoroughly as possible by first washing the articles with a powerful water-spray and then soaking them in clean water. Oxidation is further prevented by adding 0·2 per cent. of ammonia to the water. The articles are now transferred to the depositing-bath. We must refer to the original for descriptions and diagrams of baths specially adapted for tubes and spirals; in the latter the spiral is kept in continuous rotation and only a part of it is immersed in the bath at any given time. In the former the bath can be kept in continuous action, tubes being removed and replaced by fresh ones without interrupting the operation. After washing with warm water and drying in warm sawdust, the articles are ready for use. The zinc coating is much superior to that obtained by the dipping process; it is also much more uniform, so that less zinc is required. Uncoated spots or patches never occur if all the operations are carefully performed; but even if such a patch be found, it is not necessary to deposit a fresh coating over the whole article. We can make use of the electro-depositing brush patented by Dr. Wagner. This is dipped into the zinc solution and then used as an anode, the faulty part being brushed over with it.

The dynamos must be shunt machines capable of giving a large current. Baths for coating 7-in. tubes will take a current of about 2,000 ampères. If the dynamo is quite near the baths, a very low E.M.F. will suffice; 5 volts are sufficient for two baths in series.—D. E. J.

## PATENTS.

*Improvements connected with the Electrical Deposition of Zinc and other Metals.* R. Heathfield and W. S. Rawson, London. Eng. Pat. 16,105, August 23, 1894.

Articles may be covered with a thin coating of mercury by making them the cathode in an acid solution of a salt of mercury, such as the sulphate; but if they are composed of iron or steel, which resist the formation of an alloy with mercury, the deposition of the mercury is facilitated by the addition of a small quantity of the corresponding salt of zinc or other metal which is most freely dissolved in the acid of the solution and also forms an alloy with mercury. When using the solutions of zinc formed by dissolving hydrated oxide of zinc in caustic alkalis, it is advantageous to wash the oxide free from the neutral salt formed during precipitation before adding the excess of alkali, and the difficulty connected with getting sufficient metal into solution is overcome by placing in the solution zinc in contact with iron.—G. H. R.

*A Method of and Apparatus for obtaining Gold from Sea-Water.* H. C. Bull, Twickenham, England. Eng. Pat. 10,303, May 28, 1895.

Sea-water is caused to pass through a tube or conduit of wood or other suitable non-conducting material. The tube contains anodes of carbon, iron, or other suitable material, connected to an electric cable passing along the length of the tube. A strip of iron extending along the bottom constitutes the cathode, and is electrically connected with a suitable conductor. The cathode is provided with a number of cups or rings of insulating material for holding mercury. At the end of the tube where the sea-water enters, cyanide of sodium or potassium, or hydrochloric, oxalic, or other acid is caused to flow, which will decompose the iodide of gold contained in the water. The gold is deposited on the mercury.—G. H. R.

*Improvements in the Electrolytical Production of Zinc from its Ores, and Apparatus therefor.* Siemens Brothers and Co., London. From Siemens and Halske, Berlin, Germany. Eng Pat. 13,434, July 12, 1895.

This improved process for obtaining zinc by electrolysis consists in first roasting the zinc ore, then lixiviating the same preferably by means of sulphuric acid, and, after separation therefrom of the greater part of the impurities by known means, subjecting the same to electrolytic action by means of zinc cathodes and anodes of carbon, lead or other bodies not readily attacked by oxygen, whilst at the same time air under pressure is forced in at the lower part of the cells so as to produce a rapid circulation of the electrolyte, by which means it is claimed that the formation of zinc sponge is prevented. The zinc solution is preferably concentrated to about 10° B., and subjected to preparatory electrolysis until it contains 5—10 grms. of free sulphuric acid per litre. The cathodes are then cleaned from any sponge which may have been formed, and subsequently the special regular process commences, in which the acid formed in the depositing vats is fixed by dissolving zinc oxide. The pressure employed is 1·3 cubic metres of air per hour for electrode plates of about 1 metre length and 0·7 metre width, and a current density of about 50 ampères to the square metre. Partitions of wood or other neutral material extend from near the surface of the liquid in the cell to near the bottom of the vat, so as to form separate compartments, and perforated pipes passing near the lower edge of the partition admit the air under pressure.

—G. H. R.

*An Improved Method or Process for the Extraction of Precious Metals from their Ores.* A. von Siemens, Berlin, Germany. Eng. Pat. 14,402, July 29, 1895.

This improvement consists in the employment of so low an E.M.F., in the extraction by electrolysis of precious metals from a lye containing inferior ones as well, that the former alone are deposited. For instance, in operating with a lye which contains 5 grains each of the chlorides of gold, copper, and iron in one pint, and using a lead cathode, a coal anode, and a current density of 12 ampères for each 2 square yards, the limits of E.M.F. would be between 1·2 and 1·4 volt. Mere traces of copper and iron will be precipitated within these limits, whilst gold will separate completely and with sufficient speed.—G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Detection and Estimation of Metals in Fatty Oils.* H. Fresenius and A. Schattenfroh. Zeits. anal. Chem. 1895, **34**, 381.

*See under* XXIII., *page* 895.

*Qualitative Detection of Unsaponifiable Oils in Fatty Oils.* Holde. Mitt. aus. d. königl. techn. Versuchsanstalt zu Berlin, 1895, **13**, [4], 170.

*See under* XXIII., *page* 890.

*Resin Content and Liability to Resinification of Mineral Lubricating Oils.* D. Holde. Mitt. aus. d. königl. techn. Versuchsanstalt zu Berlin, 1895, **13**, [4], 174.

*See under* XXIII., *page* 891.

*Estimation of Glycerin.* F. Gantter. Zeits. anal. Chem. **34**, 1895, 421.

*See under* XXIII., *page* 895.

### PATENTS.

*Improvements in the Manufacture of Soap.* G. Stecken, Ostend. Eng. Pat. 15,780, August 18, 1894.

In order to obviate the necessity for a subsequent "blueing" or tinting of articles washed with ordinary soap, the inventor manufactures a coloured material. It is prepared by adding 0·5—1·0 grm. of a dye to every kilo. of the soap while still in a semi-fluid condition; any "aniline" colour being available that will withstand the action of the free soda existing in the substance. The following are suggested as suitable for producing different colours:—Chrysaniline, Rosaniline, Benzo blue, or even Prussian blue, whilst they may be mixed together to yield any desired shade.—F. H. L.

*Improvements in Recovering Grease from Waste Suds which have been used in Washing Wool, Hair, or other Fibre.* A. J. Inston, Kidderminster. Eng. Pat. 18,207, September 25, 1894.

See also Eng. Pat. 17,309, 1893; this Journal, 1894, 1070. In the present specification, the inventor describes various other methods for the recovery of grease from waste suds, without the use of acid. The suds are first clarified by straining or settlement, then mixed with from 5 to 10 per cent. of common salt, and agitated, hot or cold, for a time. After standing, the water is run off, the grease washed again in plain water if desired, and treated with 100 lb. per ton of a mixture of caustic and carbonated alkali. The whole is well shaken together, the water again run off, and after a final washing the grease is ready for soap-making. As an alternative process, the suds are evaporated after a preliminary filtration, until on cooling the grease will separate from the rest of the liquid: such separation being assisted by continuous agitation, during both the boiling and the cooling.—F. H. L.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (C.)—INDIA-RUBBER, &c.

### PATENTS.

*Improvements relating to the Production of Albumen from Blood and Raw Materials for certain purposes, and in Apparatus and Appliances in connection therewith.* S. Frohwein, Cologne. Eng. Pat. 13,698, July 17, 1895.

Blood of slaughtered animals is directly taken up in pans and there remains until it has congealed so as to form cakes. This blood-cake, after cooling, is cut into small pieces and placed in a sieve. The liquid portions then drop into a chest placed below. After dripping has ceased, the sieve is removed, and the wet material in the chest which contains albumin and colouring matter, is let stand for some time. The albumin then forms the upper of two layers, the lower consisting chiefly of colouring matter. By means of a pipe sliding vertically upwards from the bottom, the layer of albumin is drawn off, and it is then dried upon hot plates of thin metal. The blood-cake is dried in ovens at 80° C., and made into a meal, which may be employed in the manufacture of hard rubber, &c.—W. G. M.

*Process of Manufacturing a Substance or Product as a Substitute for Vulcanite, or for other purposes to which it may be applicable.* F. G. Kleinsteuber, Arzberg, Bavaria. Eng. Pat. 14,334, July 27, 1895.

This material, known as "ambroin," consists essentially of a solution of copal absorbed in either vegetable or asbestos fibre. When dried and pressed, it can be moulded by heat to any desired shape, and is capable of receiving a high polish. Copal varies considerably in hardness and solubility; the harder sorts being soluble only in such expensive liquids as chloroform, ether, and cajeput oil. It is accordingly sorted over, the harder lumps ground and put aside for six months, or heated to a temperature at which the resin begins to soften. On treatment with 96 per cent. alcohol, the greater part will then be found soluble, while the residue yields to the action of chloroform, &c. The two solutions are mixed, and absorbed in the fibre as described.—F. H. L.

## XIV.—TANNING, LEATHER, GLUE, SIZE.

*Electrical Tanning.* Folsing. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 167—171.

Since 1850 many attempts have been made to accelerate the process of tanning by means of the electric current. One process which has met with success, according to the author, is that of Worms and Balé, further improved, he states, by Groth. In order to accelerate the process it is thought advisable to use extracts (quebracho, oak, fir, &c.), in place of oak-bark. But, it is added that the extract should be purified, cleared, and decolorised. On dissolving commercial extract in water, a separation of coloured resinous matter is frequently observed; this forms a coating on the hides, stops up the pores, and hinders proper tanning. The author states that the Worms and Balé process reduces the time required for tanning to 48—144 hours; but it can only be used for thin skins. He says that Groth's process gives a better leather, and it can also be used for thicker hides; but for heavy ox-hides it takes as much as threee months.

The author has worked out an electrical method of tanning which he considers is suitable for both thin skins and heavy hides, and only requires 3—6 days. The tanning pit contains 15,000 litres and is about 2 m. deep and broad, and 3 m. long. Electrodes of nickelled-copper are fixed to the longer walls of the pit, in which the hides are hung so that the current has to pass right through them. A current of 12 ampères with an E.M.F. of 12 volts is used. The colour of the leather is not quite satisfactory when commercial unpurified extract is used. The author lays stress on this and he himself uses an oak extract (with a little hemlock extract added) which is cleared and decolorised by a special electrolytic process. When this is used he finds that the colour is exceedingly good and bright. Light cow-hides were found to require 72 hours, heavy cow-hides 5 days, and heavy ox-hides 6 days. The latter would require about a year by the old process.—D. E. J.

## XV.—MANURES, Etc.

*Manufacture of Potassium Phosphate for a Manure.* Jay and Dupasquier. Bull. Soc. Chim. 1895, **13**, 441—443.

Potassium hydrogen sulphate obtained by the decomposition of potassium chloride with sulphuric acid is mixed with natural calcium phosphate in proportions sufficient to convert the phosphoric acid into monopotassium phosphate whilst sufficient sulphuric acid is added to supplement that contained in the potassium hydrogen sulphate, so as to satisfy the calcium contained in the phosphate. The mixture is boiled with water for some hours and agitated, until the reaction is complete; the mud is then filtered and the solution containing the potassium phosphate, if sufficiently concentrated, is set to crystallise, if otherwise it is used as wash water for a succeeding charge. The operation may also be performed by mixing the potassium hydrogen sulphate, the phosphate and the sulphuric acid in a mixer, as in the preparation of superphosphate, leaving the mass for two or three days, extracting with water and crystallising. The change may be represented in the following manner:—

$$Ca_3(PO_4)_2 + 2KHSO_4 + H_2SO_4 = 2KH_2PO_4 + 3CaSO_4.$$

—D. A. L.

*Manure of Vines and the Quantity of the Wine.* A. Muntz. Comptes Rend. 1895, **120**, 1010—1012.

Notwithstanding the prevailing idea that the manuring of vines has an injurious effect on the wine ultimately produced, manures are, nevertheless, almost everywhere applied, and frequently in large quantities. The amounts of manure applied in the vineyards of the South of France, of Medoc, Bourgogne, and Champagne vary considerably. In Bourgogne, with rich soils, the smallest amounts are used; in the south rather more manure is used (principally artificial manures), whilst in Medoc and Champagne, where the finest wines are produced, the manuring is very much heavier, exceeding the greatest amounts applied in other branches of agriculture.

Heavy manuring does not, therefore, injure the wines, the effect, it is stated, is rather to strengthen the vines and so render them less dependent on circumstances of weather than to force them to increased fruit production. There is no doubt, however, that if the plants are cut, so as to increase the yield of fruit, then the wine would suffer.

The best results are nearly always obtained by the use of natural manures.—N. H. J. M.

*Estimation of Alumina in Phosphates.* H. Lasne. Comptes rend. 1895, **121**, 63.

*See under* XXIII., *page* 890.

### PATENT.

*Improved Process for the Disintegration of Thomas Slag.* E. Meyer, Berlin. Eng. Pat. 24,092, December 11, 1894.

To facilitate the disintegration of Thomas slag from 2·5 to 7·5 per cent of an alkaline carbonate, or (preferably) from 5 to 15 per cent. of anhydrous water glass, is mixed with the fluid slag while it is being run from the converter. All the phosphoric acid in the cinder will then be present in the citrate-soluble form. The action of the alkali may be assisted by the further addition of a reducing powder of metallic sulphide, such as iron pyrites or sodium sulphide, to the extent of from 15 to 18, or of coke powder to the extent of from 8 to 20 parts per 100 of iron present in the slag as ferric oxide.—W. G. M.

## XVI.—SUGAR, STARCH, GUM, Etc.

*Biological Conditions of the Fungus producing Core and Dry Rot in the Beetroot.* B. Frank. Botan. Ges. Ber. 1895, **13**, 192.

The author has continued his researches on *Phoma Betæ* during the year 1894. In a previous communication (this Journal, 1894, 823) he stated that this fungus may produce the following diseases:—root mortification, core and dry rot, and black spots on the peduncles and pedicels. *Phoma Betæ* was observed without exception in core and dry rot, whilst root mortification may be caused by other fungi. It is further noticeable that the appearance of diseases caused by *Phoma Betæ* is, in contrast to similar diseases, favoured by dryness of the soil and air, and not by humidity. According to the author the reason of this is that the fungus, which is usually both saphrophytic and parasitic, appears on the dead leaf stalks as a saphrophyte only in seasons of heavy rainfall, and on sufficiently humid soil. On the other hand, whenever the fully-grown leaves wither in consequence of a prolonged drought, they are attacked by *Phoma Betæ*, myriads of new spores are developed, and infection of the core of the beet, as well as of the root, is readily brought about. When the mycelium of *Phoma Betæ* is once developed as a parasite in the living tissue of the beet, poisonous ferments appear to result, which spread rapidly by osmosis, and cause the death of the tissue. Since the spores of *Phoma Betæ* remain dormant in the soil for long periods, and develop when brought into contact with beet or beet juice, it is easy to understand why the fungus appears in beetroots when the latter are grown in soils previously infected. Methods for combating this disease have already been described (this Journal, 1894, 823; and 1895, 667).—J. L. B.

*Composition of the Gas from the Beetroot Diffusers.* Neitzel. Neue Zeits. Rübenz. 1895, **35**, 22.

These gases when taken from the second to the eighth diffuser contained respectively from 11·4—51·5 per cent. of carbon dioxide, 0—57·8 per cent. of hydrogen, and 10·8—68·0 per cent. of nitrogen. Free oxygen was found only in isolated cases, or in the absence of hydrogen. The evolution of gas is ascribed to ferments of the soil, which are introduced into the diffusers with the feed water. These ferments give rise almost exclusively to carbon dioxide, but to no hydrogen. By maintaining the temperature between 75°—80°, and by boiling the raw juice before adding lime, the development of gas may be avoided. The evolution is most pronounced at 50°, and is favoured by the addition of lime to the diffusers.—J. L. B.

*Purification of Sugar Solutions by Electrolysis.* W. Bersch. Sucrerie Indigène, **44**, II., 33—36.

The author has recently carried out experiments at Haym on the electrolytic processes of Schollmeyer, Behner, and Dammeyer, for the purification of sugar solutions. The juice from the diffusers at a temperature of 40°—45° is heated to 65°, and transferred to the electrolyser. This is an iron tank divided into two compartments, each of which has a capacity of 1,500 litres, with a height of 0·5 metre, and contains seven sheet zinc electrodes, making a surface of 6 sq. m. The two compartments are alternately filled with juice which is treated for about 10 minutes with a current of 50—60 ampères. A gelatinous, greenish-grey deposit is formed on the negative pole, and the author considers that the combination of zinc with the alkalis facilitates crystallisation of the sugar. As this deposit thickens the resistance offered to the current is increased; it is therefore necessary every week to reverse the current for about five minutes; the gases generated will detach the deposit.

The process of electrolysis produces a gelatinous precipitate which renders filtration difficult; to obviate this, a small quantity of lime is added to the solution. With the old process of evaporation trouble was often experienced owing to the formation of froth, especially from beet of an inferior quality; this, however, is not the case when the juice has been submitted to electrical treatment.

The mascuites which have been obtained electrolytically yield on an average 69·5 per cent. of sugar, polarising 98°, and containing 0·48 per cent. of ash.

According to the author the initial cost is low, the consumption of zinc negligible, and the profits made in one week paid for the cost of installation. As the current required is from 50—60 ampères with 6 volts, it is advisable to have 1 horse-power dynamo.—J. L. B.

*Beet Juices, boiling with difficulty.* Polster. D. Zuckerind. 1895, **20**, 1070.

The author considers that this difficulty in boiling may be due to the large amount of organic matter and proteïns present in the juices.—J. L. B.

*Investigations on the Behaviour of Sugars towards Alkaline Copper Solutions.* J. Kjeldahl. Carlsberg Laboratoriets Meddelelser, 1895, **4**.

*See under* XXIII., *page* 896.

*Papasoglis' Method of Detecting Cane Sugar.* Dupont. Bull. Ass. Chim. 1895, **13**, 68.

*See under* XXIII., *page* 890.

*Influence of the Presence of Lead Acetate in the Estimation of Invert Sugar.* Borntrüger. D. Zuckerind. 1895, **20**, 1169.

*See under* XXIII., *page* 896.

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## XVII.—BREWING, WINES, SPIRITS, Etc.

*New Glucoside resembling Amygdalin.* E. Fischer. Ber. 1895, **28**, 1508—1511.

By the action of yeast enzymes at about 35° C., *half* the amount of the sugar in amygdalin is removed in the form of glucose and *amygdonitrileglucoside*—

$$C_6H_5.CHCy.O.C_6H_{11}O_5$$

is formed according to the equation—

$$C_6H_5.CHCy.O.C_{12}H_{21}O_{10} + H_2O = C_6H_5.CHCy.O.C_6H_{11}O_5 + C_6H_{12}O_6$$

This substance differs from amygdalin in its physical characteristics, but closely resembles it in chemical properties, especially as regards the action of emulsin, which readily breaks them both up into benzaldehyde, hydrocyanic acid, and glucose. Amygdonitrileglucoside crystallises from acetic ether or chloroform in long, thin, colourless needles which begin to soften at 140° C., but do not fully melt till 147°—149°. In aqueous solution it rotates the plane of polarised light to the left, giving $[\alpha]_D = -26·8$. It has a bitter taste (more so than amygdalin). It is easily soluble in cold alcohol, acetone, and water (difference from amygdalin), and in acetic ether, sparingly so in chloroform. It does not reduce Fehling's solution, even on warming, but when boiled with alkalis is readily decomposed, with evolution of ammonia. The author expects to find this substance already formed in the vegetable world.

From this action of enzymes on amygdalin the author concludes that the disaccharose in amygdalin is maltose.
—L. T. T.

*Studies on Starch Transformation.* H. Ost. Chem. Zeit. 1895, **19**, 1501—1507.

The author has carried out several starch transformations, following Lintner and Düll's directions, and also their method of isolating and purifying "isomaltose." The substance so obtained is not homogeneous, but can be separated into various products on treatment with ethyl alcohol of different strengths. The further examination of Lintner's method of preparing "isomaltose" was left to Ulrich. (See following abstract.)

It has been stated by Lintner and Düll that "isomaltose" is practically insoluble in 95 per cent. alcohol. By repeatedly extracting those products of a starch-conversion which are soluble in 80 per cent. ethyl alcohol, with 95 per cent. ethyl alcohol, crystalline maltose is obtained: whilst the small quantity of syrup representing the residue has a specific rotatory power below $[\alpha]_D = +145°$, and forms a compound with phenyl hydrazine similar in appearance to Lintner's isomaltosazone, which in reality is impure maltosazone.

The author's experiments with maltosazone show that it is a compound which readily undergoes change. When heated from 100°—105° the rotatory power by the aid of the Auer light, sinks from about $[\alpha] = +60°$ to $[\alpha] = +20°$ to $+40°$, and its melting-point 202°—208° becomes 150°. If the time of heating during the formation of the osazone be 3 hours, or if too small a quantity of water or phenyl hydrazine be employed, a similarly modified osazone results. A mixture of maltose and a dextrin (which latter is incapable of yielding a crystalline osazone), when heated with phenylhydrazine acetate, gives an osazone of a brown colour, melting at 152°—158°. "Isomaltosazone" was prepared in accordance with Lintner and Düll's instructions. It was found to melt at 150°—170°, and to have the composition of maltosazone. From these facts the author concludes that Lintner's isomaltose is impure maltose. (Compare Ling and Baker, J. Chem. Soc. Trans. 1895, 702; Brown and Morris, *ibid.* 709.)

The author agrees with Lintner and Düll's view that starch has the composition $(C_{12}H_{20}O_{10})_n$; but he is inclined to think that the formula $(C_{10}H_{20}O_{10})_m$ is incorrect for the first products of hydrolysis of starch, inasmuch as they contain chemically-combined water. Brown and Morris's non-reducing dextrin does not exist, it is considered, neither is the supposed relation between rotatory and cupric reducing power correct. The so-called maltodextrin or "achroodextrin II." has a higher specific rotatory power than observed by the English chemists; and the method employed by them for determining reducing-power yields erroneous results. It is uncertain whether the erythro- and achrodextrins described by Lintner and Düll are homogeneous substances. The author believes Musculus and Meyer's statement that the erythrodextrins are mixtures of achroodextrin and starch. Musculus and Meyer have prepared an erythrodextrin by mixing a dextrin giving a yellow iodine reaction with 0·5 per cent. of soluble starch.

Zulkowski obtained a dextrinous substance by heating starch with glycerol. This body has been prepared and purified by the author, and he finds the glucose value to be about 90 per cent. He is of opinion that this substance is not a true dextrin.

The author has investigated Fischer's isomaltosazone, and considers it to be maltosazone; accordingly he concludes that maltose, not isomaltose, is formed by the action of cold hydrochloric acid on glucose. The dextrin-like substance so obtained has, when purified, a rotatory power of $[\alpha]_D = +123·8°$, a reducing-power of 11·3 per cent., and a glucose value of 93·5 per cent. It differs from ordinary dextrin in its complete resistance to diastatic action. When starch (5 grms.) is triturated with hydrochloric acid of sp. gr. 1·17 (20 c.c.) until it is dissolved, and is allowed to stand eight days, the initial rotatory power, + 196·5°, sinks

to + 75°. Glucose subjected to a similar treatment shows an increase in rotatory power from + 52° to + 75°, an indication that similar products are produced in both cases.
—J. L. B.

*Isomaltose.* C. Ulrich. Chem. Zeit. 1895, **19**, 1523—1524.

The author has followed the methods of Lintner and Düll (this Journal, 1892, 766), and has arrived at the same conclusions as Ost (compare preceding abstract), namely, that the sugar found when starch is incompletely hydrolysed by malt at 70°, is maltose and not isomaltose; and that the melting-point of maltosazone varies with its method of preparation.—J. L. B.

*Specific Rotatory Power of Maltose.* H. Ost. Chem. Zeit. 1895, **19**, 1727—1728.

The specific rotatory power of maltose was determined by Meissl in 1882, apparently with great care (J. Prakt. Chem. **25**, 114). His results coincided with the formula $[\alpha]_D = + 140 \cdot 375 - 0 \cdot 01837\ p - 0 \cdot 095\ t$; thus, for a temperature of 20° and a concentration of 2 — 20, the value would be $[\alpha]_D = 138 \cdot 4$ to $138 \cdot 1$. The author's experiments indicate that the specific rotatory power of maltose for all concentrations between 2 and 21 is constant, the mean value being $[\alpha]_D = + 136 \cdot 95$ at 20°. The cause of difference between the latter value and that of Meissl is inexplicable; the numbers furnished by Brown and Heron, Effront, Herzfeld, and others are said to be inaccurate; but those given by Parcus and Tollens (Annalen, 1890, **257**, 160), when $p = 10$, and $t = 20°$, agree very well with the author's determinations.—J. L. B.

*Action of Air on Must.* Aimé Girard. Comptes Rend. 1895, **120**, 1426—1428.

The author draws the following conclusions from his researches:—1. The constituent of must which most readily undergoes oxidation is the soluble red colouring matter. 2. In some grapes there are two colouring matters, one easily oxidisable, the other very much less so. 3. The bouquet of wine is not only due to the bouquets already in the grape, and those formed during the fermentation, but also, in some wines, to those produced by the oxidation of certain constituents of the must. 4. The colour of white wines and their Madeira flavour, are due to an oxidation of the must, and are not produced during fermentation. 5. It is possible to produce white wine from black grapes by cooling the extract (to prevent fermentation), aërating the cold extract to precipitate the colouring matter, and then filtering this off to prevent its being taken up again during fermentation.—L. T. T.

*Composition of Samos Wines employed in making Vermuth.* P. Cazeneuve and Hugounenq. Bull. Soc. Chim. 1895, **13**, 601—602.

The following are numbers obtained from the analysis of authenticated samples of Samos wines, the last column being the results of an old analysis made in the municipal laboratory of Paris:—

| — | From Limenos Badios. | | From Pagondon. | From Neon Carlobasion. | Old Analysis. |
|---|---|---|---|---|---|
| | Sample I. | Sample II. | | | |
| Alcohol | 12·5° | 13·5° | 13° | 15·2° | 15° |
| | Grms. | Grms. | Grms. | Grms. | Grms. |
| Extract | 285·5 | 148·4 | 242·9 | 245·8 | 111·6 |
| Dextrose before inversion | 209·55 | 123·4 | 211·85 | 217·87 | 76·8 |
| Dextrose after inversion | 209·55 | 136·61 | 211·85 | 217·87 | .. |
| Total acidity as $H_2SO_4$ | 2·12 | 4·99 | 2·74 | 2·94 | 7·3 |
| Cream of tartar | 4·1 | 3·8 | 3·8 | 3·5 | .. |
| Ash | 2·36 | 3·2 | 2·72 | 2·62 | 3·3 |

The second Limenos Badios sample was a fermented wine without any added alcohol, and hence was poorer in sugar than the other three, which consisted of unfermented grape-musts mixed with Hungarian or German alcohol; the old sample was apparently a fermented wine.—D. A. L.

*Presence of a Diastase in "Cassé" Wines.* G. Gouirand. Comptes Rend. **120**, 887—888.

The cause of this disease of wine, the symptoms of which are turbidity on exposure to the air, followed by coagulation of the colouring matter, with decoloration and the acquirement of a yellowish tint, is still a moot point, bacteria and the chemical action of the air having been both credited with responsibility for the change. Heat prevents the malady, but filtration through Chamberland filters is without effect. The author concludes that the immediate cause is of the nature of a diastase, from the fact that the flocculent precipitate obtained by the addition of alcohol to a *cassé* wine will produce the malady in a sound and sterilised wine in a few hours. Heating up to 80° C., after the addition of the precipitate, still prevents the disease showing itself.

The turning yellow of white wines is evidently a malady of very similar nature to "*la casse*," the alcoholic precipitate from *cassé* red wines causing sound and sterilised white wines to turn yellow in a very short time. The diastase does not exist in the precipitate obtained from healthy wines. Whether it is the product of the bacteria always found in the sediment of cassé wines, or of the yeasts working under unfavourable conditions, or whether it pre-exists in the grapes ripened under certain circumstances, has yet to be determined.—J. G. W.

*Austro-Hungarian "Sweet Wines."* L. Roesler. Zeits. anal. Chem. 1895, **34**, 354—361.

The analytical results given by the author are based upon a large number of analyses which have been carried out during the last few years at the experimental station at Klosterneuburg; they refer to that class of "sweet wines" obtained by extracting dried grapes with a good natural wine and fermenting the product. These wines differ essentially from those obtained from must which has been concentrated, or by the addition of spirit or sugar to must or wine. The results obtained are compared with those yielded by true Tokay wines:—

| — | — | Percentage of Samples examined. | |
|---|---|---|---|
| | | Austro-Hungarian "Sweet Wines." | Tokay. |
| | *Per Cent. Vol.* | | |
| Alcohol | Under 10 | 3·4 | 12·5 |
| | 10—15 | 83·0 | 50·0 |
| | 15—20 | 13·6 | 37·5 |
| | *Grms. per Litre.* | | |
| Extract minus invert sugar. | Under 25 | 18·09 | 4·1 |
| | 26—45 | 66·24 | 71·0 |
| | 46—55 | 10·10 | .. |
| | Above 55 | 4·23 | 25·0 essences. |
| Glycerin | Under 5 | 26·00 | .. |
| | 5—10 | 63·27 | .. |
| | Above 10 | 10·65 | 100 |
| Phosphoric acid | 0·55—0·80 | 87·34 | 47·83 |
| | Above 0·80 | 12·66 | 52·17 |
| Free acid | Under 5 | 24·95 | .. |
| | 5—7 | 60·76 | 75·2 |
| | Above 7 | 13·79 | 24·8 |
| Ash | Under 1·5 | 2·62 | .. |
| | 1·5—1·99 | 14·70 | 8·3 |
| | 2·0—2·99 | 29·47 | 70·6 |
| | 3·0—3·99 | 26·09 | 20·7 |
| | Above 4·0 | 24·11 | .. |

—A. K. M.

*Manure of Vines and the Quality of the Wine.* A. Muntz. Comptes Rend. 1895, **120**, 1010.

*See under* XV., *page* 876.

*Carbon Tetrachloride for Separating Ethyl Alcohol from Methylated Spirit.* M. Cari-Mantrand. Comptes Rend. 1895, **120**, 1063.

*See under* XX., *page* 885.

## PATENTS.

*Improvements in Apparatus for Heating and Cooling Liquids.* A. Lawrence, Brentford, Middlesex, and Bennett, Sons, and Shears, Limited, London. Eng. Pat. 14,554, July 28, 1894.

*See under* I., *page* 854.

*Improvements in Malt-Mashing and Extracting Machines.* T. Cleminson, Liverpool. Eng. Pat. 18,254, September 26, 1894.

The patentee proposes to pass the malt, &c. in a stream through a vessel with perforated walls, water being sprayed against the malt as it is falling through these perforations. The malt and water then pass together into a horizontal vessel fitted with stirrers. He claims that more efficient extraction of the soluble matters is thus effected.—L. T. T.

*Improvements in the Treatment of Starch or Starchy Matter, or Crystallisable Sugar, for the Obtainment therefrom of Products more especially suitable for Use in Brewing.* H. C. E. Wilmot, London. Eng. Pat. 18,358, September 27, 1894.

The patentee proposes to replace the acid used in the inversion of starch and for the manufacture of saccharine matter by means of carbonic acid. He claims that by passing carbon dioxide, or that and steam under pressure, into or through a heated mixture of starch or starchy matter and water, or crystallisable sugar and water, heated to or above boiling point, thorough conversion can be effected. When conversion is complete and pressure is removed the carbonic anhydride escapes, and the need for neutralisation, &c. is thus removed.—L. T. T.

*Improvements in Apparatus for Cooling Worts.* F. N. Mackay, Shoe Lane, Middlesex. Eng. Pat. 20,087, October 20, 1894.

The cooling apparatus consists of a jacketed cylinder or cone of thin copper, through which the cooling liquid is passed from below. The cylinder is surrounded by a series of rings of pipes, each ring being connected at one side with the ring beneath it, and at the opposite side of the apparatus with the ring above it. This arrangement ensures the complete mixing of the cooling liquid in the pipes. Both cooling liquids (from the pipes and from the cylinder) have a common outlet at the top of the apparatus.

The wort passes into a vessel at the top of the cylinder and overflows over the cylinder and pipes into a pan in which the whole apparatus is fixed.

If the cooling is to be done in purified air, an outer case is placed over the whole, pure air being passed through.
—N. H. J. M.

*Production of Vinegar by Means of Ozone.* E. Andreoli, Brixton, London. Eng. Pat. 21,529, November 8, 1894.

The wort, or alcoholic liquor, is acetified with electrostatic ozone, produced as already indicated (Eng. Pat. 17,426 of 1891, 9631 and 21,794 of 1892; this Journal, 1893, 452), instead of oxygen; any apparatus for the oxidation of wort by air can be utilised.—N. H. J. M.

*Improvements in and connected with the Treatment of Brewers' Grains and Similar Materials.* L. Egyedi, J. Weiss, J. Popelka, and A. Mlady, all of Neupest Hungary. Eng. Pat. 4741, March 6, 1895.

The patentees propose to use a vacuum filter, for more completely removing than is done at present, the wort or liquid from brewers' grains, cattle foodstuffs, &c. They propose to employ shallow, flat filters (the filtering surface being composed of wire gauze, cloth, or other suitable material) connected with vacuum chambers.—L. T. T.

*Improvements in Processes and Apparatus for Ageing Fluids containing Alcohol.* A. J. Boult, London. From G. R. Besser, Berlin. Eng. Pat. 7813, April 18, 1895.

"A process for ageing alcohol containing liquids by the impregnation with oxygen of the liquid to be aged, and by setting up molecular oscillations or changes in its constitution." The oxygen is admitted to the liquid at a pressure of $\frac{1}{4}$ to $\frac{1}{2}$ atmosphere above the ordinary pressure, and alternating electric currents are then passed through the liquid. It is claimed that in this way the oxygen is made more active and "molecular oscillations" produced which greatly facilitate the ageing. The temperature of the liquid should not exceed 20° C. or go below −20° C.
—L. T. T.

*An Improved Process for the Treatment of Materials containing Cellulose for the Production of Spirit.* E. Simonsen, Christiana. Eng. Pat. 10,762, May 30, 1895.

This process consists in "boiling one part by weight of the above-mentioned materials with 3—7 parts by weight of acid of 0·4—0·8 per cent. strength under a pressure of 7—10 atmospheres for about half an hour," and then neutralising and fermenting the resultant saccharine wort.

The patentee states that the use of the suitable temperatures, pressures, and proportions of materials are essential to success, and that previous failures have been due to these being unknown. By boiling 1 kilo. of common sawdust with 5 kilos. of sulphuric acid of 0·5 per cent. strength, under a pressure of 9 atmospheres for $\frac{1}{4}$ hour, and neutralising and fermenting the separated liquid, he obtained 65 c.c. of absolute alcohol.—L. T. T.

*Manufacture and Production of Caramelised Materials especially intended for Use in the Manufacture or Treatment of Beers, Spirits, Vinegar, Aërated Water, and other Liquids or Beverages.* T. D. Lichtenstein, London. Eng. Pat. 11,154, June 6, 1895.

This process consists in "boiling sugar, glucose, molasses, or other saccharine matter or dextrin, and forcing thereinto steam or air (or oxygen), or both steam and air (or oxygen)." The heating is carried near the carbonising point, but not so far as to produce charcoal. A pressure of 60 to 120 lb. may be used with advantage.—L. T. T.

*Improvements in the Manufacture or Treatment of Beers, Spirits, Vinegar, Aërated Waters, and other Liquids or Beverages.* T. D. Lichtenstein, London. Eng. Pat. 11,155, June 6, 1895.

These improvements consist in the use of the inventor's caramelised material described in Eng. Pat. 11,154, 1895. (See preceding abstract.)—L. T. T.

*Improved Manufacture of a Colouring and Flavouring Extract for Liquids.* J. F. Theurer, Milwaukee, Wisconsin. Eng. Pat. 11,830, June 18, 1895.

This process consists in evaporating a malt wort to a thick syrup in a vacuum pan, and then subjecting this thick syrup to heat under a high pressure until there is imparted to it a rich brown colour and an aromatic or slightly acid flavour. It is generally found best to employ a temperature of 240°—250° F. and a pressure of 25—30 lb. above that of the atmosphere, and to continue the treatment for about two hours. The product is free from the bitter or burnt taste which the ordinary caramel prepared at a high temperature possesses.—L. T. T.

# XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

## (A.)—CHEMISTRY OF FOODS.

*Action of Heat upon Milk.* P. Cazeneuve and E. Haddon. Bull. Soc. Chim. 1895, **13**, 737.

The conclusions drawn by the authors from their experiments are:—

1. The yellow colour of milk when heated is due to the oxidation of the lactose in presence of alkaline salts of milk.

2. The lactose during oxidation gives off acids, and amongst them formic acid, the presence of which is sufficient to account for the coagulation of the milk without any acid being added.

3. The coagulated caseïn becomes yellow owing to the bodies formed by the presence of lactose, but the caseïn itself does not change.—H. M.

*New Process for Keeping Fruit Fresh.* United States Consular Rep., Sept. 1895, 24.

The great difficulty experienced in preserving fruits in their natural state is such that the dealers who make the attempt to furnish them out of season are compelled, on account of the heavy losses they sustain, to sell their goods at prices which render it impossible for the great majority of families to place fresh fruits on their tables during the winter months. The result of the experiments made in the latter part of the year 1894, with the view of overcoming this difficulty, and lately reported to the Horticultural Society of Soissons by Mr. A. Petit, chief of the laboratory of horticultural research at the National Horticultural School of Versailles, deserves the attention and consideration of fruit growers.

Mr. Petit observed the powerful action of alcoholic vapours on the mould generally appearing on the surface of fruit in a damp atmosphere, and noticed that pears and apples kept for several months in an atmosphere saturated with vapours of water and alcohol, even though at first in a state of decay, showed no signs of mould, whilst fruits in every particular identically similar to the former, stored under the same conditions, but not exposed to the action of alcoholic vapours, became entirely covered with it.

Mr. Petit applied this principle to the preservation of fruit in general, and in particular to grapes, as very subject to mould.

On the 31st October 1894—that is, very late in the season and at a very unfavourable time—Mr. Petit placed, with other fruits and a bottle filled with 100 c.c. of alcohol at 96°, some bunches of grapes known as "Chasselas de Fontainebleau," fresh from the vine, in a brick receptacle, cemented inside and closed by a common wooden door. In two similar receptacles, one of which was kept open and the other closed, but without alcohol, were stored similar fruits from the same trees and vines. The fruits were laid on wood shavings. The receptacles were built in a very damp cellar, the temperature of which varied regularly from 10° to 8° C. during the whole time the experiment lasted.

On 20th November the grapes placed in the open receptacle, and especially so those in the closed receptacle without alcohol, were mostly rotten and covered with mould, and were immediately removed. In the receptacle containing the bottle of alcohol, on one bunch two grapes had turned brown, but were firm, full, and free from mould, and did not taste at all sour. The hygrometer in the receptacle registered 98°. On 7th December they still kept their fine aspect; on most of the bunches, however, one or two grapes had turned brown. On 24th December the same results; on most of the bunches could be seen one or two grapes commencing to decay. At the end of nearly two months, each bunch had lost but from two to four grapes each, and all were in a perfect state of preservation, the stalks being perfectly green, and the grapes having all the qualities of fresh-cut grapes.

At the conclusion of the experiment, 28 c.c. of alcohol at 60 remained in the bottle out of the 100 c.c. at 96°, but, as Mr. Petit remarks, the door of his receptacle had not been built with great care and did not close hermetically, hence a useless consumption of alcohol.

*Analysis of the Nitrogenous Constituents present in Meat Extracts and Commercial Peptones.* A. Stutzer. Zeits. anal. Chem. 1895, **34**, 372.

*See under* XXIII., *page* 897.

### PATENTS.

*Improvements in Process of and Apparatus for Condensing and Preserving Milk.* B. F. McIntyre, East Orange, Essex, and New Jersey, U.S.A. Eng. Pat. 14,675, July 31, 1894.

The object of the process is to prepare condensed milk in a semi-solid or powdered form, employing a low temperature so as to avoid changing the albuminoids, and discoloration, and melting of the fat globules; also to sterilise and preserve the product in a non-oxidising gas.

Large quantities of milk are first separated in a centrifugal separator, and the milk concentrated by freezing out the water, the whole being agitated and stirred so that the ice forms in loose crystals, after which the concentrated milk is separated by centrifugal force; steam may be momentarily projected against the ice until free from adhering milk. The process is repeated until the product contains from 80 to 95 per cent. of solids. It is then sterilised by passing over the surface of a freezing cylinder cooled to − 10° to − 20° F., glycerin being employed to transmit the cold. The frozen milk is further concentrated in vacuum pans heated to 100° F.; the vacuum is then broken by admitting carbonic acid instead of air, to prevent oxidation. The warm semi-solid product is run into moulds.

The composition of the milk can be altered by addition of a sterilised sugar solution to the milk when in the vacuum pans. After concentration to a semi-solid state, cream (sterilised by cold) is added, so as to give a product containing 10 to 25 per cent. of milk fat.

The blocks of concentrated milk are cut into chips, placed on trays, and dried in carbonic acid heated at 100° F.; the material is then cooled to 32° F. and ground in mills worked at 32° F. The powder is preserved in hermetically sealed jars containing carbonic acid.

Partially concentrated milk may be drawn off from the vacuum pans and filled into jars in presence of carbonic acid; it then resembles ordinary condensed milk.

—N. H. J. M.

*Improvements in and Apparatus for Sterilising Milk.* F. Guilleaume and E. Goldstein, Bonn, Prussia. Eng. Pat. 20,428, October 25, 1894.

The peculiar taste of sterilised milk is due to the gas contained in it. To avoid the presence of gas the vessels in which milk is sterilised are completely filled with milk, being closed with any well-known elastic-closing device. The formation of an empty space in the vessel, which would give rise to separation of butter when jolted, is overcome by employing vessels with flexible sides which yield inwardly as the milk contracts, thus closely confining it. It is desirable, after sterilising, to transform the resilient closing device into a rigid one.—N. H. J. M.

*An Improved Method for Hermetically Closing Preserve Jars and the like.* W. P. Thompson, Liverpool. From The Conserven-Fabrik, Mombach-Mainz, Germany. Eng. Pat. 21,050, November 2, 1894.

*See under* I., *page* 854.

*Improvements in and connected with the Sterilisation and Preservation of Milk, Cream, and other Fluids.* T. R. Mason, Leamington, Warwick, and G. V. Alsing, Glasgow, Lanarkshire. Eng. Pat. 7695, April 17, 1895.

The liquid to be sterilised is heated to about 168° F., and at the same time subjected to the action of an electric current. The apparatus consists of a copper vessel, to contain the liquid, fixed in a larger vessel of zinc, the intermediate space being filled with water containing salt, alone or with other chemicals. Platinum wires are fixed to the two vessels and reach to the bottom of the inner vessel. For sterilising, the whole apparatus is heated for 20 or 30 minutes. Through the action of electricity, a portion of the oxygen of the milk is eliminated, and the milk is thus rendered less liable to turn sour or curdle.

When necessary, a filter consisting of porous plates with an intermediate layer of cotton, is employed.—N. H. J. M.

*Improvements in the Utilisation of Skim Milk and the like.* H. Christensen and R. Hamann, Copenhagen, Denmark. Eng. Pat. 13,886, July 20, 1895.

Skim milk and whey are converted into a firm mass by evaporation in a vacuum or in open vessels, at the same time being agitated. The solid product may be formed into lumps similar to coffee beans, which can be dried, or roasted and ground. A beverage can be made from the powder in the same way that coffee is made.—N. H. J. M.

## (*B.*)—SANITARY CHEMISTRY.

*Chemical Purification of Drinking Water.* F. Bordas and C. Girard. Comptes rend. 1895, **120**, 689—691.

The employment of potassium permanganate for purifying water intended for drinking is attended with difficulties, as, for instance, in the case of the presence of potassium carbonate in the waters so treated.

Calcium permanganate is a more powerful oxidising agent than the potassium salt, and has the further advantage of not contaminating the water with mineral matter. The carbonic acid produced during the oxidation, liberates permanganic acid from the salt, and so quickens the destruction of the rest of the organic matter.

In practice it is necessary to employ an excess of permanganate, which is removed by the action of lower oxides of manganese, by which it is transformed into manganese dioxide. The following reactions take place :—(1) Decomposition of calcium permanganate in presence of organic matter, with formation of calcium carbonate and manganese oxides; (2) Oxidation in the mixture of lower manganese oxides and carbon (added to agglomerate them) at the expense of the excess of permanganate; and (3) Slow reduction of the manganese peroxide thus formed by organic matter, or by the carbon.

Waters which were coloured after the above treatment, became colourless when exposed to air for 24 hours, depositing a brown gelatinous substance—a manganous manganic oxide, which appears to be soluble when first formed; the water is then free from organic matter, and contains only very little calcium carbonate and traces of hydrogen peroxide.—N. H. J. M.

*Purification and Sterilisation of Potable Waters.* Georges Michel. Bulletin de la Soc. Scient. Ind. de Marseille, 1894, 265; Proc. Inst. Civil Eng. 1895, **122**, 35—36.

It is pointed out that all the available service waters of Marseilles, when considered from the point of view of their contents in bacteria, are bad, yielding as they do on analysis from 500 to 15,000 germs per cubic centimetre. The only exceptions are the artesian well waters of St. Ferréol and a spring in the Place du Grand-Puits, which both contain less than 200 bacteria per cubic centimetre. If by any accidental contamination emanating from the large population alongside the Marseilles canal or the Merlan-Longchamp supplies, typhoid fever, or cholera germs passed into these waters, it is quite probable that these diseases might be introduced into all parts of the city. Analyses are given of the water in question, as also of some of the existing supplies, and the author points out that it is urgently necessary to purify the water now in use. The various methods of effecting this and of destroying the germs are discussed. The processes are dealt with under four heads:—(1) Sterilisation by heat; (2) Sterilisation by the employment of soluble antiseptics; (3) The precipitation of the matters in suspension and incidentally of the living germs in various ways, this process being generally followed by imperfect filtration through coarse filters; and (4) Simple filtration. Each of these systems is described at some length. Dr. De Christmas has advocated the employment of citric acid, if a soluble antiseptic is to be made use of. This acid paralyses cholera germs if used in the strength of 4 parts per 10,000, and if a solution of double this strength is employed it is absolutely fatal to germs. Under the third head of a mixed precipitation and filtration process, it is pointed out that the results thus obtained are incomplete and are not reliable.

*Destructor-Furnace Experiments at Berlin.* Gesundheits-Ingenieur, July 15, 1895, 212; Proc. Inst. Civil Eng. 1895, **122**, 39—40.

The municipal authorities of Berlin having voted a sum of 5,000*l.* for experiments with the combustion of the town dust and ashes, on the systems of Messrs. Horsfall of Leeds and Warner of Nottingham, the tests have been carried out. There were two chambers or cells on the Horsfall system and three on that of Warner; these were so arranged that additional furnaces could in either case be erected, and provision was made on the Horsfall destructor-flues for the subsequent insertion of a steam-boiler, to be heated by the residual gases.

It was found necessary to mix the refuse with coal, as it would not continue burning. The amount of extra fuel added in some cases rose to 10 per cent. by weight. Much of the added fuel was not properly consumed, but came away in the form of cinders. The system worked better when the extra fuel was first ignited in the ashpit and then distributed, when fully alight, among the contents of the destructor-chamber. It was out of the question to heat a boiler with the residual gases, and in order to produce the steam needed for the Horsfall furnaces, a separate portable engine had to be employed.

As the outcome of the tests it was ascertained that each cell or chamber was capable of treating 2·79 tons of rubbish in 24 hours, which required from 6 per cent. to 7 per cent. of added fuel, and produced 26 per cent. of slag, and 27 per cent. of ashes—a total residue of about 53 per cent.; the corresponding figures in England being 6 tons to 7 tons per cell, with a residue of 33 per cent., no added fuel being necessary.

## (*C.*)—DISINFECTANTS.

### PATENTS.

*Improvements in or connected with the Manufacture of Disinfectants.* R. England, London. Eng. Pat. 16,422, August 28, 1894.

The improvement consists in the production of a combined disinfectant and fertiliser, such as carbolic acid and a phosphate.—R. B. B.

*Improvements in Disinfecting and Preserving.* J. Y. Johnson, London. From Dr. F. von Heyden's Successors, Radebeul, Germany. Eng. Pat. 13,106, July 6, 1895.

Sulphinic acids of the aromatic series, of the general formula $R.SO_2H$, are stated to be excellent preservatives and disinfectants. For the latter purpose, either the acids themselves or a mixture of their zinc salts with zinc chlorate, may be employed. For preserving purposes only the acids can be used. The most suitable are the sulphinic acids of benzene, toluene, xylene, and naphthalene.

—R. B. B.

# XIX.—PAPER, PASTEBOARD, Etc.

*Strength of Paper and the Influence of Moisture thereon.* W. Herzberg. Mitt. aus d. königl. Tech. Versuchsanstalt zu Berlin, **13**, [3], 118—120.

*Strength of Paper.*—Machine-made paper, as is well known, is stronger in the direction parallel with the flow of the fibre on the machine than across. The ratio varies, but is generally from about 60 : 100 to 75 : 100. Table I. gives the results of a series of tests, which show that the ratio of the breaking length (strength) in the machine direction and across may be as low as 33 : 100, and as high as 99 : 100.

Samples 19—22 are interesting as showing that the strength in the two directions are almost equal; such papers, however, are quite exceptional. The stretching power of paper also differs considerably in the length and width of the paper, it being far greater in the direction at right angles to the flow of the fibre than in the direction of the flow. The ratio of the stretching powers also varies considerably, as shown in the following table:—

Table I.

| No. | Quality of Paper. | Breaking Length. |  | Ratio of Machine and Cross Direction. | Expansion. |  | Ratio of Machine and Cross Direction. |
|---|---|---|---|---|---|---|---|
|  |  | Cross Direction. | Machine Direction. |  | Cross Direction. | Machine Direction. |  |
|  |  | Km. | Km. |  | Per Cent. | Per Cent. |  |
| 1 | Writing paper | 1,570 | 4,730 | 33 : 100 | 1·7 | 1·5 | 113 : 100 |
| 2 | „ „ | 2,210 | 5,460 | 39 : 100 | 2·4 | 1·9 | 126 : 100 |
| 3 | Packing „ | 3,760 | 9,760 | 39 : 100 | 4·6 | 2·1 | 219 : 100 |
| 4 | Printing „ | 1,720 | 4,170 | 41 : 100 | 1·3 | 1·2 | 108 : 100 |
| 5 | Deed „ | 2,900 | 6,500 | 45 : 100 | 2·6 | 1·5 | 173 : 100 |
| 6 | Packing „ | 4,250 | 9,060 | 47 : 100 | 6·7 | 2·8 | 239 : 100 |
| 7 | Document „ | 4,000 | 7,950 | 50 : 100 | 5·0 | 1·7 | 294 : 100 |
| 8 | „ „ | 3,570 | 7,010 | 51 : 100 | 4·1 | 1·4 | 293 : 100 |
| 9 | Normal 3*a* (German) | 3,620 | 5,340 | 61 : 100 | 6·2 | 2·4 | 258 : 100 |
| 10 | Envelope paper | 2,490 | 3,350 | 74 : 100 | 5·7 | 2·5 | 228 : 100 |
| 11 | Writing „ | 4,060 | 4,790 | 85 : 100 | 4·5 | 3·3 | 136 : 100 |
| 12 | „ „ | 4,220 | 4,800 | 88 : 100 | 3·2 | 2·0 | 160 : 100 |
| 13 | Lithographic paper | 1,900 | 2,150 | 88 : 100 | 1·7 | 1·5 | 113 : 100 |
| 14 | Record paper | 6,050 | 6,760 | 90 : 100 | 6·4 | 4·9 | 131 : 100 |
| 15 | Writing „ | 4,220 | 4,690 | 90 : 100 | 3·0 | 2·0 | 150 : 100 |
| 16 | Normal 2*a* (German) | 5,350 | 5,950 | 90 : 100 | 5·7 | 3·2 | 178 : 100 |
| 17 | Lithographic paper | 1,750 | 1,950 | 90 : 100 | 1·5 | 1·5 | 100 : 100 |
| 18 | Writing „ | 4,050 | 4,440 | 91 : 100 | 4·6 | 3·2 | 156 : 100 |
| 19 | „ „ | 4,370 | 4,600 | 95 : 100 | 6·3 | 3·3 | 191 : 100 |
| 20 | Lithographic „ | 2,100 | 2,200 | 95 : 100 | 1·5 | 1·3 | 116 : 100 |
| 21 | Normal 3*a* (German) | 3,700 | 3,800 | 97 : 100 | 3·6 | 3·3 | 109 : 100 |
| 22 | Writing paper | 4,110 | 4,170 | 99 : 100 | 4·1 | 2·4 | 171 : 100 |

*Influence of Moisture upon the Strength of Paper.*—The moisture of the air has undoubtedly considerable effect upon the strength and expansion of paper. With an increase in the humidity of the air the strength decreases and the expansion increases. For calculating the strength and expansion for definite degrees of humidity there is no scientific or reliable basis known. The action of the moisture of the air is different upon papers of different composition. The following results show the influence of the humidity upon the strength and expansion of a good writing paper made entirely of pure rags:—

Table II.

| Relative Humidity of the Air. | Moisture contained in the Paper. | Breaking Weight. |  |  | Breaking Expansion. |  |  | Breaking Length. |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | Machine Direction. | Cross Direction. | Mean. | Machine Direction. | Cross Direction. | Mean. | Machine Direction. | Cross Direction. | Mean. |
| Per Cent. | Per Cent. | Kilos. | Kilos. | Kilos. | Per Cent. | Per Cent. | Per Cent. | Km. | Km. | Km. |
| 100 | 21·5 | 3·07 | 2·59 | 2·83 | 8·9 | 14·1 | 11·5 | 2·41 | 2·03 | 2·22 |
| 90 | 13·5 | 4·89 | 3·67 | 4·28 | 9·8 | 14·4 | 12·1 | 3·83 | 2·88 | 3·36 |
| 80 | 8·9 | 7·41 | 5·21 | 6·31 | 10·2 | 13·7 | 12·0 | 5·75 | 4·06 | 4·91 |
| 70 | 8·4 | 8·64 | 6·20 | 7·42 | 8·9 | 12·1 | 10·5 | 6·77 | 4·83 | 5·80 |
| 60 | 6·5 | 9·24 | 6·42 | 7·83 | 8·1 | 9·9 | 9·0 | 7·20 | 5·00 | 6·10 |
| 50 | 5·6 | 9·86 | 6·80 | 8·33 | 6·6 | 7·6 | 7·1 | 7·68 | 5·32 | 6·50 |
| 40 | 3·4 | 10·18 | 6·78 | 8·48 | 4·0 | 4·0 | 4·0 | 7·93 | 5·31 | 6·62 |
| 30 | 2·3 | 9·60 | 6·82 | 8·21 | 2·9 | 3·1 | 3·0 | 7·45 | 5 31 | 6·38 |

—S. P. E.

*The Influence of Water contained in Paper upon its Breaking Strain.* R. von Lenz. Papier Zeit. 1895, [61], 1934—1935.

In the *Mitt. aus den kön. tech. Versuchsanstalt zu Berlin*, [3], 120, a table is given by W. Herzberg which shows the influence of contained water upon the breaking strain of paper. This table also appears in the *Papier Zeit.* [43], 1352. Several years ago this question was investigated by the author and the results were published in the *Papier Zeit.* 35, 887. The author likewise found that by increasing the quantity of water in paper the strength decreased. Herzberg says for the calculation of the value upon a definite water-contents a scientific basis is still wanted. " He is certainly correct if he is speaking of the moisture of the air; such a basis is not only wanting, but will doubtless always be, owing to the many unmeasurable conditions that would exist even if such a basis were found. It is different, however, if one undertakes the calculation of the breaking strain upon a given water-content in the paper. The following formula for making the calculation I gave in the above cited Journal, which for practical purposes is sufficiently exact:— $Lo = L + \frac{1}{4} h$, where L is the reduced breaking strain, Lo the calculated breaking strain for the dry paper, and *h* the percentage of contained water pressed out. What I understand by the reduced breaking strain I explained in the communication referred to above. The breaking strains for paper containing different quantities of water given by Herzberg I have calculated by this formula upon dry paper, the results of which are given in the following table, together with the water-contents and breaking strains of Herzberg, omitting the second decimal, as the first can hardly be considered reliable ":—

| According to Herzberg. |  | Calculated. |  |  |
|---|---|---|---|---|
| *h.* | Breaking Strain. | L. | Lo. | Difference. |
| 21·5 | 2·2 | 2·8 | 8·2 | −0·4 |
| 13·5 | 3·4 | 3·9 | 7·3 | +0·5 |
| 8·9 | 4·9 | 5·4 | 7·6 | +0·2 |
| 8·4 | 5·8 | 6·3 | 8·4 | −0·6 |
| 6·5 | 6·1 | 6·5 | 8·1 | −0·3 |
| 5·6 | 6·5 | 6·9 | 8·3 | −0·5 |
| 3·4 | 6·6 | 6·8 | 7·6 | +0·2 |
| 2·3 | 6·4 | 6·5 | 7·1 | +0·7 |
|  |  | Mean.. | 7·8 |  |

If the observations are carefully made and the reduction is perfect, Lo would have a constant value; such, however, is not the case, hence the difference. Those engaged in paper-testing know perfectly well that the strength of paper varies in different parts of the same sheet. To obtain a reliable breaking strain for a given paper a number of tests must be made and the average taken. Herzberg does not give the number of observations made from which he obtained the results given.—S. F. E.

*Physical Alterations in Paper by Heat and Moisture.* G. Dalén. Mitt. aus d. königl. techn. Versuchsanstalt zu Berlin, 1895, **13**, [4], 163—169.

Three kinds of paper, viz., one smoothed on both sides and printed on the face, one smoothed on both sides but unprinted, and the third, smoothed on one side only and unprinted, were selected for the test.

On each strip was drawn a longitudinal line down the centre, on which a space of about 290 mm. was measured off, and a similar transverse line drawn and marked in the same way, for the purpose of measuring the expansion of the paper.

Measurements by the apparatus (which is described) were first made at 20° C. with 65, 40, 20, and 0 percentages of moisture successively, at least an hour being allowed for the paper to absorb its proper complement of moisture at each stage, and after a rest of 18 hours at zero (moisture) the experiment was reversed. In the same manner were performed the experiments at 40° C. and 0° C., and measurements were also made with 80 and 100 per cent. of moisture to determine the extent of the slight *permanent* linear alteration exhibited by the paper under these conditions, the final determination being accomplished by repeated measurements at 20° C. and with 65 and 25 per cent. of moisture.

The conclusions drawn from the tests employed, are that for percentages of moisture between 0 and 80, paper increases in length in direct proportion to the amount employed, but when the degree of moisture ranges between 80 and 100 per cent. the expansion is somewhat over proportion; that the longitudinal is less than the transverse expansion; that the effect of temperature is less than that of moisture, favouring expansion when associated with percentages up to 65, but retarding it beyond that degree; and that no permanent linear alteration is caused by moisture below 80 per cent.

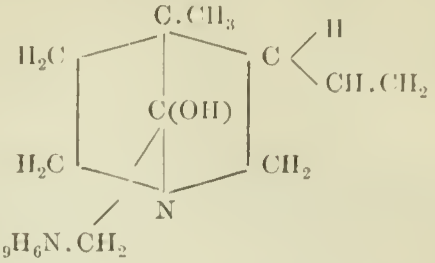
The permanent change due to high percentages of moisture is partly explained by the pulpy condition of the paper under such circumstances increasing the frictional resistance against the glass plate to such an extent as to produce displacement of the fibres of the paper, and partly affected by the process of manufacture, since the three papers exhibited differences of behaviour, No. III. expanding laterally, whereas the others contracted slightly in both directions, although all exhibited the same percentage of materials in their constitution.

It is recommended that paper for self-registering apparatus should be forced to undergo permanent alteration by steeping before being printed for use. Also that it should be so arranged in the apparatus that the direction of least expansion coincides with that in which the greater exactness of record is required, and that it is desirable experiments should be made on the expansive properties of different materials for paper and the minimising effect thereon of impregnation by various preparations.—C. S.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Distinctive Properties of Cinchona Alkaloids, a Function of Constitutional Structure (Cinchonine).* W. v. Miller and Rohde. Ber. 1895, **28**, 1056—1077.

The tertiary linking of the one N-atom (in the hydrogenised half of the molecule) indicated in the above formula for cinchonine, has been shown by Skraup and K. de Norwall (Ber. **26**, 1968) to be common to the cinchona alkaloids in general. This linking, which no longer exists in cincholeupone, cincholeuponic acid, or even methyl cinchonine, may, according to the authors, be broken down in all the cinchona alkaloids without splitting up of the molecule (a migration of atoms takes place, N being converted into NH) by boiling with dilute acetic acid. The alteration in properties attending this change in structure is most marked. The compounds formed are strong bases which expel ammonia from its salts. With phenylhydrazine they yield hydrazones possessing the peculiar property of being soluble in dilute acids to an intense orange-red solution. Physiologically, they have no antipyretic action whatever, but possess marked toxic properties. On this account it is proposed to name them *cinchotoxine*, *quinotoxine*, &c.



*Cinchotoxine*, $C_{19}H_{22}N_2O$, derived from and isomeric with cinchonine, and already previously obtained by the authors (Ber. **27**, 1187 and 1279) in the form of an oily liquid, has now been prepared in the crystalline state. The method adopted is as follows:—100 grms. of cinchonine and 200 grms. of acetic acid (50 per cent.) are dissolved in 1,200 c.c. of water and the solution boiled for 32—34 hours under an inverted condenser. To the cooled solution an excess of soda is added, and the brownish oil thus precipitated dissolved in a large volume of ether, and the latter filtered to separate unaltered cinchonine and resinous matters. The ethereal solution is dehydrated by means of caustic potash and evaporated. The residual oil, when exposed to a temperature of about 0° C. for 12 hours or more—air and moisture being carefully excluded—solidifies to a crystalline mass, which must be rapidly washed with small quantities of anhydrous ether. Thus obtained, cinchotoxine forms an almost colourless crystalline powder. But splendid wedge-shaped or prismatic crystals are obtained by allowing an ethereal solution, prepared under pressure at 40°—50° C., to cool in a closed flask. Pure cinchotoxine, when heated, first softens and then melts at 58°—59° C. It is readily soluble in alcohol, acetone, chloroform, and benzene. In hot petroleum spirit it is less soluble, and separates on cooling in oily drops, which crystallise after some time. In contact with water it gradually becomes fluid, and a small portion passes into solution. This solution is precipitated and rendered turbid by addition of an excess of alkali. Cinchotoxine yields a series of crystalline salts, and forms a hydrazone and several nitroso derivatives. The methyl derivative of cinchotoxine appears to be identical in all respects, chemical and physical—excepting some trifling differences in crystalline form, which require further investigation—with methyl-cinchonine. This similarity extends to their respective derivatives. On the other hand, cinchotoxine itself is absolutely undistinguishable—again excepting very slight disparities in the form of the respective crystals—from cinchonicine. The latter, produced by the fusion of cinchonine salts, has hitherto been obtained only in the amorphous form, but the authors have succeeded in preparing it in the crystalline condition by the process employed for cinchotoxine. For this purpose, cinchonine bisulphate was heated to 145°—148° C. until a sample when dissolved in water yielded simply an oily precipitate on addition of sodium carbonate. The fused mass was then dissolved in water, precipitated by sodium carbonate, and further treated as above described.—H. T. P.

*Alkaloids of the Fumariaceæ and Papaveraceæ.* Battandier. Comptes Rend. 1895, **120**, 1276—1277.

The author has obtained fumarine from some of the species of *Papaveraceæ*. *Bocconia frutescens*, for instance, contains *fumarine*, *bocconine*, *chelerythrine*, and a small quantity of chelidonine or a very similar alkaloid.

*Fumarine* is readily soluble in chloroform, but very sparingly so in water, ether, alcohol, or light petroleum. Its chloride yields heavy, transparent needles. With strong cold sulphuric acid, fumarine gives a dark violet or almost blue coloration, which changes to a very dark brown on the addition of a trace of potassium bichromate. Fumarine may easily be taken, from this test, for strychnine, and it is necessary in testing for the latter to make sure that the acid alone gives no coloration, and that colour is only developed on the addition of the oxidising agent.

*Bocconine* is much more soluble in water and neutral solvents than fumarine. The free alkaloid and the chloride crystallise in light, white, silky tufts. Bocconine gives a very characteristic peach colour with cold sulphuric acid.

*Chelerythrine* gives the bark of the bocconia its red colour. When the alkaloid is boiled with concentrated nitric acid the dark red colour is discharged, and if an excess of ammonia be then added, a reddish-coloured liquid is produced.

*Glaucine.*—Probst stated that glaucine gives a violet coloration with cold sulphuric acid, but this is due to traces of fumarine present. When glaucine is pure, only a scarcely perceptible greenish-blue coloration is produced in the cold, but on heating the deep violet is developed. The bromide is the only salt which crystallises well.—L. T. T.

### *Action of Hydrogen Peroxide on Coniine and β-Pipecoline.* R. Wolffenstein. Ber. 28, 1459—1466.

By the action of hydrogen peroxide on piperidine and α-pipecoline, there result amido aldehydes (Ber. 26, 2991), but the conditions have to be altered in order to obtain a similar body from coniine. Owing to the insolubility of the base, dilute acetone has to be employed as a solvent, and when treated under these conditions coniine yields α-propyl-δ-amidovaleraldehyde—

$$H_2N.CH(C_3H_7)CH_2.CH_2.CH_2.CHO,$$

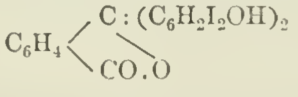
30 grms. of coniine yielding 5 grms. of aldehyde. Occasionally, however, the reaction takes a different course, coniceïne being formed, although the base obtained is not identical with γ-coniceïne. The aldehyde obtained as above is a colourless syrup, boiling at 103—105° C. under 10 mm. pressure. Its specific gravity is 0·9414 at 20° C. and $[\alpha]_D = 59\cdot95$. It has a peculiar amine-like smell, entirely different from that of coniine, and it is also less poisonous than this base. This aldehyde also appears to be present in specimens of coniine which have been kept for some time, its formation being probably due to air-oxidation. When distilled, either alone or preferably with baryta, it yields a mixture of coniine and a little coniceïne. The reconversion of the aldehyde into coniine proceeds, however, quantitatively by reduction with zinc and hydrochloric acid on the water-bath. The aldehyde is not the only product of the action of hydrogen peroxide on coniine, a certain quantity of butyryl-butyric acid—

$$C_3H_7.CO.CH_2.CH_2.CH_2.CO_2H,$$

melting at 34° C., and boiling at 280°—285° C., and some acetic acid, being also produced. From β-pipecoline β-methyl-δ-amido-valeraldehyde was produced, which boils under 10 mm. pressure at about 81° C. and gives a hydrochloride melting at 139° C. The author points out that the formation of amido-aldehydes from the pyridine hexahydrides by oxidation with hydrogen peroxide, indicates a general reaction.—T. A. L.

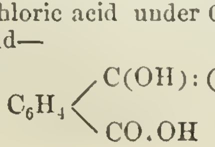
### *Action of Iodine on Phenolphthaleïn.* A. Claasen and W. Löb. Ber. 28, 1603—1611.

The action of iodine on phenolphthaleïn gives always the same product, tetraiodophenolphthaleïn—



$$C_6H_4\left\langle\begin{array}{l}C:(C_6H_2I_2OH)_2\\ \quad\diagdown\\ CO.O\end{array}\right.$$

which, under certain conditions (liberation from its salt by means of hydrochloric acid under 0° C.), can be converted into the compound—



$$C_6H_4\left\langle\begin{array}{l}C(OH):(C_6H_2I_2OH)_2\\ CO.OH\end{array}\right.$$

The reaction can take place in various solvents, soda-lye, ammonia, barium hydrate, borax, or sodium phosphate. The same compound is formed in alcoholic solution by boiling phenolphthaleïn with iodine and mercuric oxide, and can also be produced by the electrolysis of an alkaline phenolphthaleïn solution containing potassium iodide. The product is generally amorphous, but can be obtained crystalline by dissolving it in alcoholic soda and precipitating at the boiling point with alcoholic hydrochloric acid. The salts are amorphous and very stable, only those of the alkalis being gradually decomposed on exposure to the air. These latter when anhydrous are light brown, but dissolve in water to blue solutions. The salts of the alkaline earths are greyish-blue and sparingly soluble, whilst the zinc, ferrous, manganous, lead, and mercury salts are brown and insoluble, the ferric, manganic, bismuth, and aluminium salts being powders somewhat darker in colour. The following details are given for carrying out the reaction with borax solution as a solvent. A hot solution containing 5 grms. of phenolphthaleïn and 20 grms. of borax in 200 c.c. of water has gradually added to it 15 grms. of iodine in potassium iodide solution. The deep red solution turns gradually deep blue, and finally a light yellow precipitate begins to separate out. The reaction is finished when the solution is slightly tinged with iodine. The precipitate can be more readily filtered off by adding a few drops of strong hydrochloric acid. Tetra-iodophenolphthaleïn is a powerful antiseptic, the molecule acting as a whole, since, unlike iodoform, it passes through the organism unchanged.
—T. A. L.

### *Phenylcoumalin and so-called Dicotoïn of Coto-Bark.* G. Ciamician and P. Silber. Ber. 28, 1549—1558.

The compound to which Jobst and Hesse (Annalen, 199, 29) gave the name dicotoïn was recognised by the authors (Ber. 27, 841; this Journal, 1894, 756) as a mixture of cotoïn with phenylcoumalin, and Hesse, in a later paper (Ber. 27, 1182), arrived independently at an almost similar conclusion, but did not identify the constituent combined with the cotoïn. It has now been proved that phenylcoumalin combines with phenols, or at any rate with certain of them, and consequently with cotoïn, which is a phenol. The compound obtained from a mixture of equimolecular parts of phenylcoumalin and cotoïn crystallised from petroleum ether in yellowish plates melting at 77° C., whereas Hesse gives 74° or 76° C. for dicotoïn. Hesse further remarked that he had isolated another product from coto-bark which he termed pseudo-dicotoïn, and he described it as a molecular compound of cotoïn with a new substance which he termed oxyphenylcoumalin. This latter, Hesse states, on fusing with potash, gives phenylcoumalic acid, which has a characteristic sparingly soluble potassium salt. The authors point out that the former substance is very similar to phenylcoumalin, which on fusing with potash gives β-diphenylcarboxylic acid melting at 224° C., and also possessing a sparingly soluble potassium salt. Attempts to discover the presence of Hesse's oxyphenylcoumalin in a sample of coto-bark from which the cotoïn had been removed were unsuccessful. Only phenylcoumalin and paracotoïn could be detected.—T. A. L.

### *Essence of Linalöe.* P. Barbier and L. Bouveault. Comptes Rend. 121, 168—170.

The authors have analysed essence of linalöe with the following approximate results:—Terpene diatomic, 0·1; terpene tetratomic, 0·1; methylheptenone, 0·1; licareol, 90·0; licarhodol, 2·0; sesquiterpene, 3·0 per cent.

A small quantity of the licareol exists in the form of acetic ether, and a trace in the form of ethers of higher acids.—J. G. W.

### *Opoponax.* A. Baur. Arch. Pharm. 1895, 233, 209, 242.

From the author's work on this gum-resin, it appears that commercial opoponax, which is used in the distillation of oils for perfumery purposes, is not derived from a Persian umbellifera, but from a kind of balsamodendron belonging to the order *Burseraceæ.* The original plant is probably *Balsamodendron Kotal.* The Burseraceæan opoponax consists of gums, resins, and ethereal oils. The resin is composed of α-panax resin, $C_{22}H_{54}O_4$, β-panax resin, $C_{22}H_{52}O_5$, and pana-resinotannol, $C_{31}H_{50}O_4$. The β-resin is apparently an oxidation product of the α-resin, and differs from the latter in its insolubility in petroleum ether. These three bodies are not ethers, as attempts to saponify them were unsuccessful. Their chemical nature is not yet known. The ethereal oil contains ethers which, on saponification, yield alcohols, and fatty acids.

Opoponax also contains a bitter substance, which has not yet been obtained pure, or in a crystalline condition.
—J. L. B.

*Hydroxy Derivatives of Dextro-rotary Eucalyptene.* Bouchardat and Tardy. Comptes Rend. 1895, **120**, 1417—1420.

The authors have examined the dextro-rotary terebenthene (eucalyptene) obtained by Voiry from the *eucalyptus globulus*. This substance closely resembles the levo-rotatory compound. It boils at 156°—157° C., its specific gravity is 0·870 at 0° C. and 0·865 at 18° C., and its specific rotatory power is $[\alpha]_D = +39°$. The terpilenol, $C_{10}H_{18}O_2$, forms crystals melting at 33°—34°, boils with decomposition at 218° C., and has a rotation $[\alpha]_D = +88°$. The borneol melts and boils at about 213° C., and shows $[\alpha]_D = +25° 50'$. When oxidised with nitric acid, a mixture of ordinary dextro-camphoric acid and a racemoïd-camphoric acid is produced. The racemoïd acid is very slightly soluble in water, melts at 203°—204°, and gives an anhydride melting at 223° and apparently identical with the anhydride produced from the ordinary racemo-camphoric acid. The iso-borneol (fenchol) melts at 45°, boils at 198°—200°, and is levo-rotary, showing $[\alpha]_D = -10°$. It yields a camphor which is liquid at 15°, solid at 0°, and is strongly dextro-rotary.

The authors believe that all the results obtained in the study of the terebenthenes point to the existence of *two* modifications—a dextro- and a levo form—and that the other terebenthenes are simply various mixtures of these two.—L. T. T.

*Carbon Tetrachloride for separating Ethyl Alcohol from Methylated Spirit.* M. Cari-Mantrand. Comptes Rend. 1895, **120**, 1063—1064.

The denatured spirit is mixed with one-fourth of its volume of carbon tetrachloride, and after solution enough saturated brine (about 2½ times the volume of the mixture) is added. The carbon chloride separates, carrying with it in solution the impurities of the wood spirit, petroleum spirit, and essential oils, and leaving acetone and methyl alcohol in the aqueous solution along with the ethyl alcohol. The liquids are separated by means of a tap-funnel, the aqueous solution filtered through a moistened filter to remove traces of the chloride, and submitted to distillation in a fractionating apparatus capable of giving at one operation 96 or 97 per cent. alcohol. The acetone and methyl alcohol pass over almost entirely below 76°, whilst the portions which distil at 78° and above consist of pure ethyl alcohol and water.

The carbon tetrachloride is agitated two or three times with sulphuric acid and washed with water, and can then be used afresh. The salt solution, which remains after the distillation, can also be used again.—J. T. D.

## PATENTS.

*Improvements in Digestive Compounds.* J. Carnrick, New York, U.S.A. Eng. Pat. 20,263, October 23, 1894.

Digestive enzyme is obtained as follows:—The stomach, pancreas, spleen, hepatic, salivary, and Brunner's glands, and Lieberkuhn's follicles, are removed from the slaughtered animal, the portions containing the digestive cells and zymogen cut out, after neutralising the glandular organs. The glands are dried at 100° to 110° F., powdered, freed from fat, and again dried, powdered, and separated by a sieve from pieces of skin or muscular fibre. The powder is treated with a dilute ethereal solution of gum-benzoin, spread out, and allowed to dry. Each kind of gland is treated and kept separately. Mixtures are made as required. The above process refers to the peptic, pancreatic, salivary, Lieberkuhn's and Brunner's glands only.

The spleen and liver, after being washed and freed from blood, fat, &c., are chopped fine, and dried at 100° to 110° F., powdered, digested with strong alcohol on a water-bath, and the extract evaporated until it becomes thick. The extract possesses the property of emulsifying fats, and of converting starch and cane-sugar into glucose. To obtain the extracts as powders they may be mixed with milk-sugar, the powder moistened with an ethereal solution of gum-benzoin, and allowed to dry.

The different digestive powders are mixed with milk-sugar and cane-sugar in proper proportions. Citric acid and hydrochloric acid are thoroughly incorporated with the milk-sugar and cane-sugar respectively, before they are mixed with the digestive powders.

"Peptenzymene" is a mixture of all the different products, preferably in such proportion as they are obtained from each organ. Such a mixture is a complete digestive compound capable of digesting all kinds of food. Compounds of any two or more of the seven glands may be made.
N. H. J. M.

*Improvements in the Manufacture of Artificial Musk.* C. D. Abel, London. From The Fabriques de Produits Chimiques de Thann et Mulhouse, Thann, Alsace. Eng. Pat. 20,521, October 26, 1894.

By previous specifications it is known that on nitrating certain aromatic hydrocarbons and phenolic ethers, compounds result which may be used as substitutes for natural musk. The improvement consists in the nitration of the cyanide derivatives of the above hydrocarbons, &c., such as the cyanides of butyl-toluene, butyl-xylene, or butyl-methyl-cresol, whereby musk-smelling nitro derivatives are produced.—R. B. B.

*An Improved Method for Hermetically Closing Preserve Jars and the like.* W. P. Thompson, Liverpool. From The Conserven-Fabrik, Mombach-Mainz, Germany. Eng. Pat. 21,050, November 2, 1894.

*See under* I., *page* 854.

*Improvements in and connected with the Manufacture of Oxygen.* (Under International Convention.) H. L. A. Lapointe, Paris. Eng Pat. 13,959, July 22, 1895.

Sodium manganate is obtained by heating to dull redness, in a current of hot air, a mixture of manganic oxide and soda. The manganate, acted upon by superheated steam, yields oxygen, and is reproduced on again heating in air. These known reactions are assisted, under the present invention, by effecting the decomposition of the manganate by superheated steam, and therefore under more than atmospheric pressure, and also the re-composition by air under pressure. But after the re-composition, the residual nitrogen is removed by a pneumatic pump, and the nitrogen being withdrawn by the inlet entrance, the particles of the charge are alternately subjected to motions in contrary directions, so as to offer new surfaces of action.

The furnace employed, heated by gas, contains three sets of retorts, in order that the production of oxygen may be continuous; for the apparatus is so arranged that the three processes of oxidation, removal of the residual nitrogen, and decomposition, may go on successively in the three sets. The retorts are each compounded of three cylindrical chambers or retorts with a head having a cover provided with an inlet opening for admission of air or steam, as occasion requires, and for withdrawal of residual nitrogen; and an outlet for the air or steam. Air under pressure from a compressor pump is supplied in a continuous stream, which is diverted by the action of the valves as required. Ducts from all the retorts lead to a nitrogen escape pipe, carrying a regulating expansion valve. The compressed air used is purified by passage through boxes containing lime and soda; it is then strongly heated, and goes to the retorts by turn. The manner in which a cam-shaft operates the valves, so as to make the operations automatic and continuous in their order, is described. The mixture of steam and oxygen derived successively from the three sets of retorts, is led to a condenser, whence the oxygen passes to a holder. A special lamp or burner, composed of a platinum cap maintained at a red heat by a regulated stream of oil-gas, is put in communication wtth the retorts, to show, by increase or otherwise of luminosity, the nature of the gases present. The light is observed through blue glasses supported by an upper frame. Several such lamps are used, and some of these under fixed conditions, so as to serve as standards.—E. S.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*Photography in Natural Colours by the Indirect Method.* A. and L. Lumière. Comptes Rend. **120**, 875—876.

The indirect method of photography in natural colours of Cros and Ducos du Hauron, presents two points of difficulty, the selection of the colours and the preparation and superposition of the monochromatic films. For the preparation of the colour negatives the authors make use of orange, green, and violet screens, using with each a photographic plate possessing a maximum sensibility for the rays that the screen allows to pass through it. The preparation and superposition of the monochromatic films is attained in the following manner :—A glass plate is coated with a 10 per cent. solution of glue, containing 5 per cent. of ammonium bichromate and 5 to 10 per cent. of bromide of silver emulsion, and then exposed under a negative. After sufficient exposure the plate is washed in cold water and freed from silver bromide with hypo, and in this way a scarcely visible image of insoluble mucilage is obtained, which can be coloured with suitable dyes. Three of these monochromatic films, coloured red, yellow, and blue, each of which has been obtained from the corresponding colour negative, are then superposed on the same plate, care being taken to isolate each film from the others by an impermeable film, say, of collodion. This process allows of the relative intensity of the monochromes being varied, or of the addition of a fourth or more films.—J. G. W.

### PATENTS.

*Improvements in the Manufacture of Coloured Dry Plates for Photography.* E. de Coninck, Ghent, Belgium. Eng. Pat. 16,693, September 1, 1894.

The claim is for "coloured dry plates for use in photography, prepared either with coloured glass or of uncoloured glass, to which a very thin and level layer of gelatin is applied, which is sensitised by bromide of silver after drying, and to which is added in the second case at the moment of application, indelible colours having no action on the gelatin, as herein described and explained."—W. M.

*A Process and Apparatus for Recovering Volatile Solvents from Collodion Coatings of Paper.* H. de Grousilliers, Charlottenburg, Germany. Eng. Pat. 13,562, July 15, 1895.

The paper coated with the film of collodion is made to travel through a closed apparatus, in which a fan keeps up a current of hot air. After passing over the surface of the paper, the air is led to a condenser to recover the solvents; it is then heated again before admission to the evaporating chamber, which is provided with steam pipes to hasten the drying of the film.—F. H. L.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### PATENTS.

*Improvements in Explosive Cartridges, more especially intended for Use in Mines.* J. Lux, Vienna, Austria. Eng. Pat. 13,161, July 8, 1895.

The explosive, dynamite, &c., is encased in an envelope of asbestos paper which prevents explosion of gas or coal-dust in mines.—W. M.

*Improvements relating to Safety Devices for the Openings of Receptacles for containing Explosive Fluids.* A. J. A. Elvers, Wendorf, Prussia. Eng. Pat. 13,386, July 11, 1895.

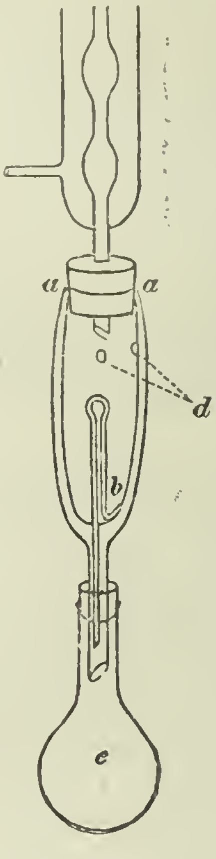
*See under I., page 854.*

## XXIII.—ANALYTICAL CHEMISTRY.

### APPARATUS, ETC.

*Modified Soxhlet Extraction Apparatus.* A. Philips. Ber. 1895, **28**, 1475.

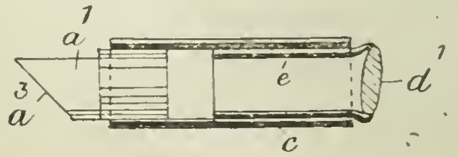
The apparatus consists of a jacketed extractor. The two vessels are fused together at the top *a*. The inner vessel, for holding the material to be extracted, terminates at the bottom in a narrow tube *b* which rises some distance in the jacket, and is then turned downwards so as to act as a syphon for removing the extracting liquid when it accumulates in the extractor. The vapour from the boiling liquid in *c* passes through the annular space between the glass vessels, and through the holes *d* in the inner vessel to the cooler. From this it falls back on to the material to be extracted. In this way the extracting liquid is constantly maintained at the boiling point by the vapour in the surrounding jacket, and the extraction is thus much facilitated.—L. T. T.



### PATENT.

*A New or Improved Optical Instrument for the Detection of Imitation Diamonds.* T. Thorp, Whitefield, near Manchester. Eng. Pat. 18,980, October 6, 1894.

The instrument is based on the great refractive power of the diamond and consists of a totally reflecting prism $a^1$ set



Instrument for the Detection of Imitation Diamonds.

in the tube *c*, which latter has a sighting lens $d^1$ fixed in the sliding tube *e*. The surface $a^3$ of the prism $a^1$ is moistened with a liquid having a high refractive index, and one of the facets of the crystal is placed directly against the polished surface $a^3$ and viewed through the lens $d^1$. In the case of a diamond the facet shows brightly with sharp outlines, but imitation crystals are scarcely distinguishable from the surrounding medium and appear without any distinct outline.—E. G. C.

## *INORGANIC CHEMISTRY.—QUALITATIVE.*

### *Detection of Small Quantities of Potassium Cyanate in Potassium Cyanide.* E. A. Schneider. Ber. 1895, **28**, 1540—1541.

Blomstrand (J. prakt. Chem. [2], **3**, 206) states that potassium cyanate yields with cobalt acetate a deep blue solution which gradually deposits azure crystals. The author proposes to utilise this deep blue colour for the detection of small quantities of cyanates. If cobalt acetate (which is the best cobalt salt to use) be added to a solution containing both cyanides and cyanates the cobalt cyanide is often precipitated in a form difficult to filter, and the filtrate frequently fails to show the blue coloration. The blue colour is also quickly destroyed by dilution of the solution with water. A very small quantity of cyanide renders the reaction uncertain. On the other hand the presence of alcohol (up to 90—95 per cent.) renders the reaction much more intense. The best way of making the test is as follows: A strong solution of the substance is treated with a stream of carbonic anhydride till all the cyanide is decomposed and the hydrocyanic acid driven off. The solution is then treated with excess of alcohol (whereby the potassium carbonate is precipitated), a few drops of acetic acid added, and then cobalt acetate. When testing for very small quantities of cyanate in potassium cyanide it is best to dissolve the cyanide in very little water, to precipitate the greater part of the cyanide by the addition of alcohol, and then to treat the filtrate with carbonic anhydride, &c., as described. In this way as little as 0·35 per cent. of cyanate in cyanide can be detected.

In aqueous solution the blue colour is not visible below a 1 per cent. solution of potassium cyanate, whereas with a 90—95 per cent. alcoholic solution it is visible in a 0·0033 per cent. solution. An alcoholic solution of potassium cyanate is much more stable towards heat than an aqueous solution.—L. T. T.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Detection and Determination of Calcium Chlorate in Bleaching Powder.* R. Fresenius. Zeits. anal. Chem. **34**, 1895, 434.

*Detection of Chlorate.*—The percentage of chlorate in bleaching powder varies from 0·2 to 2 per cent. on the average. The process for the detection of chlorate recommended may also be used for its determination if desired. It is as follows:—

20 grms. of bleaching powder are triturated with water and made up to 1 litre, and to 50 c.c. of the filtered solution excess of neutral lead acetate is added and the whole warmed in a flask. The lead chloride at first separated, along with lead hydrate, reacts further with the hypochlorite till finally there remains a brown precipitate of lead peroxide $Ca(ClO)_2 + PbCl_2 = PbO_2 + CaCl_2 + Cl_2$.

The mixture is allowed to stand, with occasional shaking, for about eight hours, until the whole of the free chlorine has disappeared, partly by evaporation, but mainly owing to the reaction—

$$2Pb(C_2H_3O_2)_2 + Cl_2 + 2H_2O = PbCl_2 + PbO_2 + 4C_2H_4O_2.$$

The solution is now filtered and the lead precipitated by addition of dilute sulphuric acid in slight excess. A small quantity of indigo solution is added to the filtrate from the lead sulphate and then sulphurous acid drop by drop. Chloric acid, if present, will then be reduced and the lower chlorine acids formed destroy the blue colour of the solution, this decoloration furnishing the evidence required.

*Estimation of Chlorate.*—To determine quantitatively the amount of chlorate present the mixture after standing till free from chlorine, is filtered and the precipitate washed till the washings show no acid reaction. These washings are concentrated and added to the filtrate, and sodium carbonate solution is then poured in in slight excess. The mixture is allowed to stand some time, then filtered, and the filtrate evaporated almost to dryness; the chloric acid being determined according to Bunsen's method, by heating with concentrated hydrochloric acid, and passing the gases evolved into potassium iodide solution. The iodine set free is then estimated by means of thiosulphate solution.—J. T. C.

### *The Determination of Sulphur and Chlorine by means of Sodium Peroxide.* A. Edinger. Zeits. anal. Chem. 1895, **34**, 362—368.

The oxidation of metallic sulphides to sulphates can be readily effected by gently heating the former with sodium peroxide and sodium carbonate in a porcelain crucible. Any silica taken up from the crucible is of course filtered off before the addition of barium chloride to the acidified solution of the product. For the determination of both sulphur and chlorine in a mixture containing a sulphide and a chloride, the mixture is heated with ten times its weight of sodium peroxide and sodium carbonate, the product dissolved in dilute nitric acid, and made up to 250 c.c. One portion of the solution is then used for determining the sulphur in the usual way, and another portion for the determination of the chlorine.

The determination of the sulphur and chlorine in non-volatile organic compounds is also readily effected by means of sodium peroxide. In the case of a sulphonic acid the author proceeds as follows:—Sodium benzenesulphonate is evaporated in a platinum dish with a concentrated solution of the peroxide, and when an oily consistency has been attained the dish is further heated over a small flame; as soon as the mass blackens, a few more drops of the peroxide solution are added, and finally the dish itself is heated in a concentrated solution of sodium peroxide. The product is acidulated with hydrochloric acid and precipitated with barium chloride in the usual way.

The chlorine in tetrachloroquinone and other compounds may be determined in a similar manner, the product in this case being acidulated with nitric acid and precipitated with silver nitrate. In the analysis of an organic platinochloride, the platinum is filtered off after acidulating with nitric acid and may be determined in addition to the chlorine.—A. K. M.

### *Separation of Arsenic from other Elements by Means of Methyl Alcohol and Hydrochloric Acid.* C. Friedheim and P. Michaelis. Ber. 1895, **28**, 1414—1422.

The old method of separating arsenic from other substances by means of HCl, as the volatile trichloride, has been improved by E. Fischer, who effects the distillation with HCl or NaCl and $H_2SO_4$ under certain circumstances, after addition of ferrous chloride. This modified process is rendered more expeditious by transmission of a current of gaseous hydrochloric acid gas. But the method is complicated by the presence of $Fe_2Cl_6$, and the estimation of Ni and Co in the same sample is rendered very difficult, whilst that of iron becomes impossible.

Other difficulties are enumerated, amongst them, that due to the tungstic acid, if present. Part of this acid would separate out during the distillation and act prejudicially, or in presence of the excess of ferrous chloride, it would cease to be precipitable by evaporation of the solution.

Under almost all these and other adverse conditions named, the authors have resorted with success to the use of methyl alcohol as a substitute for ferrous chloride, since in this case, no more stable residue is at length obtained than a little carbon, which can be removed on filtration or ignition.

A distillation apparatus, fitted with glass connections throughout, is employed; and, for this purpose, the head of the condenser may conveniently terminate in a glass cap through which passes a thistle-funnel, and which fits over the top of the retort (a 250 c.c. bulb-flask). The lower end of the condenser tube is drawn out and dips into the receiver ($\frac{3}{4}$-l. flask) which in its turn is connected to a set of absorption bulbs.

*Process.*—The arsenical solution is evaporated in the retort as far as possible, 50 c.c. of strong methyl alcohol are then added, the receiver charged with 20 c.c. of concentrated nitric acid, the bulbs with water, and dry hydrochloric acid gas is passed through the apparatus, the retort being kept cool, until the alcohol is saturated with the gas. Heat is now applied by means of a water-bath and the liquid distilled off. When the retort has become cool, more alcohol is added, and the above operations repeated. 2—3 distillations usually suffice to separate the whole of the arsenic (0·2—0·3 grm. $As_2O_5$). The alcohol used should not be too dilute. For the determination of the arsenic, the combined distillates are heated in a covered dish with 20—30 c.c. of strong nitric acid until chlorine is no longer given off. The liquid is concentrated to 100 c.c., 20—30 c.c. of nitric acid added, the whole evaporated to dryness, the residue of arsenic acid dissolved in water and precipitated by magnesia mixture in the usual way.

*Separation of Arsenic from Vanadic Acid.*—Under the conditions described above, vanadic acid is partially volatilised along with the arsenic, especially when little or no water is present. But this may be entirely prevented, by previously reducing the acid by means of sulphur dioxide. It is not, however, advisable to evaporate the contents of the retort to dryness at first, although this may safely be done prior to the second and subsequent (4—5) distillations. The arsenic having been separated, the liquid remaining in the retort is evaporated with nitric acid, the residue dissolved in ammonia, evaporated in a platinum dish, and ignited to $V_2O_5$.

*Separation of Arsenic and Molybdic Acids.*—The same remarks apply here as in the case of vanadic acid. Addition of water suffices to prevent the volatilisation of molybdic acid. The latter is finally determined by conversion into the ammonium salt, &c., as above.

*Separation of Arsenic and Tungstic Acids.*—The principle of the method is that in one portion of the substance the total weight of the tungstic and arsenic acids is determined, whilst in a second portion, the weight of the tungstic acid alone is estimated, the arsenic acid being determined by difference. A hot aqueous solution of the arsenic tungstate is precipitated by a slight excess of mercurous nitrate, the nitric acid liberated being neutralised by the addition of mercuric oxide suspended in water. After 20 minutes heating, the liquid is allowed to cool, filtered, and the precipitate washed with mercurous nitrate. The dried precipitate is removed from the filter paper, the latter washed with dilute nitric acid and the solution evaported in a platinum dish, to which the main precipitate is afterwards transferred. A known weight of anhydrous sodium tungstate in large excess (15—20 grms.) is now added, the dish filled up with water, dried down, heated gradually to 200° C., then slowly up to a red heat. The increase in weight is due to arsenic and tungstic acids together. The extracted filter paper should be ignited separately, the ash moistened with nitric acid and again ignited, as it retains traces of tungstic acid. The tungstic acid alone is afterwards determined by the same process, the precipitation and drying of the precipitate proceeding as before, only that after removing the latter from the filter, this is burnt directly without previous treatment with nitric acid. The principal part of the precipitate is then added, the mercurous precipitate being ignited without the addition of sodium tungstate.—H. T. P.

### *Estimation of Small Quantities of Arsenic.* A. Carnot. Comptes rend. 1895, **121**, 20—22.

The method consists in precipitating the arsenic as sulphide, converting it by means of ammonia, silver nitrate, and hydrogen peroxide, into arsenic acid, which is determined as the bismuth salt.

The precipitated sulphides are well washed and dissolved in warm ammoniacal water, which leaves most of the sulphur on the filter. Sufficient silver nitrate is then added. The mixture, containing silver sulphide and ammonium tri- or penta-sulphide, as the case may be, is warmed and stirred for some minutes and tested with silver nitrate. If no further precipitate is produced, some drops of hydrogen peroxide (free from any other acid than hydrochloric acid) are added. This has no action on silver sulphide, but at once converts arsenious acid into arsenic acid in presence of an excess of ammonia. The whole is heated to 100° until quite free from ammonia, slightly acidified with nitric acid, by which all the silver arseniate is redissolved and the whole of the chlorine precipitated as silver chloride. The solution, filtered from silver sulphide and chloride, is precipitated with a nitric solution of basic bismuth nitrate containing at least five or six times as much of the salt as there is arsenic to precipitate. It is then saturated with ammonia, boiled for some minutes, allowed to settle, and filtered through a weighed filter. The precipitate (bismuth hydroxide and arseniate) is redissolved in water containing $\frac{1}{15}$th its volume of nitric acid (36° B.; sp. gr. 1·33) and boiled. The heavy, crystalline precipitate is again collected on the same filter, washed with the acidified water (1:15), then with pure water, dried at 100°, and weighed. The precipitate, $As_2Bi_2O_8 + H_2O$, contains 21·067 per cent. of arsenic.

A number of experiments showed the method to be very exact, especially for small quantities of arsenic.—N. H. J. M.

### *Estimation of Arsenious Acid with Potassium Permanganate.* L. Vanino. Zeits. anal. Chem. **34**, 1895, 426—431.

The titration of arsenious acid by permanganate in the presence of sulphuric acid has not come into general use owing to the difficulty of knowing when the end reaction is reached, oxidation in both hot and cold solutions giving various shades of yellow and red which do not pass sharply into the violet of the permanganate. The author shows that this is dependent on the quantity of sulphuric acid present, concordant results being obtained under suitable conditions. Excess of sulphuric acid is necessary, and the author recommends for every 20 c.c. of $\frac{1}{10}$ n $KMnO_4$ used, the addition of 4 c.c. of 10 per cent. $H_2SO_4$ solution. The mixture to be titrated is first warmed to 70° C. and the permanganate added until a permanent red tint remains. On further warming this colour vanishes, and the addition of permanganate and subsequent warming is carried on until the colour remains in the warmed solution.

Concordant results were obtained in a series of experiments with different solutions of arsenious acid, the percentage of $As_2O_3$ found was, however, in all cases higher than that obtained on titration with iodine.

The advantage of the permanganate over the iodine method lies in the cheapness of the former reagent, the greater stability of the permanganate solution, and in its acting as its own indicator.

The disadvantages of the method lie in its comparative slowness and the, to unpractised eyes, somewhat doubtful end reaction. These difficulties may however be entirely overcome by the addition of excess of permanganate solution, and backward titration of this excess with standardised hydrogen peroxide. The same quantity of sulphuric acid is used as before and the solution is not warmed; the hydrogen peroxide must be added till the solution is perfectly colourless.

The results agree precisely with those obtained by the iodine method, and the process is applicable to the determination of the arsenical potash solutions of the Pharmacopœia.
—J. T. C.

### *New Method of Determining Carbon in Iron.* E. Volmer, Stahl und Eisen, **15**, 1895, 199. Proc. Inst. Civil Eng. 1895, **122**, 65—66.

Peipers, an engineer at Remscheid, has introduced a method of determining carbon in steel which is similar in principle to the assay by touch in use for gold. A series of test-bars of known carbon content, and varying from each other by about 0·2 per cent. between the limits 0·2 per cent. and 1·2 per cent., form the touch-needles, while the touchstone is a slab of hard-biscuit porcelain. The bar is hammered and filed to a blunt conical point, which leaves a black mark when rubbed on the porcelain slab. The sample to be examined is rubbed upon the centre of the plate to form a patch of about the breadth and length of the finger, a similar one being made on either side of it with two of the bars the composition of which is known. The chief point to be attended to is the making of the patches uniform in depth of tint, which can be readily done with a little practice. The marked slab is then immersed to about half its depth in a beaker containing a $12\frac{1}{2}$ per cent. solution of copper ammonium chloride in water, which dissolves away the iron from the immersed portions of the patches, leaving the carbon behind as a grey stain, the intensity of which increases with the percentage proportion. Steel with about $1\frac{1}{3}$ per cent. of carbon is nearly as dark after as before immersion, while that with 0·25 gives only a very pale shade when the iron is removed. If the metal were perfectly free from carbon, the mark would be completely dissolved.

For streak plates, no substance has been found equal to unglazed porcelain. In its ordinary state, however, the latter is too rough to abrade the metal equally, so that it must be rubbed down with coarse emery-cloth to render the surface sufficiently uniform. The markings may be almost completely removed by washing in water, but a more satisfactory method is to clean the slab by immersion for 15 minutes in nitric or hydrochloric acid, which removes rust, spots, and stains, and restores the original white surface. The method is capable of indicating differences of 0·05 or 0·025 per cent. of carbon under favourable conditions.

### *Preparation of Thiacetic Acid, and its Use in the Detection and Estimation of Arsenic and other Metals.* R. Schiff. Ber. 1895, 28, 1204—1206.

Thiacetic acid may be readily and quickly prepared by carefully heating and distilling a mixture of phosphorus pentasulphide, 1 part; coarsely-powdered glass, $\frac{1}{2}$ part; glacial acetic acid, 1 part. The reaction, which soon commences, is easily regulated, and is not attended by excessive frothing. Distillation must be stopped when the thermometer marks 103° C., and the distillate fractionated, the portion passing over between 92° and 97° C. being collected.

The substitution of thiacetic acid for sulphuretted hydrogen is recommended as a reagent for metals (Group II., &c.) in general and for arsenic in particular. Its advantages are, convenience in use, comparative absence of odour, and, lastly, absolute freedom from arsenic, even when prepared from material ($P_2S_5$) containing that element. A solution of arsenic in hydrochloric acid is quantitatively precipitated when boiled for a short time with thiacetic acid. In practice, a 6 per cent. solution of the reagent in water, or a 30 per cent. solution in ammonia, in slight excess, may be used.—H. T. P.

### *Estimation of Boric Acid.* H. Jay and Dupasquier. Comptes rend. 121, 260—262.

The substance under examination, after being freed from organic matter, is dried, powdered, and acidified in very slight excess with hydrochloric or sulphuric acid, and then introduced, together with 25 to 30 c.c. of methyl alcohol, into a flask which is connected in such a manner with another flask, containing 1, 2, or 3 c.c. of a normal solution of potassium or sodium hydrate, free from carbonic acid, that when both flasks are heated on a water-bath the methyl alcohol vapour, carrying with it the boric acid, passes from the first flask into the liquid contained in the second. There the alkali fixes the boric acid, the methyl alcohol vapour passing to a vertical condenser, whence it is returned to the first flask, to again aid in extracting the boric acid. The amount of alkali solution placed in the second flask depends on the amount of boric acid supposed to be present, and should always be sufficient for the alkali to be in excess. The duration of the extraction varies, but does not exceed an hour and a half for 300 mgrms. In the titration of the acid, the authors make use of litmus paper and C.L.B. blue (Engel) as indicators, in the following manner: The alkaline liquid is warmed gently, to drive off the methyl alcohol, rendered slightly acid by means of hydrochloric acid, warmed to drive off any traces of carbonic acid, and then carefully neutralised, after cooling to 15°—20° C., with a decinormal solution of potassium hydrate, freed from carbonic acid, until it gives a neutral reaction with litmus paper. Two drops of a 1 per cent. aqueous solution of C.L.B. blue are then added, and the titration continued until the first change of colour. If care be taken to work with constant volumes and at constant temperatures, and also to get rid of the carbonic acid and methyl alcohol, excellent results are obtained.—J. G. W.

### *The Quantitative Separation of Metals in Alkaline Solution by Means of Hydrogen Peroxide.* P. Jannasch and H. Kammerer. Ber. 1895, 28, 1407—1409. (This Journal, 1891, 659 and 1037; 1892, 270; and 1894, 67, 548, and 1224.)

*Manganese from Silver.*—A solution of the metals in nitric acid ($HNO_3$, 10 c.c.; water, 10 c.c.) is added to a previously prepared mixture of water 20 c.c., hydrogen peroxide 50 c.c., strong ammonia 40 c.c., and the whole heated on a water-bath for 10—12 minutes. The precipitated manganese (absolutely free from silver) is filtered off, washed with the above ammoniacal peroxide mixture, finally with hot water, and weighed in the usual way. From the filtrate, after concentration to expel ammonia, and acidification with nitric acid, the silver is precipitated as chloride. Results very accurate.

*Bismuth from Cobalt.*—The nitric acid solution ($HNO_3$, 20 c.c., water 10 c.c.) is added to—water 20 cc., hydrogen peroxide 50 c.c., strong ammonia 50 c.c., and the precipitated bismuth filtered off, washed with above solution, then with dilute ammonia (1—2), and finally with hot water. To remove traces of co-precipitated cobalt, the precipitate is redissolved in dilute nitric acid (1—3), sufficient of the strong acid added to bring the total up to 20 c.c., and the above process repeated. Finally, the precipitate is dried at 90° C., and ignited in platinum to $Bi_2O_3$. The combined filtrates are evaporated to dryness, ignited to expel ammoniacal salts, the residue taken up in water, and a little hydrochloric acid and hydrogen peroxide, the solution filtered, if necessary, and the cobalt precipitated in the usual way by sodium hydrate and a little bromine. Or the cobalt may be at once precipitated from the original filtrate by ammonium sulphide. Results, accurate.—H. T. P.

### *Estimation of Sulphur in Iron and Steel.* L. Campredon. Comptes Rend. 120, 1051—1054.

The metal is dissolved in dilute acid. The sulphur compounds evolved as gas are passed through a red-hot porcelain tube along with hydrogen and carbon dioxide, and are thus converted into hydrogen sulphide, which by treatment with zinc acetate solution is transformed into zinc sulphide. This is then treated with excess of standard iodine solution ($ZnS + I_2 = ZnI_2 + S$), and the amount of unchanged iodine is determined by standard sodium thiosulphate. Generators capable of furnishing continuous currents of hydrogen and of carbon dioxide are connected by a T-piece with a wash-bottle of silver nitrate to remove sulphur compounds, next with the flask (provided with a stoppered funnel for supplying the acid) in which the solution is to take place, then with an empty flask immersed in cold water, to condense most of the water-vapour coming over. Next follows a porcelain tube which can be heated to bright redness, an absorption-flask containing 100 c.c. of the zinc acetate solution, and a "witness-flask" containing lead acetate solution. The whole having been filled with carbon dioxide, 2, 5, or 10 grms., of fine filings are introduced, 100 c.c. of 1:5 sulphuric acid or 1:3 hydrochloric acid added. After 2 or 3 minutes in the cold, the hydrogen is turned on and the solution-flask heated. At the end of the operation, the titration is performed in the absorption-flask itself.

The zinc solution is made by dissolving 10 grms. of zinc in 25 c.c. of glacial acetic acid, making up to about half a litre, adding ammonia to re-solution of the precipitate formed, and again acidifying with acetic acid. The iodine solution contains 7·9 grms. of iodine and 25 grms. of potassium iodide in the litre, so that 1 c.c. corresponds to 0·001 grm. of sulphur. The sodium thiosulphate solution contains 10 grms. of the salt and 2 grms. of ammonium carbonate in the litre, and is titrated against the iodine solution in presence of 100 c.c. of the zinc solution.

Half an hour suffices for a sulphur estimation in iron or steel. With cast-iron a longer time is needed, and it may be sometimes necessary to replace the absorption-flask by a second, and to carry on the operation longer, to make sure that the action is complete.—J. T. D.

### *The Quantitative Analysis of Galena.* P. Jannasch and H. Kammerer. Ber. 1895, 28, 1409—1411.

0·7 to 0·75 grm. of the finely-powdered sample is moistened with dilute nitric acid; and after a few minutes treated with 10 c.c. of concentrated nitric acid, gently heated, and partially evaporated. More acid and water, and 10—15 drops of bromine are then added, and the mixture stirred and heated until the sulphur is completely oxidised. Subsequently, the mass is evaporated three times to dryness with nitric acid to decompose bromates, after which the residue is boiled with 60 c.c. of water and 20 c.c. of concentrated hydrochloric acid, filtered, and the insoluble gangue well washed. The filtrate heated to boiling, is poured into a dish containing water, 25 c.c., hydrogen peroxide 50 c.c., strong ammonia 50 c.c., and the whole is then allowed to stand for some hours. By this means, the lead is precipitated in the form of a yellowish-red, partially crystalline oxide, which is filtered off, washed with cold water, and ignited in platinum to PbO. The filtrate is evaporated to expel ammonia, 5 c.c. of hydrochloric acid, and 5 c.c. of alcohol added, and the solution heated for a short time to destroy persulphuric acid, &c., and finally the sulphuric acid is precipitated as $BaSO_4$. The filtrate from the latter will contain any Cu, Ni, Zn, or As present in the sample. The process is rapid and appears to yield accurate results.—H. T. P.

### *Estimation of Gold and Silver in Copper and in Copper Matte.* E. A. Smith, Chem. News, 72, 76—77.

In this paper the author quotes largely from a paper by Dr. A. R. Ledoux, on a "Uniform Method of Assay of Copper and of Copper Materials for Gold and for Silver," read before the American Institute of Mining Engineers in October 1894.

It was found that in the Western States the "all fire" method was almost exclusively used, whereas in the East, a combined wet and dry method was employed. The latter consisted in dissolving the material in nitric acid, evaporating with sulphuric acid, adding a lead salt, and treating the precipitated lead sulphate in lead foil in the usual dry way by scorification and cupellation. The average results respectively of the dry and the combined wet and dry methods were 128·86 and 127·25 oz. of silver, and 2·28 and 2·198 oz. of gold in the copper matte, and 158·16 and and 156·49 oz. of silver, and 0·35 and 0·277 oz. of gold in the copper borings. While these average figures show higher results by the dry method, the individual assays also show a greater variation amongst themselves in the dry method. In the matte the difference between highest and lowest results in silver was 12·50 oz. in the dry and 7·65 oz. in the combined method, whilst with the borings the corresponding differences were 16·95 and 12·90 oz. The gold assays also varied greatly.

The author ascribes various causes for these discrepancies, not the least important of which is the probable want of accuracy in weighing the end products, the slightest error at this point being magnified greatly by the multiplication and conversion into ounces per ton.—A. W.

### *Estimation of Alumina in Phosphates.* H. Lanne. Comptes rend. 1895, 121, 63—66.

The phosphate is decomposed by hydrochloric acid, evaporated to dryness with the residue, dissolved in the least possible amount of hydrochloric acid, and diluted with water.

The new method depends on the solubility of alumina in caustic soda in presence of an excess of phosphoric acid, lime, magnesia, iron and manganese being entirely precipitated as phosphates or as sesquioxides.

For 1·25 grm. of phosphate in solution, free from silica and feebly acid, 5 grms. of caustic soda, free from silica and alumina, are dissolved in a nickel dish. (Account has to be taken of the calcium carbonate present in the phosphate; with very calcareous phosphates this amount of sodium phosphate would not be sufficient). The solution of the phosphate is added to the soda, which is stirred, and kept for an hour at 100°. The whole is diluted to 250 cc., adding another 5 c.c. to allow for the bulk of the precipitate. Of the filtrate 200 c.c. (corresponding with 1 grm. of substance) is precipitated by acidifying, adding ammonium chloride and a very slight excess of ammonia. The gelatinous precipitate is then drained, dissolved in dilute hydrochloric acid (1:20), and warmed. The solution is next treated with 3·5 c.c. of a 10 per cent. solution of ammonium phosphate, neutralised with ammonia without producing a permanent precipitate, diluted to 250 c.c., and 1·5 grm. of ammonium hyposulphite added. It is then boiled for half an hour, maintaining the volume, treated with 5 drops of a concentrated solution of ammonium acetate, boiled for 10 minutes longer, filtered, and the precipitate well washed with hot water. The weight of the precipitate, ignited for a quarter of an hour, when multiplied by 0·418, gives the weight of alumina; to this 0·8 mgrm. is added to compensate for the slight solubility.

The method is more rapid than any hitherto proposed, and gives results of great accuracy.—N. H. J. M.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### *Qualitative Detection of Unsaponifiable Oils in Fatty Oils.* Holde. Mitt. aus d. königl. techn. Versuchsanstalt zu Berlin, 1895, 13, [4], 170—172.

The experiments herein detailed were undertaken with the object of ascertaining the lowest percentage of mineral oil that can be detected by the well-known preliminary qualitative test for unsaponifiable oils in fatty oils, through the precipitate of the former produced by the addition of ammonia or water to the alcoholic solution of soap prepared from the oil under examination.

According to Lobry de Bruyn the unsaponifiable higher alcohols occurring in waxes are not precipitated by this method, and therefore cannot affect the results given by mineral oils.

The results of the author's investigations go to show that as little as 1 per cent. (sometimes, though rarely, 1·25) of mineral oil can be detected in this manner, the lowest limits for rosin oil and lignite tar oil being 12 per cent. and 3 per cent. respectively. Care is requisite when making the addition of water, as otherwise the turbidity, occasioned by the precipitation of small percentages of unsaponifiable oils, being dispersed as the quantity of water is increased, may easily be overlooked.—C. S.

### *Papasoglis' Method of Detecting Cane Sugar.* Dupont. Bull. de l'Ass. Chim. 1895, 13, 68.

If 15 c.c. of an aqueous or alcoholic solution of cane sugar be mixed with 0·5 c.c. of a 5 per cent. cobalt nitrate solution, and 2 c.c. of 50 per cent. solution of sodium hydrate added, a permanent colour, varying from violet to amethyst, is produced. The colour is not affected by glycerin, milk sugar, glucose, or invert sugar; but dextrins and gums must be removed by precipitation with lead acetate and barium hydrate, or ammoniacal lead acetate. The test is suitable for the detection of the presence of saccharose in milk, honey, syrups, liqueurs, medical preparations, wines, &c. When necessary, the substances to be examined are decolorised by animal charcoal.—J. L. B.

* DETECTION OF ARTIFICIAL AND NATURAL COLOURING MATTERS ON THE FIBRE. A. Lehne and A. Rusterholz. (*Continued from page 827.*)

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride and Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 182.<br>Benzo-Grey S extra. [By.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre dark bluish-violet. Heated—fibre and liquid violet.<br>*Dil.* :—Heated—liquid faint reddish-violet: with excess of caustic soda—colourless. | *Conc.* :—Fibre dark reddish-brown, liquid brownish-red: fibre gradually decolorised, liquid bright brownish shade. | *Conc.* :—Fibre violet-black, liquid the same; on addition of water—liquid decolorised. | *Conc.* :—Fibre dark-reddish-brown, liquid on heating dull cherry-red. On diluting with water and addition of acid—liquid colourless. | On heating—liquid blackish-violet. | Fibre rapidly decolorised in the cold. | No action. | Acetic acid of 8° Beaumé, fibre somewhat bluish, liquid pale reddish. On warming, the colour becomes considerably redder. |
| 183.<br>Nigrisin. [P.]<br>New Grey. [By.]<br>Methylene Grey. [M.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre bright yellowish-brown (earth-coloured). Heated—fibre almost decolorised, liquid violet-grey: diluted with water and excess of caustic soda added—bluish-grey. | *Conc.* :—Fibre immediately yellowish-brown (earth-coloured), then decolorised; liquid brownish. | *Conc.* :—Fibre olive-green, liquid greenish.<br>*Dil.* :—Heated—fibre brighter, liquid bluish-grey. | *Conc.* :—Fibre brownish-grey, liquid brownish.<br>*Dil.* :—Heated in liquid brownish, acidified—colourless. | Heated—fibre brighter, liquid faint brownish tint. | Fibre immediately decolorised, liquid yellowish. | No action. | .. .. |
| 184.<br>Violet-Black. [B.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately blue, liquid the same; on addition of water—fibre violet, liquid colourless. | *Conc.* :—Fibre immediately light brownish-red, liquid the same: on addition of water—fibre colourless. | *Conc.* :—Fibre dark blue, on warming deep-blue; liquid bluish: on addition of water—blue liquid. | *Conc.* :—Fibre dark violet. | Fibre assumes a bright violet colour, liquid becomes intensely violet. | Fibre quickly bleached in the cold. | Some of the colouring matter extracted on boiling. | .. .. |
| 185.<br>Diamine Black R, undiazotised. [C.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre immediately violet shade, liquid rose. | *Conc.* :—Fibre immediately violet shade, liquid reddish-violet; on addition of water—fibre light violet-grey. | *Conc.* :—Fibre bluish-black, liquid greenish-blue; on addition of water—liquid blackish-violet. | *Conc.* :—Fibre bright reddish-violet, liquid the same.<br>*Dil.* :—Heated—fibre and liquid reddish-violet; on acidification—blue. | Fibre red, liquid faint rose. | Decolorised gradually in the cold. | No action. | The diazotised colours exhibit in general the same reactions. |
| 186.<br>Diamond Black. [By.]<br>(*Animal fibre.*) | *Conc.* :—Heated—fibre dark greenish-blue; on addition of water—fibre original colour. | *Conc.* :—Fibre brown, liquid yellowish.<br>*Dil.* :—Heated—fibre olive-green, liquid yellowish. | *Conc.* :—Fibre greenish-black, liquid greenish. | No action. | No action. | Fibre bleached on heating. | No action. | The ash contains chromium. |
| 187.<br>Alizarin Black S W. [B.] | *Conc.* :—Heated—fibre blackish-violet, liquid violet.<br>*Dil.* :—Heated—fibre blackish-violet, liquid rose; on slowly adding caustic soda—at first violet, then blue. | *Conc.* :—Fibre at first deep black, then brown; liquid yellowish. | *Conc.* :—Fibre violet-black, liquid the same. | *Conc.* :—Fibre blackish-blue; warmed—liquid bluish. | No action. | Fibre dark brown, liquid brownish: warmed—fibre lighter. Colour not destroyed even on boiling. | No action. | The ash contains chromium. |

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| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride and Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| 188.<br>Naphthylamine Black D. [C.]<br>(*Animal fibre.*) | *Conc.*:—Fibre dark blue, liquid faint reddish-violet. | *Conc.*:—Fibre immediately yellowish-brown, then by degrees orange; liquid the same.<br>*Dil.*:—Heated—fibre deep black, then by degrees lighter till bright brown; liquid yellowish. | *Conc.*:—Liquid dark bluish-violet; warmed—red. On addition of water—bluish-red. | No action. | No action. | Fibre decolorised on warming. | No action. | .. .. |
| 189.<br>Naphthol Black. [C.]<br>Brilliant Black B. [B.]<br>(*Animal fibre.*) | *Conc.*:—Fibre little altered, liquid faint bluish-red. | *Conc.*:—Fibre at first reddish-violet, then Bordeaux-red, and finally scarlet; liquid the same.<br>*Dil.*:—Heated—fibre at first reddish-violet, then bright brown; liquid brownish. | Warmed—liquid dull dark blue; on addition of water—bluish-violet solution. | No action. | Fibre blackish-blue, liquid bluish. | Fibre decolorised on warming. | No action. | Ammonium acetate extracts the dye on being boiled, forming a reddish-violet solution; on addition of *conc.* sulphuric acid—bluish. |
| 190.<br>Aniline Black.<br>(*Vegetable fibre.*) | *Conc.*:—Fibre olive-black, liquid yellowish-brown. | *Conc.*:—Warmed—fibre brownish-black, liquid reddish-brown. | *Conc.*:—Fibre bluish-black, liquid the same; on addition of water—liquid greenish-black. | *Conc.*:—Heated—fibre violet-black, liquid rose. | No action. | Bleached with extreme difficulty even on boiling. | No action. | .. .. |
| 191.<br>Logwood.<br>(*Animal fibre.*)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre by degrees carmine-red, liquid red; heated—fibre scarlet, liquid the same. Diluted with water and excess of caustic soda added—liquid darker (dirty reddish-violet). | *Conc.*:—Fibre immediately brown, liquid yellowish. | *Conc.*:—Fibre olive-brown, liquid golden-yellow; on addition of water—fibre lighter.<br>*Dil.*:—Heated—fibre scarlet, liquid red; excess of caustic soda added—darker (dirty reddish-violet). | Warmed—fibre fawn-brown, liquid colourless; acidified—liquid reddish-violet. | No action. | No action in the cold. Warmed—fibre and liquid scarlet. On boiling—fibre decolorised, liquid orange. | No action. | The ash (woollen) contains chromium (cotton sometimes), often copper (cotton generally), and at times iron (cotton generally). |
| 192.<br>Alizarin-Cyanin Black. [By.]<br>(*Animal fibre.*) | *Conc.*:—Fibre more bluish shade, liquid rose.<br>*Dil.*:—Heated—fibre more bluish, liquid reddish-violet. | *Conc.*:—Fibre dark reddish-violet, liquid reddish-violet; fibre and liquid by degrees orange. | *Conc.*:—Fibre dark blue, liquid navy-blue; on addition of water—liquid reddish-violet.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—Warmed—fibre dark greenish-blue. | No action. | Heated—fibre dark brown, liquid intense cherry-red. | No action. | Chromium may be detected in the ash. |
| 193.<br>Diazo Black R. [By.]<br>(Developed with β-naphthol.)<br>(*Vegetable fibre.*) | *Conc.* and *Dil.*:—No action even on boiling. | *Conc.*:—Fibre brown, liquid reddish-brown; on addition of water—fibre lighter shade.<br>*Dil.*:—Heated—fibre brown, liquid faint brownish tint. | *Conc.*:—Fibre and liquid intense navy-blue; on addition of water—liquid almost colourless.<br>*Dil.*:—No action. | *Conc.*:—Warmed—fibre dull reddish-violet, liquid faint rose tint. | Heated—fibre redder, liquid faint rose. | Fibre at first reddish-violet, then gradually decolorised. | No action. | Boiled with alkaline stannous chloride (made by adding soda-lye to a solution of stannous chloride until the precipitate first produced redissolves)—liquid intense red. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 194.<br>Diazo Brilliant Black B. [By.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre dull greenish-blue, liquid colourless. | *Conc.* :—Fibre and liquid reddish-violet; on addition of water—fibre lighter, liquid brick-red. | *Conc.* :—Fibre and liquid indigo-blue.<br>*Dil.* :—No action. | No action. | No action. | Fibre bleached in the cold. | No action. | Boiled with alkaline stannous chloride—fibre and liquid reddish-violet; rinsed, diazotised, and developed with β-naphthol—again black. |
| 195.<br>Diamine Jet Black O O. [C.]<br>(*Vegetable fibre.*) | *Conc.* :—Fibre and liquid dark violet.<br>*Dil.* :—Heated—liquid faint rose; with excess of soda-lye—faint brownish tint. | *Conc.* :—Fibre and liquid immediately brown.<br>*Dil.* :—Fibre brown, liquid brownish-yellow. | *Conc.* :—Fibre dark blue, liquid blue; on addition of water—liquid violet.<br>*Dil.* :—Same as dilute hydrochloric acid. | *Conc.* :—Fibre immediately Bordeaux-red, liquid red.<br>*Dil.* :—Heated—fibre Bordeaux-red, liquid red; acidified—light dirty violet. | Heated—liquid faint reddish-violet. | In the cold, gradually decolorised. | No action. | Boiled with alkaline stannous chloride—liquid yellowish-red, but not fibre. Oxydiamine Black N. [C.] behaves almost similarly. There is a difference, however, in the reaction with soda-lye. With oxydiamine black the fibre becomes dark reddish-violet, whereas with diamine deep black it becomes immediately Bordeaux-red. |

—A. R. L.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

### *Estimation of Thiophen in Benzene.* G. Denigès. Bull. Soc. Chim. 1895, **13**, 537.

By acting upon thiophen with mercuric sulphate in aqueous solution, a basic thiophen mercuric sulphate is formed having the formula $SO_4:(HgO.Hg)_2:SO_4.C_4H_4S$, which is fairly stable, and after losing water of crystallisation may be heated to 150° without loss of weight. To estimate the thiophen in benzene the following method is proposed:—

A solution of mercuric sulphate is made by dissolving 50 grms. of HgO in dilute sulphuric acid (200 c.c. $H_2SO_4$: 1 l. of $H_2O$); 20 c.c. of this solution are introduced into a flask of about 60 c.c. capacity, and 2 c.c. of the benzene added. A glass stopper is secured in the neck of the flask with wire, and the whole is heated for a quarter of an hour on the water bath. It is then allowed to cool, filtered through a weighed filter, washed with hot water, dried at 100°—115°, and weighed; in which case the weight of the precipitate multiplied by $\frac{84}{1108} = 0 \cdot 0758$ gives the amount of thiophen in the benzene used. Or, the mercury in the precipitate may be estimated, and the weight of mercury multiplied by $\frac{84}{800} = 0 \cdot 105$.

If it is necessary that the process should be carried on in the cold, methyl alcohol may be used as a solvent for the benzene; the insoluble sulphate is then at once precipitated. If the thiophen be in excess of the mercuric sulphate, the same compound is formed, but if the mercury be in excess, a different sulphate is formed, having the formula—

$$SO_4 : (HgO)_2 : Hg.C_4H_4S.$$

2 c.c. of the benzene are mixed with 30 c.c. of methyl-alcohol in the cold. To this, 10 c.c. of the mercury reagent are added quickly and with stirring. After about 20 minutes, the precipitate is filtered, washed with hot water, and dried at 110°.

If only traces of thiophen be present, the amount may be estimated by the rapidity with which the turbidity due to the thiophen mercuric sulphate appears. 10 c.c. of a solution made by adding 3 vols. of methyl alcohol to 1 vol. of the mercury reagent are placed in a test tube, and 1 c.c. of the benzene to be tested added. The mixture is shaken and the time noted when a turbidity begins to appear. It has been found, by using pure benzene and thiophen in known proportions, that if the time be between 10 and 40 seconds, the number of seconds ($t$) multiplied by the number of centigrms. per litre of benzene (Q) gives a constant—

$$Q\,t = 400;$$

$$\text{therefore} \qquad Q = \frac{400}{t}.$$

If 1 c.c. of the benzene gives a turbidity in 20 seconds, it contains $\frac{400}{20} = 20$ centigrms. of thiophen in 1 litre.

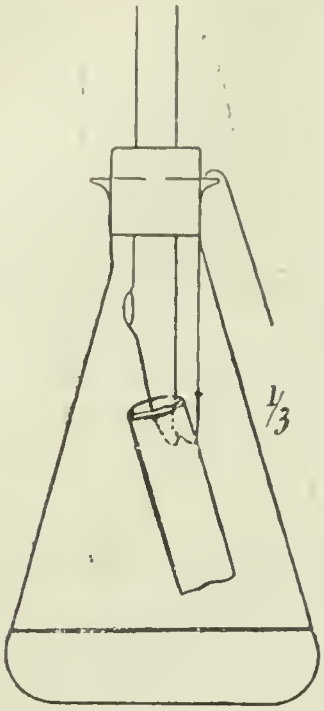
Benzenes richer in thiophen may be estimated by this method. A smaller quantity of benzene than 1 c.c. is taken. In order to do this, a certain number of drops are added to the 10 c.c. of the solution in the test tube, and the number of drops counted in 1 c.c. of the benzene.

If 1 c.c. = 72 drops, and 2 drops give a turbidity in 15 secs., then $Q = \frac{400}{15} \times \frac{72}{2}$ centigrms. = 9·6 grms. per litre of benzene.

This alcoholic solution of mercuric sulphate is a very delicate reagent for detecting traces of thiophen which escape the reaction of isatin, alloxan, &c. It is possible to detect 5 mgrms. in 1 litre of benzene. Care must be taken that the alcoholic solution be made fresh, immediately before using, as it becomes turbid after 5—6 hours. It must also be employed cold.—H. M.

### *New Method of Estimating Indigotin.* J. Schneider. Zeits. anal. Chem. 1895, **34**, [3], 347—354.

The methods hitherto introduced for estimating indigotin are all more or less unsatisfactory, and this is partly due to defective apparatus and partly to the employment of unsuitable solvents. The apparatus devised by the author consists of an Erlenmeyer flask of about 250—300 c.c. capacity, and fitted with a cork through which passes a glass tube 15 mm. diameter and 1 metre long; the lower end of the tube is contracted and slightly bent, and there is a side aperture below the cork. The indigo (0·5—1·0 grm.) is mixed with glass-wool or broken glass in a coil of filter-paper, which is then placed in a linen filter, and the whole is suspended in the flask by means of a thread and a bent pin. The solvent employed is naphthalene (50 grms.), which must be free from ash. The naphthalene is heated to boiling, and this is continued for some time after the drops falling from the filter appear colourless. When cold, ether (150 grms.) is introduced into the flask to dissolve the naphthalene and precipitate the indigotin, which is collected on a filter, washed, dried, and weighed. With commercial white naphthalene, the loss amounted to 1—4 mgrms. on 1 grm. of indigo, and this could certainly be reduced by purifying the naphthalene and heating in an oil-bath instead of over wire-gauze.—A. K. M.



*Resin Content and Liability to Resinification of Mineral Lubricating Oils.* D. Holde. Mitt. aus d. königl. techn. Versuchsanstalt zu Berlin, 1895, **13**, [4], 174—196.

With the exception of asphaltic bodies precipitated by petroleum spirit, no amount of resin sufficient to produce "gumming" has been detected in mineral lubricating oils unless adulterated. Aisinman's researches (this Journal 1895, 282), though confirmatory of this were not devoted to any attempt to establish a positive method for detecting resinous constituents in mineral oils, and the author therefore, on the basis of an experience gained in recent years, attempted to determine if such a method could be devised, and he also endeavoured to trace the connection between the presence of resins and the "gumming" tendency of the oil.

The behaviour of a dark-coloured cylinder oil on treatment with a mixture of alcohol and ether (3:4) for the detection of paraffin led to the choice of this mixture as probably a suitable means to this end. It was found that agitation with the above mixture produced a dirty brown precipitate, which when filtered, washed, redissolved in benzene, and evaporated to dryness, gave a dark, resinous, stringy mass, assuming a semi-fluid oily consistency when slightly heated. The oil itself, after the separation of the precipitate and the removal of the alcohol-ether mixture by evaporation, exhibited a considerable degree of modification in transparency and solubility in petroleum spirit, now forming in the latter a clear yellow solution with but little sediment, whereas originally the solution was dark and turbid, and the asphaltic deposit considerable. The residue left after heating a thin layer of each oil for 300 hours at 100° C., was in the case of the original oil thick and resinous when cold, but that from the treated oil was very slight and thin, though "tacky."

The application of this test to several lubricating and crude mineral oils produced precipitates of the kind described, but it was found that by increasing the proportion of alcohol in the alcohol-ether mixture up to 4:3, the volume of precipitated matters was correspondingly augmented, and it appears that the bodies last thrown down are more pitch-like, fusible, and approach more nearly in composition to oil than are the asphaltic substances first deposited. The use of a larger proportion of alcohol decreases the solvent power of the mixture, and the evaporation of ether when the solution is left to stand produces the same effect. As a rule about five volumes of mixture were sufficient to completely dissolve the oil, but cylinder oils required a much greater amount. (For the solvent action of alcohol on mineral oils, see Dingler's polyt. J. 1895, **297**, 44—47; this Journal, 1895, 812.)

All the precipitated bodies are soluble in benzene, but only the pitchy portion in petroleum spirit, and this portion may be fractionated into two parts, one insoluble in the 3 : 4 alcohol-ether mixture, and the other precipitated by the 4 : 3 mixture. It is noteworthy that the resinous matter in Russian oils is softer and more like paraffin than the asphaltic precipitates from the German oils, the latter being of high specific gravity and only melting at about 100° C.

The asphalt-resins in mineral oil contain on an average about 2 per cent. of oxygen, and, as in a typical case cited, they only amounted to some 5 per cent. of the oil, this represents an oxygen percentage in the latter of 0·1 per cent. The oil contained 0·5 per cent. of oxygen, so that Aisinman's contention that the low percentage of oxygen in mineral oil is a proof of the absence of any notable quantity of resinous matter, cannot be considered as justified.

The presence of these bodies appears to have an appreciable effect on the cold-resisting properties of oil, and on the modification of fluidity at ordinary temperatures sometimes observed.

Concerning the detection of added resin, whilst this substance is revealed by its acid reaction, and can be extracted by boiling with 70 per cent. alcohol, the latter method cannot be considered as by itself reliable, cases having been observed where resinous matters (up to 3 per cent.) were extracted by this solvent from almost or entirely neutral oils perfectly free from added resin. These bodies resembled resin, although paler in colour and more like lac, and were, like the pitchy and asphaltic precipitates already mentioned, soluble in benzene. In acid character and property of forming a lathering soap, some of them approximated to resin, but all differed from it in the colour test with acetic and sulphuric acids. Their origin may be attributable to the oxidation of some of the hydrocarbons of the oil by air, or the sulphuric acid used in refining, or to polymerisation and oxidation of the terpenes.

The extraction and precipitation of these resinous and similar bodies by the foregoing methods is, however, incomplete, and can only serve as an approximate, though sometimes very precise, indication of their amount.

For the purpose of elucidating the connection between the presence of asphaltic, resinous, or pitchy constituents and the liability of the lubricating oils to "gum" on prolonged exposure to air, a number of samples of mineral oil were spread out in thin layers and heated for periods extending up to 400 hours at temperatures between ordinary room temperature and 100° C., one series of tests being with weighed quantities of oil in order to ascertain the weight of the resins, &c. left behind. Samples of oil from which these bodies had been removed by alcohol-ether mixture or 70 per cent. alcohol were also tested in the same way for the purpose of comparison. The results consistently indicate that the tendency to "gum" is influenced by the asphaltic and similar substances under consideration, since the heavy dark-coloured oils containing petroleum residue were found to dry quicker and leave a larger amount of "gum" than the lighter-coloured oils containing no residue, or than such as had been treated by alcohol-ether or 70 per cent. alcohol; in fact "gumming" in the case of the last two classes may be considered as practically non-existent. When occurring it may be attributed to the concentration of resinous—particularly in so-called "soap oils" from the sludge obtained from the alkali treatment in the refining of mineral oils—and asphaltic substances, as a result of the evaporation of the greater part of the liquid constituents of the oil and the partial oxidation of the remainder.

Samples of crude rape oil, subjected to the exposure tests, dried completely in 70 to 120 hours at 50° C., and refined rape in 28—35 hours, *i.e.*, much sooner than the mineral oils.

The percentage of asphalt and pitch thrown down by the alcohol-ether mixture varied from 0·16 with a machine oil consisting of distillates, to 5·7 from railway oil, both of Russian origin; a thick lubricating oil from Oelheim gave 11·1 per cent., and a very thick crude oil from Wieze 15·4 per cent. In the extraction of the resinous matters by 70 per cent. alcohol, the amount of the solvent varied from 3 to 20 times the volume of oil acted on; the lowest percentages obtained (0·29 and 0·52) were from very fluid transparent oils, the railway oils yielding from 1·47 to 3·21 per cent.; a distillate from Russian crude oil (very thick, although transparent) gave 3·3 per cent. with 20 volumes of alcohol, and a thick opaque Galician oil 3·6 per cent., 20 volumes of the solvent being also required in this case.—C. S.

### *Detection and Estimation of Metals in Fatty Oils.* H. Fresenius and A. Schattenfroh. Zeits. anal. Chem. 1895, **34**, 381—390.

The determination of a metal in an oil may be effected (1) By agitating the oil with a dilute acid so as to form a soluble salt of the metal; (2) By precipitating the metal from an ethereal solution of the oil and separating by filtration; (3) By incinerating the oil and determining the metal in the ash. The last method is clearly only applicable when the oxide of the metal present is either not reducible or only so with difficulty, or where the metal is at most only volatile at the highest temperatures. The metals experimented with are copper, zinc, aluminium, lead, and iron.

*Copper* may be accurately determined by all three methods, but preference is given to the first method. The oil is dissolved in ether and the solution well shaken with dilute nitric acid; the aqueous layer contains the whole of the copper in solution. The copper may also be precipitated as sulphide from an ethereal solution of the oil, but the filtration is rather tedious. *Zinc* may be estimated by incineration or by extraction with dilute nitric or hydrochloric acid, preferably the latter. The hydrochloric acid solution obtained is simply evaporated with mercuric oxide, the residue ignited, and the resulting zinc oxide weighed. *Aluminium* may also be determined either by incineration or by extraction with dilute acid. If nitric acid be employed, the resulting nitrate is ignited and the aluminium weighed as oxide; if hydrochloric acid be used, the alumina must be precipitated by ammonia. In the case of *lead*, the incineration method gives low results, whilst accurate determinations may be made either by precipitation as sulphide or by extraction with nitric acid. A still better method is to shake the ethereal solution of the oil with dilute sulphuric acid, filter, ignite, and weigh as lead sulphate. *Iron* may be accurately estimated either by incineration, by precipitation with ammonium sulphide, or by agitation with dilute acid. When the second method is employed, the ferrous sulphide is dissolved in acid, oxidised, and precipitated with ammonia, the iron in all cases being weighed as $F_2O_3$.—A. K. M.

### *Estimation of Glycerin.* F. Gantter. Zeits. anal. Chem. **34**, 1895, 421—426.

The complete oxidation of concentrated glycerin solutions to $CO_2$ and water by means of sulphuric acid and bichromate of potash forms the basis of several analytical processes, the $CO_2$ formed being either weighed or measured, or the quantity of bichromate used determined. Of these processes the gas-volumetric is the most exact, and taking advantage of Hehner's observation that even dilute glycerin solutions are completely oxidised by strong bichromate, the author proposes to use his volumeter in the following manner:—

3 grms. of solid potassium bichromate and 5—10 c.c. of glycerin solution (containing not more than 300 mgrms. of glycerin) are placed in the reaction-flask, and in the dropping-funnel 10 c.c. of sulphuric acid (2 vols. $H_2SO_4$ to 1 vol. $H_2O$). After connecting the apparatus the greater part of the bichromate is dissolved by gentle warming and the acid added drop by drop. The evolution of $CO_2$ proceeds regularly and at a low temperature, and is completed by bringing the contents of the flask gradually to lively ebullition and maintaining this condition for 15 minutes after the whole of the sulphuric acid has been added. The water formed in the reaction is condensed, before reaching the pipette, in the empty absorption-tube used in nitrogen determinations. The $CO_2$ is measured in the ordinary way after the apparatus has cooled.

The complete analysis requires less than one hour to perform.

The reaction proceeds thus: $C_3H_8O_3 + O_7 = 3CO_2 + 4H_2O$, from which it follows that 1 c.c. $CO_2$ corresponds to 1·296 mgrms. of glycerin.

In a series of experiments the author shows that the results obtained by this method are concordant, even when very dilute solutions are used.

In a further series of experiments it is proved that glycerin does not distil with steam or alcohol vapour, but that volatilisation only occurs when the glycerin is completely dry, and that therefore no error can occur with dilute solutions from this cause.

In estimating any sample it is recommended to oxidise 259·2 mgrms. with the bichromate; the required percentage is then found by dividing the c.c. $CO_2$ evolved by 2. Crude glycerin must be treated with silver oxide and basic lead acetate before oxidising, or too high results are found.

To determine the glycerin in a fat the author saponifies 5·184 grms. of substance with strong caustic soda solution, boils with sufficient water to dissolve the soap, and, after precipitating the organic acids by addition of sulphuric acid and filtering till a clear filtrate (= 100 c.c.) is obtained, he oxidises 10 c.c. in the volumeter as described. The c.c. divided by 4 give the percentage of glycerin. The whole operation requires from 70 to 80 minutes.—J. T. C.

### *The Estimation of Starch.* H. Ost. Chem. Zeit. 1895, **19**, 1501—1507.

The amount of water is determined by heating 1—5 grms. of the sample in a Liebig's bulb tube at 50°—60° for some hours in a current of dry hydrogen. The temperature is then slowly raised to 100°—110°, when nearly all the water is given off; at 150° the product is still white. The water may also be driven off within 0·1—0·3 per cent. if the sample be placed on an open watch glass in an oven packed with asbestos and heated by several small burners, or by means of hot air, the temperature being slowly raised to 130°.

The author states that Sachsse's method of hydrolysis gives the maximum amount of glucose that can be obtained. 3 grms. of the sample are heated with 20 c.c. of hydrochloric acid (sp. gr. 1·125) and 200 c.c. of water in a boiling water bath for 2—3 hours; the weight of glucose found, as indicated by the cupric reduction, and multiplied by the factor 0·925, gives the weight of starch. The author employs the same method in the analysis of the dextrins. When 1 grm. of maltose is heated with 100 c.c. of a 1—2 per cent. solution of hydrochloric acid in a bath of boiling water for 5 hours, it yields 98—98·4 per cent. of the theoretical amount of glucose. Attempts to convert starch solely into maltose were unsuccessful.

Effront's method consists in triturating starch (5 grms.) with concentrated hydrochloric acid (20 c.c.) for 5—8 minutes; the clear solution is then made up to 200 c.c. with water and polarised. By employing hydrochloric acid of 1·17 sp. gr. fairly constant values were obtained, namely, $[\alpha]_D$ = + 196·3 to + 196·7 for anhydrous starch. The use of hydrochloric acid can be avoided by gelatinising 2—3 grms. of starch with 80—90 c.c. of water, and heating in a Lintner's flask for 3—5 hours under a pressure of 2—3 atmospheres. The solution is then made up with water to 100 c.c. and polarised. Such solutions have no reducing power, and give values for the specific rotatory power of soluble starch: $[\alpha]_D$ = + 196·5°— + 197°; if, however, a slight reducing power is observed, it has but little influence on the optical rotation. The author has not determined if this method is applicable for the estimation of starch in raw materials.—J. L. B.

*Influence of the Presence of Lead Acetate on the Estimation of Invert Sugar.* Bornträger. D. Zuckerind. 1895, **20**, 1169.

The author's experiments bear out his previous results, and he confirms Gill's statement of 1871, namely, that the titration of solutions containing sugar with Fehling's solution in presence of lead acetate, gives low results. For the removal of lead salts the author recommends the use of sodium phosphate.—J. L. B.

*Investigations on the Behaviour of Sugars towards Alkaline Copper Solutions.* J. Kjeldahl. Carlsberg Laboratoriets Meddelelser, 1895, **4**, 1—62.

The estimation of sugar as at present carried out frequently yields discrepant results. The author finds that the influence of the oxygen of the air on the copper oxide is considerably greater during the reduction of the copper solution than during the filtration. Into a conical 150-c.c. flask were placed 30 c.c. of Fehling's solution, a solution of 0·06 grm. of glucose, and the whole made up to 100 c.c. with water. The stopper of the flask was fitted with two tubes, one of which reached nearly to the bottom; through it a stream of hydrogen was led into the solution for some minutes. The flask was then placed in a boiling water bath for 20 minutes, filtered through a glass tube packed with asbestos, washed with warm water, alcohol, and ether, and dried and reduced in a current of hydrogen (I.). The following parallel experiments were carried out in the presence of air: (II.) in a narrow-necked 100-c.c. flask, (III.) in a conical 150-c.c. flask, (IV.) in a beaker, (V.) in a deep basin, (VI.) in a shallow basin. In the following table the superficies of the liquid in contact with the air are given, and the quantity of copper found :—

| — | Superficies, in contact with Air. | Weight of Copper obtained. | Difference in Weight of Copper compared with I. |
|---|---|---|---|
| | Sq. cm. | Grm. | |
| I. ............ | 0 | 0·1263 | .. |
| II. ............ | 2 | 0·1260 | − 0·0003 |
| III. ............ | 17 | 0·1239 | − 0·0024 |
| IV. ............ | 21 | 0·1215 | − 0·0048 |
| V. ............ | 65 | 0·1148 | − 0·0115 |
| VI. ............ | 186 | 0·1066 | − 0·0197 |

The cooling of the liquid before filtration does not affect the results. The heating of the asbestos is effected in a small sheet-iron air-bath. Next, strong nitric acid, warm water, alcohol, and ether, are run through the filter tube, which is finally heated in a current of hydrogen. Filter tubes which had been in use for some time generally lost 0·0008 grm. in each analysis. The author has constructed the following tables for glucose, levulose, invert sugar, galactose, milk-sugar, and maltose.

15 c.c. *Fehling's Solution.*

| Copper. | Glucose. | Levulose. | Invert Sugar. | Galactose. | Milk-Sugar, $C_{12}H_{22}O_{11} + H_2O$. | Maltose, $C_{12}H_{22}O_{11}$ |
|---|---|---|---|---|---|---|
| Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. |
| 5 | 2·2 | 2·6 | 2·5 | 2·5 | 3·4 | 3·7 |
| 10 | 4·4 | 5·2 | 5·1 | 5·0 | 6·7 | 7·5 |
| 20 | 9·0 | 10·4 | 10·0 | 10·2 | 13·6 | 15·1 |
| 30 | 13·7 | 15·8 | 15·0 | 15·5 | 20·5 | 22·8 |
| 40 | 18·6 | 21·2 | 20·2 | 20·9 | 27·6 | 30·7 |
| 50 | 23·7 | 26·7 | 25·5 | 26·5 | 34·9 | 38·7 |
| 60 | 28·9 | 32·4 | 30·9 | 32·3 | 42·2 | 46·9 |
| 70 | 34·3 | 38·1 | 36·5 | 38·3 | 49·7 | 55·2 |
| 80 | 40·0 | 44·0 | 42·3 | 44·4 | 57·5 | 63·8 |
| 90 | 46·0 | 50·0 | 48·3 | 50·8 | 65·4 | 72·4 |
| 100 | 52·3 | 56·2 | 54·5 | 57·5 | 73·5 | 81·3 |
| 110 | 58·9 | 62·5 | 61·0 | 64·4 | 81·8 | 90·4 |
| 120 | 66·0 | 69·0 | 67·8 | 71·7 | 90·3 | 99·8 |
| 129 | 72·9 | 74·9 | 74·2 | 78·7 | 98·3 | 108·4 |

30 *c.c. Fehling's Solution.*

| Copper. | Glucose. | Levulose. | Invert Sugar. | Galactose. | Milk-Sugar, $C_{12}H_{22}O_{11} + H_2O$. | Maltose, $C_{12}H_{22}O_{11}$ |
|---|---|---|---|---|---|---|
| Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. | Mgrms. |
| 40 | 17·8 | 19·8 | 19·1 | 19·8 | 26·7 | 30·9 |
| 50 | 22·4 | 24·9 | 23·9 | 25·0 | 33·6 | 38·8 |
| 60 | 27·0 | 30·1 | 28·8 | 30·1 | 40·6 | 46·8 |
| 70 | 31·8 | 35·2 | 33·8 | 35·4 | 47·6 | 54·8 |
| 80 | 36·6 | 40·5 | 38·8 | 40·7 | 54·6 | 63·0 |
| 90 | 41·4 | 45·9 | 43·9 | 46·0 | 61·8 | 71·2 |
| 100 | 46·4 | 51·3 | 49·1 | 51·5 | 69·0 | 79·4 |
| 110 | 51·4 | 56·8 | 54·4 | 57·0 | 76·4 | 87·7 |
| 120 | 56·6 | 62·4 | 59·8 | 62·6 | 83·8 | 96·1 |
| 130 | 61·8 | 68·0 | 65·2 | 68·3 | 91·3 | 104·7 |
| 140 | 67·1 | 73·7 | 70·7 | 74·0 | 98·9 | 113·3 |
| 150 | 72·5 | 79·6 | 76·3 | 79·9 | 106·5 | 121·9 |
| 160 | 78·0 | 85·5 | 82·0 | 85·8 | 114·3 | 130·7 |
| 170 | 83·7 | 91·5 | 87·9 | 91·9 | 122·2 | 139·6 |
| 180 | 89·4 | 97·6 | 93·80 | 98·0 | 130·3 | 148·6 |
| 190 | 95·3 | 103·9 | 99·9 | 104·3 | 138·4 | 157·6 |
| 200 | 101·4 | 110·2 | 106·1 | 110·6 | 146·7 | 166·8 |
| 210 | 107·5 | 116·7 | 112·4 | 117·1 | 155·0 | 176·1 |
| 220 | 113·9 | 123·2 | 118·8 | 123·8 | 163·5 | 185·5 |
| 230 | 120·4 | 130·0 | 125·5 | 130·5 | 172·2 | 195·1 |
| 240 | 127·1 | 136·8 | 132·2 | 137·5 | 181·0 | 204·7 |
| 250 | 134·1 | 143·8 | 139·2 | 144·5 | 189·9 | 214·4 |
| 260 | 141·2 | 150·9 | 146·3 | 151·8 | 199·0 | 224·3 |

50 *c.c. Fehling's Solution.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 100 | 44·7 | 49·1 | 47·2 | 49·5 | 71·4 | 82·9 |
| 110 | 49·4 | 54·3 | 52·2 | 54·6 | 78·7 | 91·3 |
| 120 | 54·1 | 59·4 | 57·1 | 59·8 | 86·1 | 99·8 |
| 130 | 58·8 | 64·6 | 62·0 | 65·0 | 93·5 | 108·4 |
| 140 | 63·7 | 69·8 | 67·0 | 70·3 | 100·9 | 117·0 |
| 150 | 68·5 | 75·2 | 72·1 | 75·6 | 108·4 | 125·7 |
| 160 | 73·4 | 80·5 | 77·2 | 81·0 | 115·9 | 134·3 |
| 170 | 78·4 | 85·9 | 82·4 | 86·4 | 123·4 | 143·0 |
| 180 | 83·4 | 91·3 | 87·6 | 91·9 | 130·9 | 151·8 |
| 190 | 88·4 | 96·8 | 92·9 | 97·4 | 138·5 | 160·6 |
| 200 | 93·5 | 102·3 | 98·2 | 102·9 | 146·1 | 169·4 |
| 210 | 98·7 | 107·9 | 103·6 | 108·5 | 153·8 | 178·3 |
| 220 | 103·9 | 113·5 | 109·0 | 114·2 | 161·5 | 187·2 |
| 230 | 109·2 | 119·2 | 114·5 | 119·9 | 169·3 | 196·2 |
| 240 | 114·5 | 124·9 | 120·0 | 125·7 | 177·1 | 205·2 |
| 250 | 119·9 | 130·7 | 125·6 | 131·5 | 184·9 | 214·3 |
| 260 | 125·4 | 136·5 | 131·2 | 137·4 | 192·7 | 223·3 |
| 270 | 131·0 | 142·4 | 137·0 | 143·3 | 200·6 | 232·5 |
| 280 | 136·6 | 148·3 | 142·7 | 149·3 | 208·6 | 241·7 |
| 290 | 142·3 | 154·3 | 148·6 | 155·4 | 216·6 | 251·0 |
| 300 | 148·0 | 160·4 | 154·5 | 161·5 | 224·6 | 260·2 |
| 310 | 153·9 | 166·6 | 160·5 | 167·7 | 232·7 | 269·6 |
| 320 | 159·8 | 172·8 | 166·6 | 174·0 | 240·8 | 279·0 |
| 330 | 165·8 | 179·1 | 172·7 | 180·3 | 249·0 | 288·4 |
| 340 | 171·9 | 185·5 | 179·0 | 186·8 | 257·2 | 297·9 |
| 350 | 178·1 | 191·9 | 185·3 | 193·3 | 265·4 | 307·5 |
| 360 | 184·4 | 198·4 | 191·7 | 199·8 | 273·7 | 317·0 |
| 370 | 190·8 | 205·0 | 198·2 | 206·5 | 282·1 | 326·7 |
| 380 | 197·3 | 211·7 | 204·8 | 213·3 | 290·5 | 336·4 |
| 390 | 204·0 | 218·5 | 211·5 | 220·1 | 299·0 | 346·2 |
| 400 | 210·7 | 225·3 | 218·3 | 227·1 | 307·5 | 356·0 |
| 410 | 217·6 | 232·3 | 225·2 | 234·1 | 316·0 | 365·9 |
| 420 | 224·6 | 239·4 | 232·3 | 241·2 | 324·6 | 375·8 |
| 430 | 231·8 | 246·6 | 239·5 | 248·5 | 333·3 | 385·8 |
| 434 | 234·7 | 249·5 | 242·4 | 251·5 | 336·8 | 389·9 |

Alkaline copper solutions undergo slight reduction when heated for prolonged periods; this is more pronounced with concentrated solutions. For the estimation of small quantities of sugar it is advisable to dilute the 15 c.c. of Fehling's solution with 85 c.c. of water.

In order to determine the acid equivalent from the oxidation of a molecule of sugar, a modification of the iodometric acid estimation can be employed, which depends on the following reactions (A = acid residue) :—

I.

$$5KI + KIO_3 + 6HA = 6KA + 3H_2O + 6I.$$

II.

$$6I + 6Na_2S_2O_3 = 6NaI + 3Na_2S_4O_6.$$

The decomposition, according to the first equation, is only possible in the presence of strong inorganic acids, but if an excess of sodium thiosulphate be added soon after the potassium iodide and iodate, the complete decomposition is effected in a short time. Evidently the energy set free by the second reaction accelerates the liberation of iodine according to the first. On the following day the excess of sodium thiosulphate is determined by titration with iodine. All carbon dioxide must necessarily be first removed. Probably besides formic acid, acids of the $C_nH_{2n}O_{n+1}$ series are formed, namely, glycollic, glyceric, trioxybutyric, arabonic, and gluconic acids.

The author has investigated the influence of sodium hydroxide on the sugars, and the acids thereby formed. By warming 1 mgrm. mol. of glucose with 50 mgrm. mols. of sodium hydroxide in 100 c.c. of water, about 1·61 acid equivalent is formed, whilst levulose forms 1·67, and arabinose 1·35. The author finds mesoxalic acid is the chief product of the oxidation of glucose with copper and potassium carbonate, and it appears to amount to more than half of its acid equivalent.—J. L. B.

*Analysis of the Nitrogenous Constituents present in Meat Extracts and Commercial Peptones.* A. Stutzer. Zeits. anal. Chem. 1895, **34**, 372—380.

In this paper the author proposes some modifications of the methods described in an earlier paper (Zeits. anal. Chem. **31**, 501).

1. *Determination of Water, Ash, Sodium Chloride, and Total Nitrogen.*—Of dry preparations 5—7 grms. are taken, of fluids 20—25 grms. The amount is weighed into a tinfoil capsule, dissolved in a little hot water, and fibrous asbestos (a weighed quantity) is added in sufficient quantity to nearly absorb the fluid; the whole is then dried until a constant weight is obtained. The residue is used for the determination of the gelatin (see 4).

2. *Nitrogen in the Form of Unchanged Albumin, Coagulable Albumin. and Meat.*—The presence of finely-divided meat is detected by submitting to a microscopic examination a portion of the residue insoluble in cold water, and if meat fibre be found, a suitable quantity of the extract is treated with cold water, and the nitrogen is determined in the insoluble residue; the latter contains only a very small quantity of other albuminoid matter. Acetic acid is added to the filtrate from the above, and the solution boiled and filtered. The determination of the nitrogen in the precipitate gives the coagulable albumin.

3. *Nitrogen in the Form of Ammonium Salts.*—A weighed quantity is dissolved in water and distilled with the addition of barium carbonate.

4. *Gelatin Nitrogen.*—The tinfoil capsule (from 1), with contents, is cut into narrow strips, which are introduced into a beaker and washed four times with absolute alcohol. The residue is then treated twice with ice-cold water containing 10 per cent. of alcohol, stirred for about two minutes, filtered, and the insoluble matter washed with ice-cold water until a colourless filtrate is obtained. The residue containing the gelatin is then boiled with water, filtered, and, after concentrating the filtrate, a nitrogen determination is made.

5. *Nitrogen in the Form of Meat Bases soluble in Alcohol, also Leucine, Tyrosine, and other Decomposition Products.*—To an aqueous solution (25 c.c.) of the preparation are added 250 c.c. of absolute alcohol, the solution filtered after 10—12 hours, and the residue repeatedly washed with alcohol. The solution contains the leucine, tyrosine, and other decomposition products, together with a portion of the meat bases. The alcohol is distilled off, the residue dissolved in water, and the clear solution made up to 500 c.c. 100 c.c. are then taken for the determination of the total nitrogen and a second volume of 100 c.c. for that present as ammonia, the difference being due to the meat bases and decomposition products.

6. *Treatment of Residue insoluble in Alcohol.* — The above residue (from 5), insoluble in alcohol, is treated with water and filtered; the residue contains a small portion of the albumose rendered insoluble by the action of the alcohol, and this should therefore be extracted with hot water and a nitrogen determination made. The filtrate from the above is made up to 500 c.c., and of this 50 c.c. are used for determining the total nitrogen, another 50 c.c. for the albumose, gelatin, and peptone, and 100 c.c. for the determination of the peptone (see below). The remainder is concentrated to a small bulk and employed for the qualitative detection of true peptone as follows:—An excess of ammonium sulphate is added and the precipitated albumose and gelatin filtered off; the filtrate is then treated with a very dilute solution of copper sulphate, and an excess of concentrated caustic soda or potash added, when the characteristic red coloration is produced.

7. *Pancreas-peptone.*—The 100 c.c. of the above solution are concentrated to 8—10 c.c., and, when cold, mixed with at least 100 c.c. of a saturated solution of ammonium sulphate; the precipitate is collected, washed with ammonium sulphate solution, dissolved in boiling water, and evaporated almost to dryness with the addition of barium carbonate; the residue is treated with water, filtered, and from the amount of nitrogen found in the filtrate the pancreas-peptone can be calculated.

8. *Albumose-peptone.*—50 c.c. of the solution mentioned above (see 6) is mixed with an equal volume of dilute sulphuric acid (1:3), and phosphotungstic acid is added until no further precipitate is produced. The precipitate is washed with dilute sulphuric acid and a nitrogen determination is made. It consists of albumose, pancreas-peptone, and gelatin, and, as the two latter have already been determined, the difference will represent the albumose.

9. *Nitrogen in the Form of Meat Bases insoluble in Alcohol.*—This is represented by the difference between the total nitrogen in solution 6 and that contained in the phosphotungstic precipitate (8).—A. K. M.

## XXIV.—SCIENTIFIC AND TECHNICAL NOTES.

*Specific Heat and Boiling-Point of Carbon.* J. Violle. Comptes rend. **120**, 868—869.

Above 1000° the mean specific heat of graphite increases with the temperature according to the formula—

$$C\frac{t}{o} = 0\cdot355 + 0\cdot00006\ t.$$

The heat given out by 1 grm. of solid graphite in cooling from its boiling-point to 0° is 2050 calories, and consequently the boiling-point of carbon is 3600° C. These results were obtained with an electric furnace, the temperatures being measured calorimetrically or optically.

—J. G. W.

*New Type of Lignocelluloses.* W. C. Hancock and O. W. Dahl. Ber. 1895, 1588.

The authors have submitted to exhaustive examination the substance of the pith-like stem of the aquatic *Æschynomene Aspera.* With the physical characteristics of the piths, this product has nevertheless been long recognised as morphologically a true wood (specialised to serve as a float). The author's results show that it is in effect a *lignocellulose*, characterised by reactions approximating rather to those of the celluloses, amongst which it is usually classified by botanists. The following are the results of the investigation:—

*Physical Characteristics.*—Cylindrical mass of air-filled cells, 1 grm. occupying the enormous volume of 45—50 c.c. Colour opaque-white to yellowish.

*Reactions.*—With aniline salts and phloroglucinol (in HCl.Aq) the colour reactions characteristic of the woods generally, only in certain cells lying round the central axis and scattered throughout the tissue in concentric circles. With hydriodic acid (1·5 sp. gr.), a pure indigo blue. No reaction with Fehling's solution.

*Composition.*—Hygroscopic moisture, 8—9 per cent.: ash 1—2 per cent.

*Constants related to Constitution*:—

(*a.*) *Alkaline Hydrolysis.*—On boiling with dilute alkaline solutions (1 per cent. NaOH) rapidly loses 29 per cent. of its weight, only slightly increased on prolonged boiling.

(*b.*) *Cellulose.*—By method of chlorination, &c., 54·4 per cent. Chlorine consumed in the reaction, 18·5 per cent., of which one-half combines to form the lignone chloride.

(*c.*) *Furfural.*—Total yield, 11·6 per cent., of which 8·0 per cent., *i.e.*, 70 per cent. of the total, is yielded by the residue from alkaline hydrolysis. The distribution of the "furfuroids" is therefore unaffected by the treatment.

(*d.*) *Methoxyl.*—The percentage number—$OCH_3 = 2{\cdot}9$ per cent.—is much lower than for the lignocelluloses generally.

(*e.*) *Ferric ferricyanide Reaction.*—The tissue reacts strongly with the red solution obtained by mixing ferric chloride and potassium ferricyanide. Very large percentages of the blue cyanides are fixed, of which the composition was determined to be $Fe_4(CN)_{12}$.

(*f.*) *Nitrates.*—Yellow nitrates were obtained containing not more than 7—9 per cent. N.

(*g.*) *Thiocarbonate.*—On treatment with alkaline hydrate (NaOH) and carbon disulphide, the tissue is gelatinised, but the proportion converted into soluble derivatives is low (20—30 per cent.).

The author's main conclusions are as follows:—The tissue substance is a lignocellulose in all its constitutional features, but differentiated from the group in respect of colour reactions. These reactions are, in certain cases, due to by-products, notably those with aniline salts and phloroglucinol.

The furfuroids of the tissue are for the most part *not* pentosanes.—C. F. C.

*Experiments with Persulphuric Acid [Sulphur Heptoxide, $S_2O_7$] and Persulphates.* K. Elbs. Zeits. f. Elektrotechnik u. Elektrochem. 1895, **2**, 162—163.

The formation of free persulphuric acid, and also of its potassium salt, can be exhibited on the small scale as follows:—A wide test tube is used as the electrolytic cell. The anode consists of a vertical platinum wire reaching to the bottom of this and insulated, excepting near the bottom, by a narrow glass tube. The cathode consists of a loop of platinum wire surrounding the anode near the surface of the electrolyte. The bubbles of oxygen gas evolved at the anode might carry with them the liquid from the neighbourhood of the anode to the cathode. In order to prevent this the anode is surrounded by a second (open) glass tube, somewhat wider below than above. The whole apparatus stands in a beaker of cold water. The current-density at the anode should be about 100 ampères per sq. decimetre. The test-tube is filled with dilute sulphuric acid of density 1·4. After passing a current for 5 minutes, the liquid in the neighbourhood of the anode will give all the usual reactions of persulphuric acid.

If we fill the test-tube with a cold saturated solution of potassium sulphate in dilute sulphuric acid of density 1·3, and electrolyse with the same current-strength, the anode-fluid soon becomes turbid owing to the separation of potassium persulphate ($K_2S_2O_8$). In 10 minutes the lower part of the tube becomes filled with crystals of this salt. As the apparatus contains no porous cell everything is easily visible. The separation of ammonium persulphate requires a longer time.

The apparatus can be used for showing the conversion of a cobaltous into a cobaltic salt. A saturated solution of cobaltous sulphate in dilute sulphuric acid is used. In the course of 10 minutes the liquid near the anode turns brown, then bluish-violet, and finally dark green, while the cathode liquid remains red.—D. E. J.

*Amalgamated Aluminium; Use as a Neutral Reducing Agent in Presence of Water.* H. Wislicenus and L. Kaufmann. Ber. 1895, **28**, 1323—1327.

Although it has been long known that water is rapidly decomposed by amalgamated aluminium, very little use has been made of the discovery. According to the authors, however, the material is eminently adapted for use as a reducing agent, more particularly for the purposes of organic research. Amalgamated aluminium has no action on absolute alcohol and ether, but traces of water, if present, are at once attacked with liberation of hydrogen. Obviously, therefore, by its means these solvents may be readily brought to the anhydrous state. Moreover, amalgamated aluminium possesses over sodium, &c., the advantage that it is more under control; whilst the product of its oxidation (alumina) is an indifferent body. Solutions of nitro-bodies, &c., in absolute alcohol or ether, are treated with amalgam, and water added drop by drop until reduction is complete. The alumina formed is readily separated by filtration and retains very little of the solution. By varying the conditions of experiment, as regards temperature and proportion of amalgam used, intermediate reduction products may be obtained. Nitrobenzene, for example, may be reduced completely to aniline, or partially to β-phenylhydroxylamine. The process is also well suited for the hydrogenisation of unsaturated carbon compounds—especially of the aromatic series—ketones, lactones, &c. The amalgam is prepared as follows:—Aluminium shavings (freed from oil, grease, &c.) are treated with soda solution until hydrogen is given off briskly, then slightly rinsed with water, and steeped for 1—2 minutes in a ½ per cent. sublimate solution. These operations are repeated to thoroughly get rid of scum and dirt, and the metal finally washed consecutively with water, alcohol, and ether, and preserved for use under petroleum spirit.—H. T. P.

## New Books.

CHEMISCH TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1894. Zweites Halbjahr. Zweite Hälfte. Mit in der Text gedruckten Illustrationen. 1895. R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstr. 26, Berlin, S.W. H. Grevel and Co., 33, King Street, Covent Garden, London.

The second issue for the second half-year of 1894, of Dr. Jacobsen's Repertory of Chemical Technology. It contains reports of the progress of the following branches of chemical industry:—I. Foodstuffs. II. Paper. III. Photography. IV. Residuals, Manures, Disinfection, and Sanitation. V. Soaps. VI. Explosives and Matches. VII. Preparation and Purification of Chemicals. VIII. Chemical Analysis. IX. Apparatus, Machinery, Electrotechnology, and Thermotechnology. X. Appendix, Adulteration of Trade Products, &c. XI. New Books. Alphabetical Index for the four quarterly issues for 1894. This number contains 168 pages of subject-matter and is illustrated with numerous woodcuts.

EXAMINATION OF WATER FOR SANITARY AND TECHNIC PURPOSES. By Prof. HENRY LEFFMANN, M.D., Ph.D. Third edition, revised and enlarged. P. Blakiston, Son, and Co., 1012, Walnut Street, Philadelphia, U.S.A. 1895. H. Grevel and Co., 33, King Street, Covent Garden, London. Price $1.25.

Small 8vo. volume, containing 140 pages of subject-matter. Following this an Appendix with analytical data and tables covering 9 pages. The work ends with an alphabetical index. The text is illustrated with 12 wood-engravings. The subject is treated under the following sub-divisions:—HISTORY AND CLASSIFICATION OF NATURAL WATERS. ANALYTICAL OPERATIONS. Sanitary Examinations. Technical Examinations. INTERPRETATION OF RESULTS. TECHNICAL APPLICATIONS. ADDENDA. ANALYTICAL DATA.

QUANTITATIVE CHEMICAL ANALYSIS. Adapted for Use in the Laboratories of Colleges and Schools. By Prof. FRANK CLOWES, D.Sc., and J. BERNARD COLEMAN, F.I.C. Third Edition. J. and A. Churchill, 11, New Burlington Street, London. 1895. Price 9*s.*

This is the third edition of the work on Quantitative Chemical Analysis, the first appearance of which was noticed in this Journal, 1891, 957. The subject-matter now fills 480 pages, and the Appendix, with Tables and a variety of data, 35 pages more, including some 104 illustrative cuts.

The whole work is divided into five parts. Part I. Various Preliminary and General Operations of Analysis. II. Gravimetric Analysis. III. Volumetric Analysis. IV. More Complex Quantitative Estimations and Technical

Analysis. V. Gas Analysis, Technical Methods. Appendix, with valuable series of typical analyses of technical products.

Practical Proofs of Chemical Laws. A Course of Experiments upon the Combining Proportions of the Chemical Elements. By Vaughan Cornish, M.Sc. Longmans, Green, and Co., London and New York. 1895. Price 2*s*.

Small 8vo. volume, bound in cloth, and containing 92 pages of subject-matter, divided into eight chapters, preceded by a Table of Contents and Preface. As a system of laboratory instruction in connection with a course of lectures, the author undertook with his pupils this series of experimental verifications of fundamental quantitative analytical laws. The following laws were thus experimentally verified:—I. Dalton's Atomic Theory and the Laws of Combining Proportions. II. The Law of the Conservation of Mass. III. First Part of the Law of Definite and of Constant Proportions. IV. The Law of Equivalent Proportions. V. Second Part of the Law of Definite and of Constant Proportions. VI. Law of Multiple Proportions. VII. Law of Simple Volumetric Proportions in the Chemical Reaction of Gases. VIII. Exercises Supplementary to the Course, illustrating the Scope of the Term "Equivalence" in Chemistry.

# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

*(From the Board of Trade Journal.)*

### Austria-Hungary.

#### *Colouring Matters in Wines.*

The *Reichsgesetzblatt* of September 1st last, publishes a Ministerial Decree of the 25th August last, respecting the fulfilment of the provisions of the Ministerial Decree of August 10, 1892, as to the prohibition of the importation of wine coloured with colouring matters derived from tar (aniline dyes). The following is a translation of the decree in question:—

"In agreement with the Royal Hungarian Ministries concerned, the decree of the 10th August 1892 (Reichsgesetzblatt, No. 134), as to the prohibition of the importation of wines coloured with colouring matters derived from tar, is extended, so that in case such colouration is not shown by testing the red wine with acetate of lead solution and amylic alcohol, as provided for in this decree, a further test with yellow oxide of mercury is to be carried out in accordance with the instructions forwarded to the offices.

"The Customs offices may only permit the importation of the wine when both tests show that the wine is uncoloured.

"In cases of doubt, or when the test gives rise to suspicions that the wine has been coloured with coal-tar dyes, the opinion of one of the Austrian or Hungarian experimental laboratories mentioned in point 5 of the Ministerial Decree of August 10, 1892 (Reichsgesetzblatt, No. 125), must be taken before the wine is rejected."

This decree is to come into force at once.

### France.

#### *Salicylate of Soda and Salol.*

*Chemist and Druggist, 19th October* 1895, 599.

In the French Customs tariff salicylate of soda is classified under sodium salts not specially enumerated, and salol under chemical products obtained by the distillation of coal-tar. As such they are liable to the ordinary duties, but a recent decision of the Committee of Customs points out that although neither of the preparations mentioned contains alcohol, either in its free state or as a chemical combination, yet they are to be liable to an additional tax on account of the spirit which has been used in their manufacture. The committee states that this amounts to 75 centilitres of pure alcohol to every kilo. of salicylate of soda and salol.

### France.—Guadaloupe.

#### *Tariff Changes.*

A despatch, dated September 15th last, has been received at the Foreign Office from the Marquis of Dufferin and Ava, Her Majesty's Ambassador at Paris, enclosing extract from the *Journal Officiel*, publishing decree of the French Government, by which all descriptions of chemical manures can be imported into the colony of Guadaloupe free of duty.

### Duty on Esparto Grass Exported from Tunis.

With reference to the statement on p. 170 of the August number of the *Board of Trade Journal*, to the effect that the duty on the export of esparto grass from Tunis was to be reduced, the Board of Trade now understand that the reduction of duty as announced will not be made.

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### Mines and Minerals.

#### *Mineral Statistics of the United Kingdom for the Year 1894. Price 1s. 7½d.*

*(From Board of Trade, Chemical Trade, and Engineering and Mining Journals.)*

This is an annual statement prepared by direction of the Secretary of State for the Home Department. In the introduction it is stated that the present volume contains an account of the quantity and value of all minerals wrought in mines, the value of all minerals obtained from openworks, brineworks, &c., a table of the mines' inspection districts, with the names and addresses of inspectors of mines, assistant inspectors, secretaries to boards for examinations, and the clerk of mineral statistics; also an appendix showing the production of minerals in the British Colonies and Possessions, compiled from official reports.

The sources from which minerals are obtained in the United Kingdom are classed under three heads:—

1. Mines under the Coal Mines Regulation Act.
2. Mines under the Metalliferous Mines Regulation Act.
3. Openworks, brineworks, &c., which are not comprised by these Acts.

An annual return has to be sent from every mine to the inspector for the district, specifying, under the Coal Mines Act, the quantity of minerals raised during the year, and, under the Metalliferous Mines Act, the quantity of minerals dressed and of the undressed mineral sold, treated, or used during the year.

The statistics of minerals raised from mines are prepared from these statutory returns.

Table I.

Mineral Production of the United Kingdom.

| Mineral. | | 1893. | | 1894. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| | | | £ | | £ |
| Alum clay (Bauxite). | Tons | 8,740 | 4,150 | 7,970 | 5,618 |
| Alum shale .... | „ | 2,115 | 264 | 3,972 | 496 |
| Arsenic ........ | „ | 5,976 | 57,694 | 4,801 | 48,614 |
| Arsenical pyrites. | „ | 3,036 | 2,918 | 3,288 | 3,823 |
| Barytes ........ | „ | 22,343 | 25,363 | 20,656 | 21,410 |
| Bog ore ........ | „ | 10,747 | 2,686 | 7,803 | 1,951 |
| Clays (excepting ordinary clay). | „ | 3,065,208 | 817,419 | 3,263,768 | 823,701 |
| Coal ........... | „ | 164,325,795 | 55,809,808 | 188,277,525 | 62,730,179 |
| Copper ore...... | „ | 5,346 | 12,961 | 5,752 | 13,909 |
| Copper precipitate. | „ | 230 | 2,210 | 241 | 2,313 |
| Fluorspar ..... | „ | 215 | 161 | 126 | 69 |
| Gold ore ....... | „ | 4,489 | 7,657 | 6,603 | 13,573 |
| Gypsum........ | „ | 143,486 | 59,369 | 153,450 | 66.355 |

TABLE I.—*continued.*

| Mineral. | | 1893. | | 1894. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| | | | £ | | £ |
| Iron ore | ,, | 11,203,476 | 2,827,947 | 12,367,308 | 3,190,647 |
| Iron pyrites | ,, | 15,837 | 7,292 | 15,523 | 8,042 |
| Jet | Lbs. | 888 | 177 | 479 | 48 |
| Lead ore | Tons | 40,808 | 280,539 | 40,599 | 266,995 |
| Lignite | ,, | 3,264 | 816 | 334 | 83 |
| Manganese ore. | ,, | 1,336 | 762 | 1,809 | 740 |
| Ochre, umber, &c. | ,, | 10,534 | 13,880 | 8,516 | 11,040 |
| Oil shale | ,, | 1,956,520 | 489,130 | 1,986,385 | 496,598 |
| Petroleum | ,, | 260 | 488 | 19 | 92 |
| Phosphate of lime. | ,, | 3,300 | 5,771 | 700 | 1,277 |
| Salt | ,, | 1,924,029 | 735.222 | 2,235,912 | 763,329 |
| Slates and slabs | ,, | 438,993 | 1,107,626 | 461,673 | 1,171,366 |
| Soapstone | ,, | .. | .. | 10 | 45 |
| Stone, &c. | ,, | .. | 7,773,743 | .. | 7,695,716 |
| Strontia sulphate. | ,, | 5,812 | 2,325 | 6,823 | 1,962 |
| Tin ore | ,, | 13,689 | 637,053 | 12,910 | 487,523 |
| Uranium ore | ,, | 25 | 500 | 19 | 815 |
| Wolfram | ,, | 22 | 420 | .. | .. |
| Zinc ore | ,, | 23,754 | 81,270 | 21,821 | 67,311 |
| Total values | | .. | 70,767,651 | .. | 77,898,938 |

The total value of the mineral output of the Kingdom showed, according to this statement, an increase of 7,181,287*l.* over that for 1893, nearly all of which resulted from the gain in coal production. The year 1893, however, as compared with 1892, showed a decrease of 11,583,000*l.* There was therefore a reduction last year from 1892 in values, and a still larger one from 1891, as is shown by the following table giving the value of the output in four years :—

TABLE II.

| —— | 1891. | 1892. | 1893. | 1894. |
|---|---|---|---|---|
| | £ | £ | £ | £ |
| England | 65,334,539 | 58,476,040 | 49,992,042 | 56,954,496 |
| Wales | 15,064,012 | 13,572,812 | 11,212,528 | 12,299,750 |
| Scotland | 10,356,054 | 9,837,740 | 9,327,085 | 8,419,510 |
| Ireland | 394,233 | 387,128 | 170,396 | 174,312 |
| Isle of Man | 86,194 | 77,040 | 65,600 | 50,870 |
| Total | 91,238,032 | 82,350,760 | 70,767,651 | 77,898,938 |

It must be remembered, however, that values in 1894 were generally low, and that a reduction in the money amount does not necessarily represent one in the actual amount of mineral raised. The most notable changes shown last year, as compared with 1893, were an increase of 23,951,730 tons of coal, of 1,163,832 tons of iron ore and an increase of 311,883 tons of salt. The increase in coal was chiefly due to the fact that in 1893 production was almost stopped for a time by the great strike of the miners.

The statement regarding the metals obtained by smelting is as follows. The values in this and preceding tables are taken at the average market price :—

TABLE III.

| Metal. | | 1893. | | 1894. | |
|---|---|---|---|---|---|
| | | Quantity. | Value. | Quantity. | Value. |
| | | | £ | | £ |
| Copper | Tons | 426 | 20,522 | 416 | 19,482 |
| Gold | Ozs. | 2,309 | 8,691 | 4.235 | 14,811 |
| Iron | Tons | 3,978,694 | 9,333,797 | 3,347,472 | 9,999,186 |
| Lead | ,, | 29,698 | 292,402 | 29,687 | 284,624 |
| Silver | Ozs. | 274,100 | 40,687 | 275,696 | 33,313 |
| Tin | Tons | 8,838 | 785,741 | 8,327 | 604,500 |
| Zinc | ,, | 9,281 | 167,770 | 8,130 | 131,029 |
| Total values | | .. | 10,649,610 | .. | 11,086,945 |

In addition to the general summary of the mineral products, the returns contain tabulated details of the items above named in Table I., from which particulars we cull the following figures :—The highest monthly price for best selected British copper during 1894 was 47*l.*, and the lowest 41*l.* 2*s.* 6*d.*, the average price for the year being 43*l.* 12*s.* 8*d.*, while the corresponding figure for foreign copper (Chili bars) was 40*l.* 9*s.* 6*d.*

Some interesting figures as to the amount of burnt cupreous iron pyrites which have been treated at the 18 different extraction works are supplied by Mr. T. W. Bird, of Liverpool. The total amount of burnt ore treated in 1894 was 309,268 tons, the estimated yield being 1,790 ounces of gold, 311,413 ounces of silver, and 14,013 tons of metallic copper.

The following table shows the amount of manganese ore imported into the United Kingdom, the ore being obtained from sources other than those included in the foregoing statistics :—

TABLE IV.

MANGANESE ORE IMPORTED INTO THE UNITED KINGDOM.

| Countries whence Imported. | 1894. | |
|---|---|---|
| | Quantity. | Value. |
| | Tons. | £ |
| From Australasia | 2,571 | 5,396 |
| ,, British North America | 1 | 6 |
| ,, Russia | 58,809 | 146,806 |
| ,, Sweden | 308 | 732 |
| ,, Belgium | .. | .. |
| ,, France | 3,005 | 7,631 |
| ,, Italy | 1 | 5 |
| ,, Portugal | 6,848 | 17,344 |
| ,, Spain | 7,684 | 18,515 |
| ,, Turkey | 3,085 | 7,830 |
| ,, United States of America | .. | .. |
| ,, Chili | 29,903 | 89,785 |
| ,, Other countries | 15,766 | 44,340 |
| Totals | 127,981 | 338,400 |

The importance of the shale oil industry fully warrants the production of the next table, that gives the output from mines which come under the Coal Mines Regulation Act, thus causing the total to fall slightly below the figures for the total production in Table I. for the United Kingdom and Isle of Man :—

TABLE V.

PRODUCTION OF OIL SHALE.

| County. | 1894. | |
|---|---|---|
| | Quantity. | Value at the Mines. |
| | Tons. | £ |
| ENGLAND AND WALES. | | |
| Cumberland | .. | 994 |
| Flintshire | 1,374 | |
| Staffordshire, North | 2,602 | |
| Yorkshire, East and West Ridings | .. | |
| Totals | 3,976 | 994 |
| SCOTLAND. | | |
| Edinburghshire | 709,141 | 495,602 |
| Fifeshire | .. | |
| Lanarkshire (East) | 86,881 | |
| ,, (West) and Renfrewshire | 15,402 | |
| Linlithgowshire | .. | |
| Renfrewshire (included with West Lanarkshire). | 1,168,488 | |
| Stirlingshire (East) | 2,497 | |
| Totals | 1,982,409 | 495,602 |

Now that so much, in fact almost all, the phosphate of lime comes from abroad, the following table of imports is more interesting than the statement of the actual home production. The chief increases in imports have been from the United States of America, Belgium, and France:—

### TABLE VI.

### IMPORTS OF PHOSPHATE OF LIME.

| Countries whence Imported. | 1893. | 1894. |
|---|---|---|
| | Quantity. | Quantity. |
| | Tons. | Tons. |
| Belgium | 62,298 | 76,094 |
| France | 34,866 | 44,162 |
| Portugal | .. | .. |
| United States of America | 195,785 | 218,028 |
| Dutch West India Islands | 5,636 | 4,337 |
| British North America | 5,068 | 3,192 |
| British West India Islands | 7,690 | 570 |
| Other countries | 12,184 | 33,886 |
| Totals | 323,527 | 380,269 |

The salt returns are more than usually interesting, as the production has been higher than for several years previous. The following table gives the exports in 1893 and 1894 :—

### TABLE VII.

### QUANTITY AND VALUE OF SALT (ROCK AND WHITE) EXPORTED FROM THE UNITED KINGDOM.

| Countries to which Exported. | 1893. | 1894. | |
|---|---|---|---|
| | Quantity. | Quantity. | Value. |
| | Tons. | Tons. | £ |
| Russia | 14,015 | 20,460 | 10,091 |
| Sweden and Norway | 24,746 | 21,109 | 11,503 |
| Denmark | 37,956 | 35,419 | 15,895 |
| Germany | 22,892 | 21,167 | 11,960 |
| Holland | 25,157 | 17,736 | 5,433 |
| Belgium | 28.325 | 34,399 | 21,277 |
| West Coast of Africa | 35,755 | 37,222 | 46.579 |
| British Possessions in South Africa | 5,718 | 8,535 | 7,944 |
| British East Indies | 244,020 | 328,921 | 226,781 |
| Australasia | 48,976 | 57,569 | 69,199 |
| British North America | 70,022 | 69,790 | 51.371 |
| United States of America | 59,862 | 96,263 | 99,426 |
| British West Indies | 4,648 | 6,430 | 8,166 |
| Foreign West Indies | 72 | 11 | 121 |
| Chili | 1,620 | 3.045 | 3,203 |
| Brazil | 8,395 | 6,277 | 7,196 |
| Other countries | 3,956 | 4,646 | 8,020 |
| Totals | 636,135 | 768,999 | 604,105 |

In consideration of the importance of the minerals imported from abroad, we add the following abstract of the summary of the mineral output in the British Colonies and possessions. Owing to the difficulties of compilation the returns are always a year behind those for the United Kingdom. The figures as under are therefore for 1893 :—

### TABLE VIII.

### PRODUCTION OF MINERALS AND CERTAIN METALS IN THE BRITISH COLONIES AND POSSESSIONS.

*Abstract of Summary.*

| Description of Mineral. | | 1893. | |
|---|---|---|---|
| | | Quantity. | Value. |
| | | | £ |
| Asbestos | Tons | 5,815* | 65,096† |
| Barytes | " | .. | .. |
| Coal (including some coke) | " | 10,670,558* | 4,370,731* |
| Cobalt ore | " | 26† | 305† |
| Gold | Ozs. | 3,781,140* | 13,981,610* |
| Gypsum | Tons | 174,075† | 41,672† |
| Kauri gum | " | 8,317† | 510,775† |
| Manganese ore | " | 2,951* | 10,273* |
| Mica | Cwts. | 23† | 11,104† |
| Nickel | Tons | 1,783† | 426,647† |
| Ochre | " | 955* | 3,639* |
| Oil shale | Tons. | 55,660† | 101,220† |
| Petroleum | Galls. | 10,359,812* | 53,151* |
| | Brls. | 798,406* | 171,439† |
| Phosphate of lime | Tons | 15,010† | 26,582† |
| Platinum | — | .. | 370† |
| Pyrites | Tons | 52,270† | 36,088† |
| Salt | " | 903,479† | 370,337† |
| Wolfram | " | 4* | 48* |

* Increase. † Decrease as compared with 1892.

## GENERAL TRADE NOTES.

### TIN AND OPIUM IN PERAK.

In a short article on affairs in the Native Malay States, the *London and China Telegraph* of September 9th notes that the Government of Perak have taken up a suggestion which was mooted at the beginning of the year. Parcels of white and red poppy seed have been obtained from India, and small samples have been despatched to district magistrates and others, in order that the suitability of the soils of the different districts for the cultivation may be tested. If it is proved that the Native States can produce opium profitably, it would be of great advantage to the tin-mining industry, and plenty of private capital would no doubt be found to start the cultivation.

The report on Upper Perak for 1894 notes, as regards mining, that Ulu Temelong offers a bright prospect. The tin ore secured by prospecting is of very good quality, and about 20 piculs have been taken out. Applications for land have already been received. The Kenering mines are still being worked, but the number of coolies employed is so small that the output of tin is such as demands little notice. A great portion of the district still remains unprospected, no officer of the Mines Department having been detailed for the work.

The phenomenal success of the French Mining Company appears to be one of the sensations of the day. Their headquarters are at Kampar, where the manager, M. Colligan, resides; but they have recently opened new fields, and wherever they have worked they appear to have been successful. On their five or six properties they now employ about 3,000 men. During the last six months they have raised 20,000 piculs of tin, of a total value of about 400,000 dols., or an average of over 20 dols. per coolie per month. In duty they have paid to the Government no less than 50,000 dols. during the last half-year.

### THE TIN-PLATE DUTY IN THE UNITED STATES.

The New York *Iron Age* for August 29th last states that manufacturers of light sheets and of tin-plates are beginning an agitation for a higher duty on tin-plates. The tin-plate duty having been cut in two under the new tariff, the present rate is declared to be inadequate for the protection of the new industry, owing to the sharp advance in the price of steel.

### GERMAN COKE FOR AUSTRALIA.

The *Engineering and Mining Journal* (New York) says that Mr. Theodore M. Stephen, United States Consul at Annaberg, writes that a dozen large sailing vessels have been chartered to load coke for Port Pirie, Australia, where it will come into competition with the Durham (English) coke. The Durham producers believed that they could retain without trouble the Australian market, having supplied it almost exclusively ever since it existed, but they may find German competition an important factor in the future.

### "BLUE BILLY" BRICKS.

*Chemist and Druggist, October 12th, 1895, 568.*

A process having been discovered whereby a waste product known as "Blue Billy," of which vast quantities accumulate at alkali works, can be converted into bricks, the directors of the United Alkali Company have decided to construct a new and extensive plant for that manufacture at the works of Messrs. Wigg, Old Quay, Runcorn. There is a very big stock of the material on hand at this place, and during the past week a number of men have been engaged removing a portion of it to clear a site for the erection of the proposed works. It is expected that the new bricks will be in ready demand in the manufacture of iron and steel. The new industry is heartily welcomed at Runcorn, where trade has been in a very depressed condition lately.

### More Alkali Works.

*Chemist and Druggist, October 12th*, 1895, 568.

It is stated that the Salt Union (Limited) have purchased a large tract of land adjoining their salt works at Weston Point, near Runcorn, and that they intend to establish an alkali and general chemical factory there.

### The Teeside Salt Industry.

*Chemical Trade Journal, 19th October* 1895.

It is reported that Messrs. Brunner, Mond, and Co., Ltd., will shortly take over the salt works of Messrs. Bell Bros., on the north bank of the Tees.

### The Rubber Industry at Lagos.

*Chemical Trade Journal, 19th October* 1895, 240.

The newly developed production of india-rubber in Lagos promises to attain important dimensions very soon. In 1893 no imports of this article were recorded as received from the colony, and last year the amount was only 5,995*l.* By a single steamer which left Lagos at the beginning of last month, however, the value of the india-rubber shipped for Liverpool was 15,000*l.* The new industry appears to have given rise at Lagos to some excitement resembling that which is often occasioned by a new gold discovery. Numbers of clerks, small traders, and others, including, it is said, even professional men, have gone into the interior to profit by the collection and manufacture of the gum. The native owners of the forests are, however, insisting upon the payment of royalties, and some of them are themselves entering into the business of preparing the rubber for the market. Prices in the interior have been considerably advanced, and there is no longer so much profit as there was at first in purchasing and transporting it to the coast. Some fear is expressed that the ordinary trade in palm oil and palm kernels may suffer from the diversion of labour to the fresh industry, and that the supply even of india-rubber itself may be threatened by the indiscriminate tapping of immature trees. It is suggested that the Colonial Government should take steps to prevent the spread of this last-named evil.

### Discovery of Gum Copal in United States of Colombia.

*Chemist and Druggist, October 12th*, 1895, 547.

The United States Consul at Carthagena, Colombia, describes the recent discovery of a large quantity of gum copal in the alluvial deposits of the country, and the arrangements which have been made to market the product in the United States The deposits occur chiefly near Mazangua, Punta Barrila, and Gelares, all on or near the San Jorge river. The discoverers have obtained a concession from the Colombian Government, giving them the sole right to mine gum copal in Colombia for the next 20 years. In return for this grant the Government will exact the sum of 1 dol. (Colombian) for every quintal (220·46 lbs.) of copal shipped from the country. The Colombian gum is said to compare favourably with the kauri gum of New Zealand, and the expense attached to the mining and shipping of the stuff will not exceed 10 cents per lb., landed in New York. The gum is found in large lumps in the soft alluvial soil at the foot of the algarroba tree, and as the labour of digging for it is comparatively light, native women may be employed for the purpose at a cost of 10 cents per diem.

### By-Product Coke.

*Ironmonger, 19th October* 1895, 125.

It will be remembered that an attempt is being made to introduce the by-product system into America to supersede the present beehive method, which is there universal, and that in this country also increased attention is being given to the system in order to obtain the considerable profits arising from the conversion of the hitherto wasted gases into valuable products. The latest battery erected in this country has been put down at the Malton Colliery, Lanchester, near Durham, where 70 ovens have been put up upon the Simon-Carves principle. The other batteries working in this country to-day are mainly as follows:—100 at the West Crook Collieries, Durham, of Pease and Partners; 50 at the Bear Park Colliery, near Durham; 70 at the Newport Furnaces, Middlesbrough, of Sir B. Samuelson and Co.; 50 on the Semet-Solvay principle, at the Northwich Soda-Ash Works of Brunner, Mond, and Co.; and 30 at the Brymbo Steel and Iron Company's Works. At these last works a second bank of ovens is also about to be put up. Near Pomfret an entirely new oven, which has attracted a great deal of attention among coke-burners, is just now being erected, but sufficient has not yet been demonstrated in practical work to allow any more being said of the process at present. As concerns the introduction of the system into America, two considerable blocks of ovens are nearly completed there. One block of 60, on the Otto-Hoffman principle, is being built at the Cambria Ironworks, Johnstown, Pennsylvania. A second bank of 50 or 60, on the Semet-Solvay system, is being built by the Dunbar Furnace Company, Dunbar, Pennsylvania. Additional plants are certain to make their appearance next year. That a large return can be made by laying down closed ovens admits of no question. The annually increasing demand for ammonia, for which there is, indeed, an unlimited call, is alone sufficient to ensure large profits. English experience demonstrates that ironmasters using retort-ovens can realise 4*s.* per ton of coal from the resultant by-products, or 6*s.* per ton of coke produced. There is still a prejudice on the part of some pig-iron makers that by-product coke will not bear the same weight in the furnace as that which is beehive manufactured. The erroneousness of this idea has been repeatedly proved, and although sealed-oven coke does not realise quite the same price in the market as best Durham beehive, yet "it is in every way suited to the necessities of the iron trade," otherwise it may, it is argued, be certain that neither Messrs. Samuelson nor the German ironmasters would have adopted the retort-ovens so extensively. The retort-system is spreading much more rapidly on the Continent than in this country, and the German and Belgian ironmasters exhibit not the slightest reluctance to use the resultant fuel. Yet in Germany the system of fast blowing obtains far more largely than with us. It is remarkable that there is no fault to be found in practical iron-making with retort-oven coke. Notwithstanding their poorer use the German furnaces are, we are told, at the present time working at an extremely low coke-consumption—on an average 85 to 90 per cent., and some exceptional works with 90 and 95 per cent.; hence it is clear that continental iron-making practice does not suffer from the abandonment of beehive coke.

### Reports on German Chemical Industries in 1894.

*Ber. über Handel u. Industrie, Berlin*, 1894, 102—309.

#### *Rape-Seed Oil.*

Trade in rape-seed oil during 1894 was very unsatisfactory. The cold weather in May and June was unfavourable for the ripening of the seed pods; and this, together with the wet harvest time, caused the yield to be everywhere poor in quality and, in many districts, in quantity also.

Prices fluctuated considerably, varying from 41·4 Mk. to 48·2 Mk., and the oil-cake decreased in value about 3 Mk. per 100 kilos.

#### *Potato Manufactures.*

No improvement is reported upon the depression of the previous few years. New factories have been started for starch and farina, and the production has thus increased, but the demand has not increased in proportion.

*Starch and Farina.*—Up to the middle of August, trade was fairly good, though at low prices. At the end of August, rumours of a poor maize crop in America, and a small potato crop at home, caused some improvement, prices advancing from 15·50 Mk. to 17·50 Mk. per 100 kilos.

The exports for 1894 were 369,997 bags of 100 kilos., as against 304,900 bags in 1893.

The increase of 65,000 bags is not of such great importance if a comparison be made of the last four years with the previous four.

| Exports in | Bags. | Average Price per Bag of 100 Kilos. |
|---|---|---|
| | | Mk. |
| 1890 | 513,410 | 21·25 |
| 1889 | 438,917 | 21·75 |
| 1888 | 416,843 | 21·75 |
| 1887 | 438,945 | 17·00 |
| Total ....... | 1,808,115 | .. |
| 1894 | 369,997 | 16·50 |
| 1893 | 304,901 | 18·25 |
| 1892 | 128,529 | 30·75 |
| 1891 | 147,643 | 25·50 |
| Total ....... | 951,070 | .. |

In 1894 the potato crop was 25—30 per cent. smaller than in 1893, but this was balanced by the large crops of fodder (hay, turnips, &c.) and the cheapness of other cereals.

*Potato-Sugar and Syrup.*—This manufacture has suffered in its export trade by competition of the American cane-sugar, although the quantity exported was slightly higher than in 1893, viz.:—

| | |
|---|---|
| In 1894 ...................... | 71,525 D.-ctr. |
| In 1893 ...................... | 54,496 D.-ctr. |

Prices were low up to the beginning of the new season, when there was an advance of about 2 Mk., bringing up the price to 19—20 Mk. Towards the end of the year prices declined again.

*Wet Potato Starch.*—The production of wet starch was smaller than in the previous year. At the beginning of the year the production was high, on account of the large potato crop of 1893, but prices were low, the average being 7·70 Mk. per 100 kilos. In September and October the price rose, and in November reached 9·60 Mk., but dropped again before the end of the year.

*Dextrin.*—This trade suffered from over-production. Almost every year new factories are started, increasing competition and depressing prices. The exports for 1894 were 73,596 bags at 100 kilos., against 73,660 bags in 1893. The price varied between 21·50 and 23·25 Mk. per 100 kilos. in Berlin.

### *The Sugar Trade.*

Excepting in June, this trade declined very considerably, especially during the last three months. The general question of duties in America and the depressed state of agriculture in Germany are ascribed as the chief causes of the falling-off.

The following tables (by F. O. Licht) show the production, exports, consumption, and prices:—

| Year. | Production of Beet-Sugar | |
|---|---|---|
| | In Germany. | In Europe. |
| | Ctr. | Ctr. |
| 1891-92 | 23,963,100 | 70,038,100 |
| 1892-93 | 24,506,600 | 68,570,300 |
| 1893-94 | 27,632,000 | 77,671,800 |
| 1894-95 estimated | 38,000,000 | 99,500,000 |

The exports from the most important Colonial crops were:—

| Year. | Ctr. |
|---|---|
| 1891-92 | 56,860,000 |
| 1892-93 | 53,920,000 |
| 1893-94 | 63,900,000 |
| 1894-95 estimated | 62,500,000 |

The German sugar export amounted to:—

| Year. | Expressed as Raw Sugar. | Refined. |
|---|---|---|
| | Ctr. | Ctr. |
| 1891-92 | 13,195,000 | Including 5,345,500 |
| 1892-93 | 13,794,700 | „ 5,578,500 |
| 1893-94 | 14,123,800 | „ 5,496,300 |
| 1893 (Aug. to Dec.) | 6,219,568 | „ 2,253,516 |
| 1894 „ | 8,910,860 | „ 2,905,200 |

Prices per 50 kilos. (in Magdeburg):—

| —— | Raw Sugar Basis, 88° Rend.* | Crushed Lump Sugar. | Fine Loaf Sugar. |
|---|---|---|---|
| | Mk. | Mk. | Mk. |
| 5th January ............... | 12·90 | 24·50 | 26·00 |
| 13th June ................. | 12·75 | 24·00 | 25·25 |
| 17th August ............... | 11·95 | 23·25 | 25·00 |
| 28th December ............. | 9·00 | 19·50 | 21·25 |

* Home trade price, exclusive of 9·00 Mk. duty.

The consumption of sugar in Germany in pounds per head:—

| Year. | Lb. per Head. |
|---|---|
| 1889-90 | 20·8 |
| 1890-91 | 21·7 |
| 1891-92 | 21·4 |
| 1892-93 | 20·8 |
| 1893-94 | 24·2 |

In Europe and North America together:—

| Years. | The Consumption was:— | The Stocks on July 31st were:— |
|---|---|---|
| | Ctr. | Ctr. |
| 1890-91 | 90,497,780 | 9,766,020 |
| 1891-92 | 92,916,428 | 9,589,160 |
| 1892-93 | 88,820,620 | 6,406,540 |
| 1893-94 | 96,564,340 | 11,960,960 |

### *Pharmaceutical, Chemical, and Allied Industries.*

The drug trade generally showed an increase as compared with the previous year. Exports improved in consequence of the commercial treaty with Russia and the new tariff in the Union.

In aërated waters the trade did not quite reach that of 1893, but natural medicinal springs turned out as much as ever, in spite of the competition with artificial substitutes.

Imports of certain dye-woods (Honduras, logwood, fustic) were in excess; but of others, particularly red-wood, the supply was not great, and prices were kept high.

The indigo trade suffered in 1893 from the poor quality, but the output in 1894 was satisfactory.

The use of the finer quality of petroleum (water-white) has greatly increased, and is now estimated at three-fifths of the total consumption in Berlin. Russian petroleum does not make progress.

Trade in bones, bone-dust, and other manures was fairly good, and prices rose towards the year end, through scarcity of the raw material. Superphosphates, &c. dropped to the lowest price on record.

The splendid olive-oil harvests of Asia Minor, and its good quality, removed former prejudices, and business was brisk, but at low prices. Tallow and train oils were of good quality and cheap.

The production of soaps was excessive, and consumption for manufactures declined. Best toilet and perfumed soaps suffered from the competition of cheap imitations, and the Berlin makers were also damaged by increased outside production. Exports suffered from the preference given to French and English soaps.

Prices of stearine and its by-products show an improvement on 1893.

The chemical industries suffered on the whole from over-production and low prices.

The trade in tar colours was very satisfactory, chiefly owing to newly-discovered colours and the great increase in exports to the United States.

The various commercial treaties of the German Empire with Austro-Hungary, Italy, Switzerland, Belgium, and Russia, have influenced single products in very different degrees, and it is therefore difficult to express a definite opinion on the general industry.

The gasworks have not done as well as in the previous year. The increased consumption of gas for heating purposes has not made up for the decrease through competition with electricity, and the use of incandescent burners, &c. The production of by-products (coke, &c.) was certainly not greater than in 1893, but, in proportion to the amount of coal used, has not decreased.

### *Paper.*

Over-production on the one hand and decreased exports on the other, flooded the home markets in pulp and paper, and brought prices down in the spring of the year. Austrian competition abroad and at home was also keener than ever. In spite of these drawbacks most manufacturers kept in full work. In fancy paper the Russo-German treaty was sufficiently favourable to counterbalance the decrease of exports to England, the United States, and other countries. Miscellaneous goods for carnivals and amusements were in greater demand.

Business in paper-hangings was satisfactory during the first half of the year, but the turnover declined in the second half, chiefly owing to the increased demand for English goods.

### *Leather.*

Business in raw hides, skins, and leather was more favourable than in the preceding year owing to the low prices of raw material and the stability of prices of the manufactured articles. Expectations of an expansion of trade, especially with Russia, were not fully realised, but hopes are now entertained of its being able to successfully meet foreign competition and regain its former position.

### *Artificial Silk.*

This article and the goods manufactured from it have been placed in the same class for duty as natural silk and silk products. Reports of experts have decided that artificial (celluloid) silk is much inferior to the natural article on account of its higher specific gravity, less elasticity, and above all its inflammability. Further, its manufacture is as yet difficult, and only a very small quantity can be put upon the market.

Serious competition with natural silk and silk products seems therefore out of the question.—H. M.

### PRODUCTION AND CONSUMPTION OF PHOSPHATES.

*D. Levat. Bull. Soc. Chim.* 1895, **13**, 602—616.

This paper deals with the production and disposal of Florida and Carolina phosphates; the position of basic slag in Europe, of which France is stated to produce 70,000 tons per annum; the decline of the phosphate industry in the north of France owing to impoverishment and the opening of new and richer fields; the variation of prices due to increased production and speculative operations, the lowest price recorded for raw phosphates being 14 francs a ton for 40—45 per cent. material, and 40 francs for 60—65 per cent. Algerian and Tunisian phosphates obtained commercial significance in 1885-6; they are found in the lower eocene and upper cretaceous formations, the presence in the latter being due to impregnation from eocene phosphatic matter. The eocene deposit proper consists of a bed of phosphatic chalk containing 62—65 per cent. of tricalcium phosphate. The first deposit was discovered in Tunis, 60 kilometres west of Gafsa and 250 kilom. from the port of Sfax, and proved profitable in spite of the want of railway communication. Now deposits of varying value have been found all through Algiers and even in Oran. There are important workings near Tebessa, whence 62—65 per cent. phosphate is delivered by rail at Boña, at a cost of 16 to 18 francs a ton. It is easily worked; is friable, even pulverulent; and, containing but very little iron and alumina, is well suited for superphosphate-making. The shipments and deliveries from the port of Boña during the year 1894 and the first three months of 1895 are shown in tons in the following table:—

| —— | Total. | England. | Italy. |
|---|---|---|---|
| 12 months 1894........ | 49,593 | 25,915 | 8,480 |
| 3 months 1895........ | 12,835 | 3,600 | 2,429 |

| —— | Austria. | France. | Other Countries. |
|---|---|---|---|
| 12 months 1894........ | 5,325 | 3,145 | 6,728 |
| 3 months 1895........ | 470 | 5,645 | 700 |

On the 23rd March 1895, there was a stock of 6,800 tons at the port.

With regard to the consumption of phosphate calculated as of 50 per cent. richness, England and Germany are each reckoned as consuming 800,000 tons; France, 500,000 tons; Austria, 150,000; Belgium, 80,000; Italy and Spain, 80,000; other countries, 90,000.

In 1894 France imported 86,776 and exported 105,380 tons of natural phosphate, and imported 98,629 and exported 35,000 tons of superphosphate.—D. A. L.

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Month ending 30th September. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals.............................. | 1,605,524 | 1,444,864 |
| Chemicals and dyestuffs ........... | 381,299 | 419,963 |
| Oils.................................. | 549,473 | 596,581 |
| Raw materials for non-textile industries. | 4,262,855 | 4,319,668 |
| Total value of all imports .... | 30,240,461 | 30,618,854 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 30th September. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) .... | 2,263,814 | 2,480,097 |
| Chemicals and medicines........... | 654,719 | 649,706 |
| Miscellaneous articles............... | 2,352,216 | 2,696,148 |
| Total value of all exports..... | 17,599,320 | 19,461,940 |

### IMPORTS OF METALS FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Copper :— | | | | |
| Ore ............ Tons | 12,722 | 8,958 | 64,514 | 57,099 |
| Regulus ........ „ | 9,066 | 6,192 | 176,319 | 129,508 |
| Unwrought..... „ | 3,954 | 2,806 | 160,050 | 126,809 |
| Iron :— | | | | |
| Ore............. „ | 292,599 | 441,292 | 193,120 | 288,836 |
| Bolt, bar, &c. ... „ | 7,228 | 7,105 | 68,416 | 58,545 |
| Steel, unwrought.. „ | 439 | 707 | 4,288 | 5,882 |
| Lead, pig and sheet „ | 15,089 | 8,792 | 141,532 | 92,720 |
| Pyrites .......... „ | 50,149 | 34,694 | 86,820 | 63,866 |
| Quicksilver ....... Lb. | 118,200 | 71,640 | 9,695 | 6,920 |
| Silver ore....... Value £ | .. | .. | 209,275 | 119,980 |
| Tin .............. Cwt. | 76,687 | 73,495 | 271,315 | 237,903 |
| Zinc ............. Tons | 3,601 | 5,383 | 55,727 | 83,078 |
| Other articles ...Value £ | .. | .. | 164,453 | 173.718 |
| Total value of metals | .. | .. | 1,605,524 | 1,444,864 |

### IMPORTS OF OILS FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Cocoa-nut......... Cwt. | 9,157 | 25,056 | 10,274 | 27,671 |
| Olive.............. Tuns | 1,329 | 733 | 41,072 | 27,497 |
| Palm ............. Cwt. | 88,146 | 90,495 | 96,445 | 95,023 |
| Petroleum ........ Gall. | 14,126,388 | 14,664,690 | 209,238 | 273,821 |
| Seed .............. Tons | 1,997 | 1,919 | 43,345 | 38,306 |
| Train, &c.......... Tuns | 2.538 | 2,268 | 40,528 | 35,739 |
| Turpentine ....... Cwt. | 41,844 | 27,894 | 42,182 | 28,284 |
| Other articles .. Value £ | .. | .. | 66,389 | 70,240 |
| Total value of oils... | .. | .. | 549,473 | 596,581 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Bark, Peruvian .. Cwt. | 4,338 | 1,263 | 5,160 | 2,128 |
| Bristles.......... Lb. | 486,880 | 462,595 | 70,536 | 69,190 |
| Caoutchouc ...... Cwt. | 18,815 | 24,757 | 187,384 | 249,204 |
| Gum :— | | | | |
| Arabic......... „ | 2,875 | 4,560 | 6,983 | 9,581 |
| Lac, &c......... „ | 5,642 | 4,425 | 31,112 | 24,836 |
| Gutta-percha .... „ | 2,652 | 3,999 | 26,565 | 26,930 |
| Hides, raw :— | | | | |
| Dry............ „ | 27,127 | 29,152 | 66,826 | 70,212 |
| Wet ........... „ | 51,050 | 51,641 | 99,573 | 125,043 |
| Ivory......... .. „ | 1,245 | 619 | 45,756 | 27,156 |
| Manure :— | | | | |
| Guano ......... Tons | 1,645 | 7,160 | 11,850 | 53,484 |
| Bones ......... „ | 4,758 | 4,289 | 22,179 | 18,131 |
| Nitrate of soda... „ | 7,665 | 6,357 | 70,581 | 51,305 |
| Phosphate of lime „ | 38,059 | 17,854 | 70,056 | 28,689 |
| Paraffin.......... Cwt. | 38,186 | 54,181 | 39,063 | 58,395 |
| Linen rags....... Tons | 1,773 | 2,129 | 13,050 | 17,206 |
| Esparto.......... „ | 15,680 | 12,742 | 67,613 | 59,883 |
| Pulp of wood .... „ | 24,028 | 29,000 | 110,853 | 150,102 |
| Rosin............ Cwt. | 192,566 | 106,763 | 52,535 | 27,996 |
| Tallow and stearin „ | 163,830 | 104,500 | 208,400 | 123,670 |
| Tar .............Barrels | 32,399 | 36,159 | 20,314 | 29,074 |
| Wood :— | | | | |
| Hewn ......... Loads | 255,033 | 275,862 | 449,751 | 535,984 |
| Sawn .......... „ | 729,343 | 743,567 | 1,569,988 | 1,539,537 |
| Staves......... „ | 17,327 | 21,303 | 54,466 | 67,274 |
| Mahogany ... . Tons | 8,059 | 3,054 | 60,955 | 23,356 |
| Other articles....Value £ | .. | .. | 901,306 | 931,302 |
| Total value ....... | .. | .. | 4,262,855 | 4,319,668 |

Besides the above, drugs to the value of 102,749*l.* were imported, as against 66,956*l.* in September 1894.

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1891. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 13,541 | 11,616 | 10,718 | 8,664 |
| Bark (tanners', &c.) „ | 30,122 | 37,216 | 13,246 | 12,759 |
| Brimstone ........ „ | 34,455 | 21,764 | 7,206 | 5,603 |
| Chemicals...... Value £ | .. | .. | 89,893 | 101,588 |
| Cochineal ......... Cwt. | 414 | 306 | 2,402 | 1,967 |
| Cutch and gambier Tons | 1,580 | 1,732 | 35,178 | 38,828 |
| Dyes :— | | | | |
| Alizarin ....... Value £ | .. | .. | 17,605 | 20,081 |
| Anilin and other „ | .. | .. | 32,585 | 27,604 |
| Indigo ............ Cwt. | 797 | 1,451 | 10,538 | 15,611 |
| Nitrate of potash . „ | 25,337 | 17,136 | 21.577 | 15,790 |
| Valonia ........... Tons | 2,007 | 1,780 | 24,740 | 20,918 |
| Other articles... Value £ | .. | .. | 115,641 | 150,550 |
| Total value of chemicals | .. | .. | 381,299 | 419,963 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 8,495 | 8,548 | 30,190 | 34,402 |
| Copper :— | | | | |
| Unwrought ..... „ | 30,969 | 60,106 | 67,200 | 144,761 |
| Wrought ....... „ | 28,706 | 25,196 | 73,986 | 70,103 |
| Mixed metal.... „ | 28,320 | 24,371 | 59,238 | 52,325 |
| Hardware ..... Value £ | .. | .. | 155,264 | 164,660 |
| Implements ...... „ | .. | .. | 91,897 | 104,462 |
| Iron and steel..... Tons | 238,978 | 269,346 | 1,572,950 | 1,709,377 |
| Lead ............. „ | 4,026 | 2,730 | 44,384 | 33,152 |
| Plated wares... Value £ | .. | .. | 26,426 | 32,420 |
| Telegraph wires „ | .. | .. | 49,820 | 45,268 |
| Tin ................ Cwt. | 7,772 | 7,833 | 28,480 | 26,799 |
| Zinc .............. „ | 16,755 | 12,204 | 11,101 | 8,450 |
| Other articles .. Value £ | .. | .. | 52,878 | 53,918 |
| Total value ......... | .. | .. | 2,263,814 | 2,480,097 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 30TH SEPTEMBER.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 587,100 | 662,700 | 12,412 | 13,704 |
| Military stores.. Value £ | .. | .. | 100,809 | 199,106 |
| Candles.......... Lb. | 1,702,900 | 1,657,200 | 28,125 | 27,756 |
| Caoutchouc ..... Value £ | .. | .. | 92,272 | 97,519 |
| Cement.......... Tons | 42,668 | 37,027 | 70,969 | 61,060 |
| Products of coal Value £ | .. | .. | 86,674 | 104,106 |
| Earthenware ... „ | .. | .. | 151,146 | 146,904 |
| Stoneware ...... „ | .. | .. | 14,174 | 13,076 |
| Glass :— | | | | |
| Plate........... Sq. Ft. | 83,624 | 129,273 | 5,000 | 7,986 |
| Flint........... Cwt. | 7,790 | 7,832 | 18,063 | 17,945 |
| Bottles......... „ | 55,271 | 63,381 | 26,766 | 30,656 |
| Other kinds.... „ | 16,800 | 19,372 | 13,192 | 13,977 |
| Leather :— | | | | |
| Unwrought .... „ | 9,940 | 13,213 | 92,501 | 127,155 |
| Wrought ..... Value £ | .. | .. | 31,309 | 38,134 |
| Seed oil.......... Tons | 3,756 | 3,267 | 79,551 | 67,813 |
| Floorcloth ..... Sq. Yds. | 1,557,000 | 1,645,500 | 60,249 | 68,673 |
| Painters' materials Val. £ | .. | .. | 110,129 | 123,096 |
| Paper ........... Cwt. | 68,257 | 73,771 | 108,950 | 119,728 |
| Rags............. Tons | 4,250 | 3,871 | 25,098 | 21,729 |
| Soap ............. Cwt. | 44,221 | 60,160 | 49,226 | 62,667 |
| Total value .......... | .. | .. | 2,352,216 | 2,696,148 |

Exports of Drugs and Chemicals for Month ending 30th September.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 499,663 | 519,068 | 136,594 | 126.960 |
| Bleaching materials „ | 114.585 | 104.723 | 45,412 | 39,161 |
| Chemical manures. Tons | 30,452 | 30,694 | 172,929 | 156,125 |
| Medicines....... Value £ | .. | .. | 75,562 | 88,827 |
| Other articles.. „ | .. | .. | 224,222 | 238,633 |
| Total value .......... | .. | .. | 654,719 | 649,719 |

# Monthly Patent List.

*** The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.**

## I.—GENERAL PLANT, APPARATUS, and MACHINERY.

### Applications.

17,742. S. Cutler. Safety fittings for water-gas generators. September 23.

17,746. H. Gabe. Improvements in apparatus for decomposing calcium carbide. Complete Specification. September 23.

17,942. F. Garros. Improvements in filtering apparatus. September 25.

18,190. J. B. Graham. Improvements in apparatus for generating carbon dioxide and sulphur dioxide especially for use in extinguishing fires. Complete Specification. September 28.

18,218. J. Foster. Improvements in and relating to evaporators. September 30.

18,464. J. Wood. Improvements in furnace pans, coppers, and the like. October 3.

18,158. S. Pitt.—From La Soc. Internat. des Procédés A. Seigle. Improvements in apparatus for treating liquids by means of heat. Complete Specification. October 3.

18,562. J. E. Preston. Improved amalgamating apparatus. October 4.

18,722. A. W. Paul. Improvements in condensers and like apparatus for use in the transference of heat between fluids. October 7.

18,857. C. Tissier and H. J. Ernaux. Improvements in filtering apparatus for purifying and sterilising liquids, fluids, gases, and vapours. Complete Specification. October 8.

19,056. C. Pollak. Improved means and apparatus for testing specific gravity of liquids, specially applicable for testing battery acids. October 10.

19,103. A. M. Hugill, J. Overton, and R. H. Catley. Improvements in means or apparatus for heating, evaporating, and concentrating infusions and liquids. October 11.

### Complete Specifications Accepted.*

1894.

20,480. J. J. Meldrum, T. F. Meldrum, and J. W. Meldrum. Treating liquids by gases. October 2.

20,874. A. Bloch. Apparatus for mixing liquids and gases. October 9.

1895.

108. J. Osman. Continuous firing kilns. October 9.

918. A. T. Clarkson and J. B. Spurge. Improvements in apparatus for regulating the flow of compressed gases. October 16.

## II.—FUEL, GAS, and LIGHT.

### Applications.

11,848A. H. H. Lake.—From E. N. Dickerson. Improved methods of and apparatus for mingling gas or air and acetylene gas or other enriching gas for illuminating purposes. Filed September 23. Date claimed June 18, 1895.

17,268. J. E. Pfiel. An improved method of and apparatus for vaporising solid and liquid fuels, and utilising the vapour for heating purposes. Complete Specification. September 16.

17,372. J. Turner. Frugal fuel. September 18.

17,472. J. H. Lyon. Improvements in the apparatus used in connection with the manufacture of gas, and commonly known as the "hydraulic main." September 19.

17,514. W. Quaadt. Improvements in incandescent lamps, operating by the vaporisation and combustion of volatile fuel. September 19.

17,568. O. Rose. An improved method of producing peat charcoal and apparatus therefor. September 20.

17,667. F. Fowler.—From A. S. Fowler, Cape Colony. An improved saturator for limelight apparatus. September 21.

17,742. S. Cutler. *See* Class I.

17,795. W. L. Voelker. Improvements in incandescent gas lamps. Complete Specification. September 24.

17,851. H. Zening. Improvements in incandescence lamps for liquid fuel. Complete Specification. September 24.

18,025. B. Bagshawe, F. G. Worth, and S. Fox. Improvements in generators for the production of acetylene gas. September 26.

18,041. H. Schneider. Improvements in the generation of acetylene gas. September 26.

18,156. G. Haycraft. Improvements in the manufacture of fuel. September 28.

18,248. C. J. Fox. An apparatus for projecting liquid fuel intimately mixed with air and steam in a state to be burnt for heating steam boilers and for other purposes. September 30.

18,263. W. H. Wheatley.—From C. Schmid. Improvements in the manufacture of incandescence bodies for illuminating purposes. Complete Specification. September 30.

18,334. F. Livesey. Improved apparatus for the extraction of cyanides and other compounds from illuminating and other gases. October 1.

18,395. J. T. Thomas and A. V. Hunt. Improvements in the manufacture of coal-gas. October 2.

18,517. S. Pitt.—From La Soc. Internat. des Procédés A. Seigle. Improvements in vaporising or heating hydrocarbons and in apparatus therefor. Complete Specification. October 3.

18,719. J. H. Exley. Improvements in apparatus for generating acetylene gas. October 7.

18,877. P. Dvorkovitz. Improvements in means or apparatus for distilling, applicable also for enriching gases by means of hydrocarbons. October 8.

18,966. F. Edwards. Method and means for utilising radiant heat. October 9.

19,037. T. E. de Wolf. Improvements in the disposal of refuse and the like and in the manufacture of gas. October 10.

19,183. T. R. Shillito.—From C. M. Rompler and H. Axmann. An improved means for automatically regulating the mixture of gas and air for incandescent gas lighting and for heating purposes, and for suppressing the noise made by the inrush of air when incandescent gas lights are turned low. October 12.

19,202. S. H. Crocker. Improvements in mantles for incandescent light. October 12.

### Complete Specifications Accepted.

1894.

18,091. R. Clough, M. L. Mulholland, and R. Clough, jun. Apparatus for purifying coal or the like material by the washing process. September 25.

1895.

1420. H. T. Stevenson. Manufacture and production of fire-lighters. October 16.

4799. J. E. Campbell. Improvements in the manufacture or preparation of materials for the purification of gas, sewage, or the like. October 2.

## IV.—COLOURING MATTERS and DYES.

### Applications.

17,260. B. Willcox.—From The Badische Anilin und Soda Fabrik. Improvements in the manufacture of dis- and poly-azo dyes by oxidation. September 16.

17,402. W. Clarke. Improvements relating to the treatment of mangrove bark for the obtainment therefrom of pure solid tannin, dye, and cutch. September 18.

17,639. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of new diamido-bases derivatives of azimidobenzene and of azo dyes from these. September 21.

17,642. J. Imray.—From La Soc. Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Manufacture of sulphuretted colouring matters dyeing fibres without mordants. September 21.

17,660. B. Willcox.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new mordant-dyeing colouring matters. September 21.

17,738. H. E. Newton.—From The Farb. vorm. F. Bayer and Co. The manufacture or production of dyestuffs for cotton. September 23.

### Complete Specifications Accepted.

1894.

22,273. S. Pitt.—From L. Cassella and Co. The production of mixed disazo dyestuffs from delta-amidonaphthol. September 25.

22,454. H. E. Newton.—From The Farb. vorm. F. Bayer and Co. Manufacture or production of dyestuffs and materials therefor. October 9.

22,603. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. The manufacture and production of new black colouring matter, and the production of black colour on vegetable fibre. October 16.

22,743. L. G. Williams and A. Turner. Improvements in dyes. September 25.

22,914. S. Pitt.—From L. Cassella and Co. The production of fast yellow dyestuffs from the sulpho acids of dehydrothiotoluidine or analogous bases. October 2.

23,584. H. E. Newton.—From The Farb. vorm. F. Bayer and Co. Manufacture or production of colouring matters and materials therefor. October 9.

1895.

14,331. G. W. Johnson.—From F. von Heyden. The manufacture or production of para-phenetidin succinic acid and of para-phenetidin-dioxy-succinic acid. October 16.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

17,692. J. Wright. Improvements in or appertaining to woven fabrics. September 23.

18,765. H. H. Lake.—From A. K. J. von Gerkan and E. Zietz. An improved process of producing floor-covering material and the like from the needles or leaves of pine trees. October 7.

### Complete Specifications Accepted.

1894.

14,903. T. Burrows. Improved means or apparatus for de-gumming or otherwise treating the fibres extracted from the plants, stems, or straws of flax, hemp, ramie, or the like. October 9.

21,029. W. G. Thomson. Improvements in the method of and apparatus for manufacturing inlaid linoleums and other floor-cloths. October 9.

1895.

12,012. H. Schire. Carbonisation of wool and other material.

12,645. C. F. Fecker. Preparation of wool for under-clothing. October 2.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

17,833. S. Schwabe and Co., Ltd., and R. Boral. Improvements in producing and brightening coloured patterns on an aniline black ground upon woven fabrics, which may or may not be subsequently mercerised. September 25.

18,040. R. Thomas and E. Prevost. Improvements in or relating to Mercer's system of treating vegetable fibres or fabrics for dyeing purposes. Complete Specification. September 26.

18,529. E. Wilkinson. Improvements in colouring and bronzing paper. October 4.

18,570. N. Browne. From A. A. Vogelsang. Improvements in bleaching and dyeing yarn on spools and apparatus therefor. Complete Specification. October 4.

18,943. H. H. Lake.—From K. Oehler. An improved process for dyeing leather by means of aniline black and other oxidation colours. October 9.

### Complete Specifications Accepted.

1894.

22,221. J. Clapham, W. W. L. Lishman, and M. Jefferson. Improvements in machinery for dyeing and bleaching yarns and fabrics. October 9.

22,603. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. *See* Class IV.

23,119. J. Arnold. Improvements in or relating to dyeing. October 16.

1895.

16,002. E. Weldon. Improvements in dyeing machines. October 2.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

17,376. C. G. Millar. Improvements in and relating to the manufacture of saltpetre. September 18.

18,016. C. D. Abel.—From H. Meeus. The utilisation of the gases resulting from fermentation and from lime kilns for the production of alkaline bicarbonates and of pure carbon dioxide, applicable for treating saccharine matters, the production of liquid carbon dioxide, and other purposes. Complete Specification. September 26.

18,076. C. R. Illingworth and D. Arthur. Process for the recovery of ammonia from sewage and other ammoniacal liquors. September 27.

18,096. A. R. Davis. Improvements in the treatment of copper liquors and in the manufacture of chlorine. September 27.

18,406. G. B. Baldo. *See* Class X.

18,785. H. Hilbert and A. Frank. Improvements relating to the production of phosphorus, its acids and salts, from mineral phosphates, bones, and other materials containing phosphoric acid. October 7.

18,836. J. T. A. Walker. An improved process for the recovery of carbonate of lime from caustic soda sludge. October 8.

18,890. J. B. Readman. Improvements in obtaining cyanides. October 9.

19,009. T. H. Cobley. Improvements in the production of alkaline plumbates from the ores of lead, oxide of lead, and other substances containing lead, and the application of said plumbates to the manufacture of salts, pigments, and compounds of lead. October 10.

19,120. G. Bamberg. Improvements in the manufacture of alkaline silicates and carbonated alkali, and in decomposing apparatus for that and other purposes. October 11.

19,138. J. L. F. Vogel. Improvements in the production of alkaline cyanides. October 11.

19,192. F. Valentiner. Improvements in obtaining pure concentrated nitric acid from dilute or impure solutions. Complete Specifications. October 12.

19,201. G. C. Downing.—From J. R. Moise. Improvements in the manufacture of alkaline cyanides, ferrocyanides, and their derivatives, and in apparatus therefor. October 12.

### Complete Specifications Accepted.

1894.

15,941. J. E. Chaster. Manufacture of cyanides. September 25.

15,942. J. E. Chaster. Manufacture of cyanides and apparatus therefor. September 25.

18,792. W. McD. Mackey and J. F. Hutcheson. Production of cyanides and ammonia.

22,028. L. Gautreau, E. Charbonnier, and E. Serrant. Process of manufacture and employment of humic acid and its compounds. October 2.

22,207. H. H. Lake.—From C. Pieper and C. Fellner. Manufacture of ammonia and by-products. October 2.

22,826. J. Brock, A. E. Wareing, and F. Hurter. Improvements in the treatment of solutions of zinc chloride for the purification thereof for electrolytic purposes. October 2.

22,827. J. Brock, A. E. Wareing, and F. Hurter. Improvements in the treatment of solutions of chloride of zinc for the purification thereof for electrolytic purposes. October 2.

22,828. J. Brock, A. E. Wareing, and F. Hurter. Improvements in the utilisation of zinc blende for obtaining metallic zinc and sulphur, and in effecting the decomposition of common salt for the production of soda and chlorine. September 25.

22,853. J. W. Walker. Improvements in obtaining a continuous supply of hydrochloric acid or nitric acid gas, and in utilising acid sulphates. October 2.

23,262. C. F. Claus. Roasting sulphide ores. October 9.

23,370. L. P. Hulin. Process and apparatus for the manufacture of caustic alkalis from alloys of the alkali metals. October 9.

24,113. J. Holt and J. G. Lorrain. *See* Class XVIII. A.

1895.

1419. J. L. Kessler. Improvements in the manufacture, treatment, or purification and production of salts or compounds of alumina. October 9.

15,429. R. W. Barker.—From M. Sommer. Improvements in salt. October 2.

15,991. H. Gabe. Automatical apparatus for decomposing carbide of calcium. October 2.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

17,931. G. B. Ellis.—From. M. Hirsch. Improvements in the manufacture of glass. Complete Specification. September 25.

18,916. A. J. Boult.—From P. A. J. Gasse. Improvements in or relating to painting or printing upon earthenware. October 9.

19,203. W. A. Whiston. Improvements in the mode of and means for the production of transfers for the decoration of ceramic ware. October 12.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

17,227. H. Stanton. Improvements in fire-resisting floors. September 16.

17,669. E. C. Smith. Improvements in the method of and apparatus for the manufacture of plaster boards, slabs, or the like. Filed September 21. Date applied for April 1, 1895, being date of application in United States.

18,189. G. Michaelson. A process for imparting an artificial shaded colouring to and for speckling or "curling" wood, metal, stone, and the like. Complete Specification. September 28.

18,258. W. Haussman. An improved kiln for manufacturing white and coloured cement. September 30.

18,326. G. de Bruyn. Improvements in fireproof ceilings. October 1.

18,331. E. Robbins. An improved cement and means and methods for producing the same, and architectural and other works thereof. October 1.

18,409. G. de Bruyn. Improvements in fireproof ceilings. October 2.

18,410. H. Hellewell. Improvements in the preparation or manufacture of asphalt or cement for laying pavements, floors, or the like. October 2.

18,450. J. Dougan and J. McMillan. Improvements in materials and methods of making concrete floors. October 3.

18,455. M. Hilton. A method of making plain, ornamental, or other tiles, slabs, and pavements, which may be required for domestic, sanitary, and public use or ornament, and for building purposes. October 3.

18,576. G. de Bruyn. Improvements in slabs for building and like purposes. October 4.

18,654. J. H. Barry. An improved paving by the utilisation of waste materials, and in the manner of laying the same. October 5.

18,847. H. W. J. Cheffins. Improvements in the method of grinding and mixing materials for the manufacture of Portland cement. October 8.

18,936. A. Boulton. Improvements in mortars or cement. October 9.

19,101. A. Gosling. Artificial stone. October 11.

### Complete Specifications Accepted.

1894.

12,811. J. J. Pfeiffer. Process for the manufacture of artificial sandstone. October 9.

22,001. W. Youlten. Improvements in fireproof construction. October 9.

1895.

416. The Adamant Co., Ltd., and J. Wilkinson. A new or improved fireproof flooring and ceiling. October 16.

13,761. E. F. Badgley, A. R. Green, and A. Crockett. Improvements in or appertaining to apparatus for, and the art of treating, working, and handling bituminous or similar compounds and articles made therefrom. October 9.

15,561. C. Brand. Manufacture of scoria or slag blocks, and moulds therefor. September 25.

16,422. V. Kjeldsen. Building blocks or bricks. October 9.

## X.—METALLURGY, MINING, Etc.

### Applications.

17,250. R. I. Roman. Improvements in aluminium compounds, and means for producing the same. September 16.

17,256. R. Lewis. Improvements in finishing tin and terne plates. September 16.

17,320. J. Woolford. Improvements in apparatus for collecting metallic fumes. September 17.

17,413. H. Bailey. Improvements in the recovery of tin from tin slags or other débris. September 18.

17,618. W. T. Leyshon. Improvements in or additions to machinery for the coating of metals. September 21.

17,624. J. Brierley and J. G. C. Kay. An improved solution for the treatment of steel. September 21.

17,664. H. Warrington and H. J. Warrington. Improvements in puddling iron. September 21.

17,766. J. Swinburne and A. A. Beadle. Improvements in soldering or working aluminium. September 24.

17,799. C. T. J. Vautin. Extraction of metals. September 24.

17,812. H. L. Sulman and H. F. Kirkpatrick-Picard. Improvements in or relating to the extraction of precious metals from their ores. September 24.

17,813. H. L. Sulman and H. F. Kirkpatrick-Picard. Improvements in or relating to the extraction of precious metals from their ores. September 24.

17,901. W. J. May. Improvements in ferro-sodium fluxes. September 25.

17,932. Davies Bros. and Co., Ltd., E. A. Davies, and S. T. Thomas. Improvements in preparing metal sheets for the purpose of galvanising them or otherwise coating them with metal or metallic alloy. September 25.

18,068. J. Ruffle. An improved method for coating iron in a solid state, or steel in a solid state, with lead or the alloys of lead. September 27.

18,077. H. L. Sulman and H. F. Kirkpatrick-Picard. Improvements in or relating to the extraction of precious metals from their ores. September 27.

18,078. H. L. Sulman and H. F. Kirkpatrick-Picard. Improvements in or relating to the recovery of precious metals from their solutions. September 27.

18,116. F. C. May. An improved process for the extraction of gold and silver from their ores. September 28.

18,177. H. A. de Neufville. Process and apparatus for the extraction of gold and silver from their ores and from other auriferous and argentiferous substances. Complete Specification. September 28.

18,537. Gottig. New or improved process for colouring aluminium. October 1.

18,406. G. B. Baldo. Mode of producing contemporary hypochlorites, chlorates, hydrochloric acid, caustic soda, and hydrogen from the sea-water by means of the electricity. Complete Specification. October 2.

18,489. H. R. Gregory and F. L. Marshall. Improvements in apparatus for recovering gold and certain other metals from various solutions. October 3.

18,643. A. McT. Spencer. Improvements in and relating to the construction and manufacture of compound armour plates and other plates. October 5.

19,154. F. J. Clinch-Jones. An improved method of recovering tin and other metals. October 12.

19,180. H. V. Holden. Improvements in moulds for casting steel in layers. October 12.

### Complete Specifications Accepted.

1894.

14,306. Davies Bros. and Co., Ltd., E. A. Davies, and S. T. Thomas. A novel or improved method of preparing metal sheets for the purpose of galvanising them or otherwise treating them with metal or metallic alloy, and apparatus for use therein. October 2.

18,279. A. E. Morgans. Process for extracting precious metals from their ores. September 25.

22,740. L. Oliven. Improvements in or relating to the soldering of aluminium and its alloys. October 16.

24,815. J. F. Allen and J. Brock. Improvements in alloys of manganese with other metals. October 2.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

17,269. C. E. C. Jungnickel. Improvements in dry cells September 16.

17,288. W. A. Rosenbaum. Improvements in and connected with the electrolytic decomposition of alkaline salts. Complete Specification. September 17.

17,505. C. Hoepfner. Improvements in electrodes. September 19.

17,525. C. Kellner. Improvements in the electrolytical manufacture of bleaching liquid. September 19.

17,528. A. F. B. Gomess. A new and improved electro-deposition, more especially applicable to electro-plating. September 19.

17,573. G. Poore. Improvements in electrolysis. September 20.

17,603. M. M. Bair. Improvements in electric batteries. Complete Specification. September 20.

17,655. B. M. Drake and J. M. Gorham. Improvements in secondary batteries. September 21.

17,745. H. H. Lake.—From C. Hoepfner. Improvements in or relating to electrolytic cells. September 23.

17,821. F. King. Improvements in or connected with secondary batteries. September 24.

17,825. W. H. Beck.—From J. Johnson, J. H. Robertson, J. H. Crosman, and W. H. Jewell. A new or improved porous plate, body, or electrode. September 24.

17,925. R. W. Hill. Production of carbonate of soda and chlorine gas by electricity. September 25.

17,949. E. Kronke. An improved process for electro-copper-coating ships' hulls in a dock. Complete Specification. September 25.

18,034. H. Leitner. Improvements in oxidising lead and lead compounds for the construction of electrical accumulators. Complete Specification. September 26.

18,036. H. Leitner and E. Reicher. An improved process for the preparation of electrodes for primary, secondary, and dry batteries. Complete Specification. September 26.

18,038. H. Leitner and E. Reicher. Improvements in and appertaining to electrodes. Complete Specification. September 26.

18,226. C. Fisker and L. Bertram. Improvements in secondary batteries. September 30.

18,487. J. Heibling. Improvements in the electrolytic manufacture of ferro-manganese, ferro-chrome, ferro-aluminium, ferro-nickel, and other alloys having an iron base. October 3.

18,557. J. B. Torres. Improvements in galvanic and storage batteries. October 4.

18,586. R. Pearson. An improvement in secondary batteries or accumulators. October 4.

18,692. F. E. Everard. Improvements in the construction of electrodes or plates for secondary batteries. October 5.

### Complete Specifications Accepted.

1894.

12,483. C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell. Improvements in or connected with electric batteries. October 2.

18,172. J. J. Maclean. Apparatus for extracting gold by electrolysis. September 25.

19,423. J. H. Dunn. Production of gas by use of electricity. October 16.

20,354. P. Marino. Improvements in and connected with the electro-deposition of aluminium and aluminium alloys. October 16.

22,973. C. S. W. Brown. Improvements in and relating to storage batteries. October 2.

23,680. A. M. Clark. From La Société des Cuivres de France. A process of and apparatus for making compressed electrolytic copper, applicable also to other metals capable of being deposited by electrolysis. October 9.

24,714. L. Epstein. Secondary voltaic batteries. October 16.

1895.

9937. S. Hammacher. Manufacture of active material for secondary batteries. September 25.

12,622. A. Müller. Secondary or accumulator cells. September 25.

15,886. C. J. Wollaston. Electric batteries. October 2.

16,702. P. Vandersmissen. An element for secondary voltaic batteries. October 2.

## XII.—FATS, OILS, and SOAP MANUFACTURE.

### Applications.

17,239. G. Mitchell. Process and apparatus for separating and otherwise treating oils and like liquids. September 16.

18,163. R. E. Green. Improvements in the manufacture of soap. September 28.

18,239. J. Holmes, H. E. Tankard, and W. Scaife. A new or improved method of and apparatus for removing fatty matters from the effluent waters of wool-washing machines and the like. September 30.

18,760. S. E. von Graeve. A new or improved process of manufacture of petroleum soap. October 7.

18,835. G. T. Jolland. An improvement in lubricants for the chains of velocipedes and for other machinery. October 8.

19,021. J. W. Barclay. Improvements in the manufacture of soap. October 10.

### Complete Specifications Accepted.

1894.

20,158. M. Perls. Improvements in materials for and in the manufacture of soft soap. September 25.

20,974. H. A. Leverett. *See* Class XVII.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

17,217. W. T. Mealley. Improvement in black-lead. September 16.

17,640. W. Briggs. Improvements relating to the application of bituminous substances or materials to the plating and other metallic surfaces of iron or steel steamships and sailing vessels. September 21.

17,786. R. A. Sloan.—From The Inch Non-Corrosive Metal Co. An improved metallic paint and method of making same. Complete Specification. September 24.

17,871. W. L. Gunn. Improvements in compositions for protecting ships' bottoms against fouling, preserving wood, and shielding submarine electric cables from penetration by torpedo worms. September 24.

17,874. R. V. Ash and J. B. Smith. An improvement in the manufacture of blandite and such like substitutes for rubber. September 25.

19,130. P. C. D. Castle. New or improved chemical substance and the application thereof to industrial purposes, such as rubber, gutta-percha, or celluloid substitutes, insulations of electrical conductors, coverings for ships' bottoms, or wall or floor coverings. October 11.

### Complete Specification Accepted.

1894.

24,673. R. Hutchison and J. Binnie. Treating gutta-percha. October 16.

## XIV.—TANNING, LEATHER, GLUE, and SIZE.

### Applications.

17,356. W. Mathews. An improved process of dressing or finishing leather. September 17.

17,402. W. Clarke. *See* Class IV.

18,178. A. F. Diehl. An improved process and apparatus for the treatment of raw hides. Complete Specification. September 28.

18,605. J. B. Scammell and E. A. Muskett. Improvements in and relating to the currying of leather. October 5.

18,639. J. C. Ody. Production of artificial leather or a substance that can be used in the place of leather. October 5.

18,879. L. A. Groth. Improvements in apparatus employed in tanning hides and skins. October 8.

18,943. H. H. Lake. From K. Oehler. *See* Class VI.

### Complete Specifications Accepted.

1894.

21,550. J. Y. Johnson.—From F. Kornacher and Diesel, and Weise and Co. Improvements in tanning. October 2.

22,968. W. R. Earp. Improvements in or relating to the treatment of hides for the manufacture of leather. October 9.

23,585. A. Zimmermann.—From The Chemische Fabrik auf Actien vormals E. Schering. A process for rendering insoluble albumen and albumen-like matters, casein, albumose, and the products of conversion of glue and gelatine. October 16.

1895.

14,936. E. Schmahl and F. Feller. An improved glue or size, and process of manufacturing same. October 9.

## XV.—AGRICULTURE and MANURES, Etc.

### Applications.

18,635. T. Jamieson. Process for the manufacture of phosphates of ammonia and potash in an alkaline mixture suitable for manure. October 5.

19,054. M. Bird. An improved method for producing a certain by-product for fertilising purposes, applicable likewise for other uses. October 10.

### Complete Specifications Accepted.

1894.

24,063. W. P. Thompson.—From Wirth and Co. An improved process for obtaining dry manure and ammonia from fæces or fæcal matter, and apparatus therefor. October 2.

1895.

11,905. C. H. Langdale and A. W. Langdale. Treatment of ground slags intended for use as fertilisers. September 25.

12,769. D. T. Day. Process of making phosphate of lime fertilisers. October 2.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

18,016. C. D. Abel.—From H. Meeus. *See* Class VII.

18,260. L. Walker. A machine for cleaning gum and other substances by washing. September 30.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

17,496. H. Elion. Improvements in the manufacture of yeast. September 19.

17,611. J. Bradbury. Improved methods of utilising the waste products from breweries, distilleries, vineyards, and the like, including suitable machinery and apparatus for the same. September 21.

18,061. T. C. Hitchen and W. Ackroyd. Improved methods of brewing, whereby the quantity of natural phosphates is increased. September 27.

18,296. J. W. Folkerts. Improvements in the manufacture of yeast. October 1.

18,999. J. F. H. Gronwald. Improvements in or connected with the process of and apparatus for pasteurising beer. October 10.

19,171. N. Anderson. Improved apparatus for blending or mixing spirits. October 12.

### Complete Specifications Accepted.

1894.

20,974. H. A. Leverett. Maturing alcoholic liquors, vegetable oils, tobacco, and other substances, and in apparatus connected therewith, partly applicable to other purposes. October 2.

1895.

14,925. G. Kassner. An improved process for the manufacture of sugar. October 2.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

17,823. P. N. Jenkins. A new or improved method or process and apparatus for the transportation or storage of perishable produce, such as meat, game, fish, and the like articles. Complete Specification. September 24.

17,844. J. D. Postle. An improved method or process for the preservation and storage of perishable organic substances by cold. September 24.

18,043. A. Ernecke. Improvements in apparatus for preserving food and the like. September 26.

18,767. A. J. Boult.—From H. Davidson. Improvements in or relating to apparatus for sterilising or pasteurising milk and other liquids. Complete Specification. October 7.

#### *B.—Sanitary Chemistry.*

17,648. E. E. Scruby. Improved means of purifying sewage effluents and other impure liquids. September 21.

17,828. C. Tellier. Improvements in the manufacture of ice and in the production of cold, and in apparatus therefor. September 24.

18,093. J. W. Slater and The Native Guano Co., Ltd. Improvements in the treatment and purification of sewage and impure water. September 27.

19,037. T. A. de Wolf. Improvements in the disposal of refuse and the like, and in the manufacture of gas. October 10.

#### *C.—Disinfectants.*

18,223. J. L. Wade. An improved disinfectant compound which may be used for dipping sheep, also as an antiseptic for purifying, disinfecting, and general detergent purposes. Complete Specification. September 30.

18,229. E. Burton. An improved disinfectant and cleansing and purifying compound. September 30.

18,356. W. H. Beck.—From J. W. Hill. Improved gases or vapours for disinfecting and for destroying germs and insects, and apparatus for producing such gases or vapours. October 1.

### Complete Specifications Accepted.

#### *A.—Chemistry of Foods.*

1894.

23,270. G. A. Clowes. A new or improved medicinal and nutritive compound or preparation. October 9.

24,713. J. Holt and J. G. Lorrain. Manufacture of vinegar. October 16.

#### *B.—Sanitary Chemistry.*

1894.

19,482. H. L. Hinnell. Construction of filter beds for the filtration of liquids from sewage, sludge, mud, bleachers', dyers', tanners', and manufacturers' refuse, and in apparatus or arrangements for use therein and covering the same. October 16.

20,447. W. Michalk. Furnace smoke - consuming arrangements. October 9.

25,119. T. Craig and A. E. Raper. Improvements in the treatment of wash waters, sewage, and other fouled waters in order to purify the same. October 9.

1895.

4799. J. E. Campbell. *See* Class II.

10,238. P. Jensen.—From J. C. Anderson. Improvements in and relating to a method of and apparatus for the treatment of garbage and other refuse matter. October 9.

#### *C.—Disinfectants.*

1894.

22,494. F. M. Spence. Disinfecting powders. September 25.

16,009. A. Lenhardsson. A new or improved antiseptic and preservative preparation. October 2.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

17,375. R. A. McLaurin. Improvements in and relating to blotting-paper. September 18.

18,503. W. Brothers. Improved process or treatment of waste materials obtained in the manufacture of ammonium compounds to produce a substance suitable for use as a paper filling in the manufacture of paper. October 3.

19,008. J. S. Rigby. Improvements connected with the application and utilisation of the residual liquors produced in the manufacture of vegetable parchment paper. October 10.

### Complete Specification Accepted.

1895.

11,261. C. T. Fox. Manufacture of waterproof paper or fabrics specially applicable for use in the manufacture of cartridge cases, trunks, drapers' boxes, postal tubes, and fireworks. October 2.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

### Applications.

17,322. J. Imray.—From La Société Chimique des Usines du Rhone Anct. Gilliard, P. Monnet, and Cartier. Improvements in the manufacture of vanillin from protocatechuic aldehyde. September 17.

17,351. W. Schmidt. A process for the preparation of camphor in the condition of powder. September 17.

17,417. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of pharmaceutical compounds. September 18.

17,827. I. R. Sharpe. New or improved process for making essences and extracts from barks, herbs, roots, grain, and other vegetable substances, applicable for imparting a head, body, flavour, to beer and liquids, and as anti-ferments for liquids generally. September 24.

18,297. J. C. Richardson. Improvements in or relating to the manufacture of artificial camphor and its treatment. October 1.

19,040. F. Valentiner. Process for the preparation of acetophenonphenetidid. Complete Specification. October 10.

### Complete Specifications Accepted.

1894.

22,028. L. Gautreau, E. Charbonnier, and E. Serraut. *See* Class VII.

22,190. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of casein compounds. September 25.

22,191. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of a new solid silver compound. September 25.

23,438. R. Jurgensen and A. Bauschlicher. Manufacture of acetone. October 9.

25,311. F. Sahlfeld. Improvements in the production of fish extracts. October 2.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### Complete Specifications Accepted.

1894.

22,013. C. E. Hearson. Apparatus for imparting a predetermined temperature to liquids for use in developing photographic plates and for other purposes. October 2.

1895.

10,749. J. Jensen.—From M. Anderson. Method and apparatus for the production of coloured photographs. September 25.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

17,307. J. R. Robinson. Improvements relating to matches. September 17.

17,935. P. R. J. Willis.—From W. C. Peyton. Improved process of and apparatus for making gunpowder. September 25.

18,401. J. E. Chaster. Improvements in the manufacture of gunpowder. October 2.

18,575. J. I. Williams. An improvement or improvements in or connected with matches. Complete Specification. October 4.

### Complete Specifications Accepted.

1894.

18,921. O. Imray.—From F. C. Glaser and Co. Manufacture of a new explosive. September 25.

21,729. J. W. Swan. Apparatus for the manufacture of nitro-cellulose or guncotton. October 16.

24,235. A. F. Hargreaves. Manufacture of nitro-cellulose ammunition. October 2.

1895.

15,834. L. W. Buse. Manufacture of explosives. October 9.

## XXIV.—PATENT UNCLASSIFIABLE.

### Complete Specification Accepted.

1894.

21,913. C. D. Ekman and C. Christian. Treatment of locust beans in order to obtain useful products therefrom. September 25.

Printed and Published by Eyre and Spottiswoode, East Harding Street, London, E.C., for the Society of Chemical Industry.

# THE JOURNAL

OF THE

# Society of Chemical Industry:

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No. 11.—Vol. XIV.] NOVEMBER 30, 1895. [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee is now 20*l.*, instead of 15*l.* as heretofore.

### Collective Index.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form accompanying this issue of the Journal | 5s. |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10s. |
| To Subscribers | 12s. 6d. |
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Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. Eyre and Spottiswoode, the Society's printers and publishers, to whom all communications respecting them should be addressed. The circulation of the Journal is now more than 3,000 per month.

Foreign and Colonial Members are reminded that the subscription of 25s. for 1896, payable on January 1st next, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1896.

## LIST OF MEMBERS ELECTED 22nd NOVEMBER 1895.

Allison, Wm. O., 72, William Street, New York, U.S.A., Publisher of *Oil Paint and Drug Reporter.*

Bacon, Nathaniel T., Peace Dale, Rhode Island, U.S.A., Chemical Engineer.

Baskerville, Dr. Chas., University, Chapel Hill, North Carolina, U.S.A., Assistant Professor of Chemistry.

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Martin, Chas. H., 1, Oakfield Terrace, Crescent, Salford, Soap Works Manager.

Mitchell, Ralph, The Cedars, 4, Augustus Road, Edgbaston, Birmingham, Chemical Student.

Morgan, J. R., Broginin, Avenue Road, Highgate, N., East India Merchant.

Morison, Jno. Gillies, Aberfoyle, 5, Birdhurst Road, South Croydon, Chemist.

Perry, Jos. H., 176, Highland Street, Worcester, Mass., U.S.A., Teacher of Chemistry.

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Evans, R. E., l/o Shakespeare Street; 3, Glencoe, Stratford-on-Avon.

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Leipsiger Färber Zeitung (late Färb. Muster Zeitung); Gustav Weigel, Buchhandlung, Leipzig, Germany.

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SESSION 1895-96.

December 2nd:—

Mr. J. Hargreaves. "Alkali Manufacture by the Hargreaves-Bird System of Electrolysis."

Dr. S. Rideal and Mr. S. Rosenblum. "The Analysis of Chrome Iron Ore, Ferrochrome, and Chrome Steel."

*Meeting held Monday, November 4th, 1895.*

MR. B. E. R. NEWLANDS IN THE CHAIR.

## THE FILTRATION OF SEWAGE EFFLUENT.

BY W. J. DIBDIN, F.I.C., F.C.S., ETC.

THE economical and complete purification of sewage is a question of such wide importance and general interest that I offer no apology for intruding upon the notice of the Society the latest outcome of work done in this direction. Up to within a few years back the general idea relating to this question was that the purification of foul water by means of filtration was brought about by the double process of mechanical straining and chemical oxidation by direct combination of the organic matters with atmospheric oxygen. The work done in this as well as in other countries, has shown that such supposed direct action is not a facts except to a minor extent in the presence of iron and similar compounds, but that this process of oxidation is effected by the life action of minute organisms, viz., the bacteria in their various forms, and is in fact analogous to the process of fermentation.

In a paper which I submitted to the Institution of Civil Engineers in January 1887, I referred to this question, and pointed out that without the intervention of these organisms no material destruction of the complex bodies existing in sewage can take place. "That modern experience shows that, when this subject is better understood, in all probability the true way of purifying sewage, where suitable land is unavailable, will be first to separate the sludge, and then to turn into the neutral effluent a charge of the proper organism, whatever that may be, specially cultivated for the purpose: retain it for a sufficient period, during which time it should be fully aërated, and finally discharge it into the stream in a really purified condition. This is, indeed, only what is aimed at and imperfectly accomplished on a sewage farm. It is true that knowledge on the subject is not yet fully advanced to put such a system into practical operation, but sufficient is known to show that the antiseptic treatment of sewage is the very reverse of nature's method. The author has not the slightest doubt but that the future treatment of sewage will be a combined chemical and biological one, as suggested elsewhere by Dr. Dupré."

It was, indeed, upon these lines that Dr. Dupré and I worked when considering in 1884 the best means of effecting the purification of the Thames; as, after ascertaining that while chemical action was valuable as an aid to mechanical deposition, we concluded that the purification of the organic matters remaining in solution could be effected only by the action of living organisms; and that in the case of the Thames it was immaterial whether these effected their work either on land or in the river, as the water of the lower reaches could not be used for drinking purposes in consequence of the large proportion or sea-water almost invariably present. It was also for this reason that I abandoned the use of chloride of lime in 1884 as a deodorant for the sewage, pending the construction of the precipitation works, and employed the permanganates in its place, as sterilisation by chloride of lime was not purification, a view which was confirmed by the condition of the river in 1887, when chloride of lime (bleach) was again experimentally resorted to against my advice.

Following the publication of the above paper, the State Board of Health of Massachusetts commenced a series of most elaborately conducted experiments, and during the years 1887 to 1890 obtained very valuable results. As these experiments were made upon the raw sewage, including the suspended matters, they do not strictly come under the heading of this paper, but as the results are the outcome of most careful experiments, it will be as well to shortly summarise them.

The various filtering media used were coarse clean mortar sand, very brown soil from manured garden, coarse and fine sand and fine gravel with and without sandy loam and brown soil, compact sandy hard pan of clay, sand, gravel, and brown soil. Each filter had an area of one two-hundredth of an acre. Crude sewage was used. With fine solids the filters retained water so long, as is also the interval during which this must settle and dry away to allow air to enter the filter, that the amount of sewage that can be purified is very small. Otherwise the results are excellent. With peat, for the same reason, viz., the difficulty of drying so as to admit the air, the filtration was impracticable. The experiments with gravel stones gave the best illustration of the essential character of intermittent filtration. In these, without straining the sewage sufficiently to remove even the coarse suspended particles, the slow movement of the liquid in thin films over the surface of the stones, with air in contact, caused to be removed, for some months, 97 per cent. of the organic nitrogenous matter, a large part of which was in solution, as well as 99 per cent. of the bacteria, which were, of course, in suspension, and enabled these organic matters to be oxidised or burnt, so that there remained in the effluent but 3 per cent. of the decomposable organic matter of the sewage, the remainder being converted into harmless mineral matter. The mechanical separation of any part of the sewage by straining through sand is but an incident, but the essential conditions are very slow motions of very thin films of liquid over the surface of particles having spaces between them sufficient to allow air to be continually in contact with the films of liquid.

The coarse sand filtered 117,000 galls. per acre per day for three months, after which the quantity was increased, and averaged for five months 177,000 galls. per acre per day. The purification was less complete for the first month after the change, but in the second and third months it was more complete than with the quantity given above. The fourth and fifth months, however, gave less satisfactory results, showing that the filter was becoming overburdened and the surface became much clogged with organic matter. The filter was evidently overworked. The other filters, filtering quantities decreasing with their perviousness from 60,000 galls. per acre per day to 9,000 galls., indicated that they would continue giving as good results indefinitely.

The results of experiments as to the effect on filtration of exclusion of air, *i.e.*, by continuous instead of intermittent filtration, was that no nitrification takes place, and the effluent gradually becomes worse until it contains as much organic matter as the sewage.

Valuable as were these results, they still left the question in an all but impracticable form, as the quantity of sewage thus treated was so small. Doubtless this was due to two reasons: firstly, the use of crude sewage; and, secondly, the high degree of purification arrived at. It therefore became necessary that precise data on a working scale, with sewage water from which the grosser suspended matters had been removed, should be obtained; and, with this object, the Main Drainage Committee of the London County Council instituted a series of experiments at the Northern Outfall Sewage Precipitation Works, and continued them up to October last. As the results have now been published in the form of a report by myself to that Committee I venture to place the salient features before this Society in order that they may be as widely known as possible, and be fully discussed.

Before proceeding further it may be interesting to point out that the general results fully confirm the opinion expressed by myself in 1887, already quoted, as to the biological treatment of the sewage effluent; the only departure from the suggestion then made being the fact that, instead of its being necessary to feed the sewage with any specially prepared organism, we now know that the sewage already contains these in abundance, and that all that is required is to give them free scope under favourable conditions to enable them to fully exert their special function of breaking up the organic matters to any extent that may be desired.

The experiments made at the Main Drainage Works at Barking Creek may be conveniently divided into two main groups, viz.:—

(1.) Experiments with small filters using various filtering materials.

(2.) Experiments with a 1-acre filter, using coke breeze only as material.

The latter may again be sub-divided into—

(*a.*) Preliminary trials on velocity of passage, &c.
(*b.*) Experiments on biological lines.
(*c.*) Experiments with doubled means of filling.
(*d.*) Experiments with increased facilities for emptying.
(*e.*) Experiments on recuperative power.

### *Series No.* 1.

The tanks for filters used in the first series of experiments were built of wood, and were each equal in area to $\frac{1}{200}$th part of an acre. They were four in number, and were filled with pea ballast, coke breeze, burnt clay, and a proprietary material (with gravel and sand), respectively. All four were worked at the same rates and during the same hours. During the first six weeks, sewage effluent was passed through at the rate of 500 galls. per sq. yd. per day, whilst from the middle of July to the end of August the rate was reduced to one-half or 250 galls. per sq. yd. in 24 hours. The filtration was intermittently continuous, the filters passing effluent constantly for eight hours daily and resting during the remaining 16 hours, being allowed to run dry at the end of each day's work. The outlet valve was closed just sufficiently to keep the filters full, the effluent being level with the surface of the filter material.

The whole quantity of effluent passed through amounted to 185,000 galls., in a total of 2,160 hours, of which the filter worked 484 hours and rested empty 1,676 hours. The average rate therefore, inclusive of rest periods, was 411,000 galls. per acre in 24 hours.

Filter No. 1. Burnt Ballast.—The material for this filter was obtained by burning clay taken from the marsh land adjoining, and was placed in the tank to a depth of 4 feet.

The purification effected by this filter was less than that attained by any of the remainder. The clarification was also less than in the case of the pea ballast and proprietary filters, being exactly the same as effected by the coke breeze. This was undoubtedly owing to the extreme looseness and porosity of the materials. The filtrate was free from putrefactive odour, remaining sweet for many months in either stoppered or open bottles.

Filter No. 2. Pea Ballast.—This filter was filled with Lowestoft shingle, of pea size. The clarification effected in the filtrate was 75 per cent. more than in the case of the burnt ballast. The purification was also greater, the reduction of oxidisable organic matter amounting to 52·3 per cent.

Filter No. 3. Coke Breeze.—The filter was filled with coke breeze to a depth of 4 feet, and 3 inches of gravel was placed on the top to prevent the coke from floating As far as clarification is concerned, this filter ranked just even with the burnt ballast; but the purification effected was higher than in the case of any of the other materials, the reduction of the oxidisable organic matter in solution amounting to 62·2 per cent. No renewal of the material was required.

Filter No. 4. Sand.—This filter, having an area of 16 square yards, or 1/300th of an acre, was filled with gravel, walnut size 5 inches, bean size 2½ inches, pea size 1½ inches, and sand 10 inches, taken in order from below upwards. It formed part of the compound proprietary filter. The rate at which effluent was passed through was one half more per square yard than in the case of the other filters, the sand filtration being a preliminary to and part of the treatment by the proprietary article, and the areas of the two portions being together equal to one of the remaining filters, already described.

The clarification effected was much greater than in the case of Nos. 1, 2, and 3, but the purification, measured by the reduction in the amount of oxidisable matter in solution, was considerably less than in the case of the coke breeze, somewhat less than by the pea ballast, and practically the same as by the burnt clay. On two occasions the filtrate became slightly putrid, the results thereby differing from those obtained from any other filtering material employed. Doubtless this tendency to become putrid was to a great extent due to the deficient aëration of the interior of the filter, in consequence of the capillary attraction of the finer particles of sand holding the water, and thus choking the pores when the filter was emptied. This filter had to be repeatedly raked and cleared, whilst 2½ inches of sand were removed and replaced by new on the 11th of July.

No. 5. Proprietary Filter.—This filter contained an area of 8 square yards, and was filled with 3 inches of gravel, walnut size; 2 inches gravel, bean size; 1½ inches gravel, pea size; 1 inch sand; and 12 inches of the proprietary material; taken in order from below upwards.

The effluent which it received had already passed through filter No. 4 (sand), and had thus been greatly clarified, whilst the dissolved impurity had been removed to the extent of 42 per cent. The rate of filtration was three times that of the other filters, so as to bring up the rate of the combined filter to an equality with the rest. The filter was supplied with perforated pipes leading to the surface for aëration. In general appearance the filtrate from this compound filter was slightly superior to all the others, the clarification effected being a little more than in the case of the sand forming the first portion. The purification effected by this process of double filtration amounted to 61·6 per cent., a figure practically the same as was obtained by the use of coke breeze. None of the filtrates showed any signs of putrescence when kept for lengthened periods in either open or closed bottles.

The following are the results of numerous analyses made in each case during the months of June, July, and August 1892 :—

Table No. 1.

| Description of Filter. | Oxygen absorbed in Four Hours. Grains per Gallon. | | Albuminoid Ammonia. Grains per Gallon. | | Average Purification effected, as determined by Oxygen absorbed. |
|---|---|---|---|---|---|
| | Crude Effluent. | Filtrate. | Crude Effluent. | Filtrate. | |
| | | | | | Per Cent. |
| Burnt ballast ................. | 1·881 | 1·072 | 0·243 | 0·125 | 43·3 |
| Pea ballast.................... | 1·881 | 0·889 | 0·257 | 0·142 | 52·3 |
| Coke breeze.................... | 1·881 | 0·711 | 0·262 | 0·103 | 62·2 |
| Sand .......................... | 1·725 | 1·001 | 0·250 | 0·132 | 42·0 |
| Proprietary filter ............ | 1·881 | 0·721 | 0·267 | 0·106 | 61·6 |

From the results obtained it appeared that a considerable amount of purification could be effected by any filtering material, the desiderata evidently being porosity and consequent power of re-absorbing atmospheric oxygen. For foul waters sand proved too fine, whilst the burnt ballast used was too coarse. Coke breeze seemed to unite the necessary qualifications, and as it is also a cheap material it was selected for the further trials on a large scale. There can be little doubt, however, that the question of cost of material should be allowed to decide what should be used for a filter in any given place, since burnt ballast or gravel may be made much more effective by using a greater depth of more finely granulated material combined with a slower rate.

In the course of the above experiments, numerous gelatin plate cultivations were made to ascertain the effect of filtration upon the number of micro-organisms present. The number in the tank effluent before filtration, and in the filtrates, were found to vary very considerably, those in the filtrate generally being present in larger numbers ; but it soon became apparent that the presence of comparatively few or more microbes afforded no indication of the degree of purification effected, the main point being that the presence of a large number of organisms was evidence of the activity of the process of splitting up the organic compounds in the sewage matters passing through the filters. A considerable reduction or a practically complete removal of organisms might have been effected by the use of a finer grained material and slower filtration, but the object held in view during the experiments was the attainment of the highest degree of speed consistent with such purification as would remove all objectionable characters such as odour, colour, and liability to putrefaction.

*Series No. 2.*

In the second series of experiments a filter was constructed covering one acre of land. The ground was levelled, and embanked where necessary, and perforated drains laid, meeting in a common trunk for discharge. The filtering material consisted of 3 ft. of coke breeze covered with 3 ins. of gravel.

(*a*.) In the first part of the series under notice, the special object of the experiments was rather the ascertaining of the rate at which it was possible to pass effluent through the filter, and not the manner of producing the best results. The filter, however, speedily became clogged, and after the sixth week all the filtrates were putrid. The daily quantity that could be passed fell rapidly, until at the end of 12 weeks the filter was quite useless, being putrid throughout. Valuable information was thus gained, for it was shown that rest and aëration are vital, and also that in order to obtain the best work from a filter, the quantity poured on it must increase very gradually, so as to permit of the proper biological condition being reached. The rate of working varied from close on one million to a quarter of a million gallons per diem. The filling was during several weeks continued until the water stood 6 ins. above the surface ; when the filter was emptied this portion ran through without having time for purification, and this fact doubtless aided largely in reducing the efficiency of the filter during this set of experiments.

During this period the following analytical results were obtained :—

Table No. 2.

| Date. | Oxygen absorbed in 4 Hrs. Grains per Gallon. | | Albuminoid Ammonia. Grains per Gallon. | | Nitrogen as Nitrate. Grains per Gallon. | | Purification effected on Oxygen absorbed. |
|---|---|---|---|---|---|---|---|
| | Effluent. | Filtrate. | Effluent. | Filtrate. | Effluent. | Filtrate. | |
| 1893. | | | | | | | Per Cent. |
| 28th September to 6th October...... | 3·631 | 2·128 | .. | .. | 0·000 | 0·083 | 41·0 |
| 9th October to 13th „ ...... | 2·884 | 0·509 | .. | .. | 0·029 | 0·215 | 82·0 |
| 16th „ to 20th „ ...... | 3·295 | 0·502 | .. | .. | 0·029 | 0·117 | 85·0 |
| 23rd „ to 30th „ ...... | 3·915 | 1·447 | .. | .. | 0·103 | 0·021 | 63·0 |
| 30th „ to 6th November .. | 4·420 | 1·546 | .. | .. | 0·000 | 0·000 | 65·0 |
| 6th November to 13th „ .. | 4·404 | 1·285 | 0·394 | 0·110 | 0·283 | 0·203 | 71·0 |
| 13th „ to 20th „ .. | 4·122 | 1·125 | 0·368 | 0·097 | 0·299 | 0·317 | 73·0 |
| 20th „ to 27th „ .. | 4·336 | 1·203 | 0·403 | 0·091 | 0·304 | 0·211 | 72·0 |
| 27th „ to 4th December ... | 4·832 | 1·135 | 0·457 | 0·119 | 0·180 | 0·175 | 77·0 |
| 4th December to 8th „ ... | 4·745 | 1·070 | 0·435 | 0·109 | 0·077 | 0·080 | 77·0 |
| 11th ;, to 18th „ ... | 3·821 | 0·979 | 0·401 | 0·092 | 0·021 | 0·130 | 76·0 |
| 19th „ to 23rd „ ... | 4·877 | 1·387 | 0·393 | 0·191 | 0·000 | 0·000 | 71·6 |

(*b.*) The first series of experiments on biological lines, conducted with the same filter as the preceding, was then commenced. The surface was raked, and the bed was allowed to rest during three and a half months. For fully three months of that time a putrid odour was observable when the filter was disturbed, but this gradually disappeared, and during the last fortnight the coke breeze was perfectly sweet. From that time the filter was kept practically constantly at work for nearly a year, the only rest of any length being from the 17th November 1894 to the 2nd of January 1895, when alterations in the arrangements were made to admit of more rapid emptying.

The process adopted was to begin with small quantities, the filter being merely filled and emptied twice daily, with a view to getting it into the necessary biological condition. This was commenced on 2nd April 1894, and continued for a few weeks, the purification effected gradually rising. The quantity of effluent passed was about 500,000 galls. per diem, and the purification between 70 and 80 per cent. The highest state of efficiency was reached on the 3rd May, or after a full month's working. The purification reached 83 per cent., and fish placed in the filtrate lived for many weeks. In fact fish (minnows, &c.) came up the ditch by which the filter was emptied to the very mouth of the outlet.

(*c.*) Alterations were then made in the arrangements for filling, the feeding trough being doubled. The daily quantity was increased to over 600,000 galls., the analytical results continuing to be highly satisfactory, as shown by the averages of the daily analyses from August 3rd to November 9th, 1894.

(*d.*) Towards the end of 1894 the emptying arrangements were supplemented by a pump to prevent tide-locking, and later the resting time was shortened, until finally the filter passed $1\frac{1}{6}$ million gallons daily for six days, resting empty from 10 p.m. on Saturdays until 6 a.m. on Mondays. The method adopted was, to fill the filter to just level with the surface, which occupied an average time of two hours, allow it to remain standing full for one hour, the emptying occupying an average of five hours, thus completing the cycle in eight hours. Working in this way the filter passed an average of one million gallons a day, including all times of rest, during a period of eight weeks, the filtrates being clean and sweet, and the purification effected 78 per cent. Nitrification proceeded satisfactorily, and the filter was apparently capable of continuing for an indefinite time.

A point of the greatest importance is the fact that the filter was able to do its work satisfactorily during the exceptionally severe weather in January and February 1895. A thin coat of ice was formed on the surface, but the filtration proceeded without intermission, the only noticeable change being the decreased production of nitric acid.

(*e.*) After the filter had been successively dealing with one million gallons daily for about eight weeks, a large quantity of sludge, amounting to at least 10 tons, was run upon it accidentally. This occurred during the week ending 23rd February. The result was an immediate falling off in the quality of the filtrate; a putrescent odour was observed, and finally the filter had to be thrown out of work. Remarkable evidence of the recuperative power of the coke breeze was, however, obtained, as after 20 days' rest it was quite sweet again, nothing objectionable being observed on digging down to a depth of about 2 ft. The coke had only the odour of ordinary earth when moist, and on being burnt gave no objectionable smell. On resuming work, 28 days after resting, satisfactory results were again obtained.

From this time until the end of September in the same year, the filter was kept continuously at work (except during one week in August) on the same system, viz., alternate filling, resting full, and emptying, with 24 hours' entire rest each week. The results are shown in the following table; the figures given are averages of daily analyses, each sample being a mixture of quarter-hour samples from each filling and emptying.

The following are the averages of the analyses of the samples of the effluent and the filtrate from one acre filter, composed of 3 ft. of coke breeze and 3 ins. of gravel:—

Table No. 3.

| Date. | Quantity of Effluent passed Daily per Acre. Average of Seven Days. | Oxygen absorbed in Four Hours. Average of Seven Days. Grains per Gallon. | | Albuminoid Ammonia. Grains per Gallon. | | Nitrogen as Nitrates. Grains per Gallon. | | Precipitation effected, as determined by Oxygen absorbed. |
|---|---|---|---|---|---|---|---|---|
| | | Effluent. | Filtrate. | Effluent. | Filtrate. | Effluent. | Filtrate. | |
| 1894.<br>April 7 to June 9..... | 500,000 | 4·096 | 0·856 | 0·416 | 0·095 | 0·1280 | 0·2378 | Per Cent.<br>79·3 |
| Aug. 3 to Nov. 9 ..... | 600,000 | 3·608 | 0·730 | 0·396 | 0·113 | 0·0223 | 0·1414 | 79·6 |
| 1894. 1895.<br>Nov. 16 to March 2... | 1,000,000 | 4·113 | 0·935 | 0·382 | 0·114 | 0·3956 | 0·6990 | 77·5 |
| 1895.<br>April 8 to April 20 ... | 1,000,000 | 3·512 | 0·884 | 0·360 | 0·102 | 0·1431 | 0·7700 | 75·4 |
| May 4 to Sept. 28..... | 1,000,000 | 3·233 | 0·638 | .. | .. | .. | .. | 80·7 |

The experiments, taken as a whole, show that sewage, especially if previously clarified by precipitation, may be purified to any desired degree, the actual amount of purification depending upon (1) the length of time during which the effluent is allowed to remain in contact with the filter, and (2) the length of time allowed for aëration. If a reduction of 75 per cent. in the oxidisable organic matters in solution be considered as sufficient, the quantity that can be treated per diem on one acre of coke breeze is one million gallons, which gives a required area for the treatment of the whole of the metropolitan sewage—taken at 180 million gallons—of 180 acres only. This rate is probably the highest that can be worked under all conditions of seasons.

If, however, only the effluents from the strong day sewage were submitted to filtration, as those from the weak night sewage obtained by precipitation after chemical treatment are sufficiently satisfactory, the area required would be proportionately reduced, viz., to about 120 acres.

It will be noticed that while the above results show that so large a quantity as 1,000,000 galls. of sewage effluent can be treated per acre per day, the Massachusetts experiments with raw sewage showed that only 60,000 galls. could be continuously treated, so that the effect of the suspended solids in the sewage would increase the area of land required for 1,000,000 galls. of sewage to 16·6 acres. This area was reduced by Lowcock, by means of his system of pumping air through the filter, to 3·8 acres per million gallons.

*Experiments with Sewage collected on the "Separate System," excluding Rainfall.*

By the courtesy of the Sutton (Surrey) Urban District Council I am enabled to append the following statement of results obtained by similar treatment of the sewage as carried out at the sewage works of that Council. The trials in question were made during the period of office of the late Sutton Local Board, of which authority I was at that time a member, and therefore am able to speak of the results from personal experience. The works were under the direction of Mr. A. D. Greatorex, Assoc. M.I.C.E., surveyor to the Board.

The filters employed are seven in number, as follows:—

| | | Square feet each. |
|---|---|---|
| 2 proprietary, 35 feet by 20 feet.... | area | 700 |
| 2 coke breeze „ „ .... | „ | 700 |
| 2 sand „ „ .... | „ | 700 |
| | | 4,200 |
| 1 burnt ballast $\left\{\begin{matrix}142\\120\end{matrix}\right\}$ feet by 34 feet | „ | 4,454 |
| Total area................ | | 8,654 |

The filters are constructed as follows—

*Proprietary.*

Top, $6\frac{1}{2}$ ins., medium sand.
„ 3 „ pea gravel.
„ $10\frac{1}{2}$ „ proprietary article mixed with sand.
„ 5 „ extra coarse sand.
„ 4 „ pea gravel.
Bottom, 5 ins., coarse shingle round the pipes.

*Coke Breeze.*

Top, 8 ins., medium sand.
„ 12 „ coke breeze.
„ 5 „ extra coarse sand.
„ 4 „ pea gravel.
Bottom, 5 ins., coarse shingle.

*Sand.*

Top, 8 ins., medium sand.
„ 12 „ „
„ 5 „ extra coarse sand.
„ 4 „ pea gravel.
Bottom, 5 ins., coarse shingle.

*Burnt Ballast.*

Top, 4 ins., soil.
„ 6 „ fine ashes.
Bottom, 18 ins., burnt ballast.

120,000 gallons of effluent water are passed through the filters per day, working nine hours. The six small filters are worked one day and the large the next day, thus allowing alternate days of rest; the six filters have been at work nearly two years and the large one three months, with the exception of the bad days in the winter.

The percentage purification of the oxidisable organic matters effected is shown in the following table, which is prepared from analyses made by Dr. Jacob, medical officer of health for the Sutton district—

| Date 1894. | Proprietary Filter. | Coke Breeze Filter. | Sand Filter. |
|---|---|---|---|
| May 2nd ............. | 36·4 | 47·6 | 31·0 |
| July 13th ............. | 51·5 | 41·0 | 32·2 |
| „ ............. | .. | 50·0 | .. |
| „ ............. | .. | 53·0 | .. |
| October 16th.......... | 61·0 | 51·0 | 30·0 |
| „ .......... | 54·0 | 48·0 | 24·0 |
| November 24th ....... | 53·3 | 14·9 | 50·0 |
| „ ....... | 44·2 | 26·5 | 51·6 |
| Average .......... | 50·1 | 41·5 | 36·5 |

On the 24th April 1895, Mr. Greatorex kindly collected for me a series of samples of crude sewage, precipitation effluent, and filtrates, the samples being averages of 10 hours' working. These were analysed in the Council's laboratory, and yielded the following results :—

| 24th April 1895. | Sewage, including Suspended Matters. | Sewage, excluding Suspended Matters. | Effluent before Filtration. | Burnt Ballast Filter. | Sand Filter | | Proprietary Filter. | | Coke-breeze Filter. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | No. 1. | No. 2. | No. 1. | No. 2. | No. 1. | No. 2. |
| Oxygen absorbed ....... | 8·98 | 4·29 | 2·92 | 2·54 | 1·13 | 1·08 | 1·22 | 0·85 | 0·85 | 0·66 |
| Purification per cent. on unfiltered effluent. | .. | .. | 0·0 | 13·0 | 61·3 | 63·0 | 58·3 | 70·0 | 70·9 | 77·4 |
| | | | | | 62·1 | | 64·6 | | 74·1 | |

From the first table of the results obtained at Sutton, it would appear that the proprietary filter gave the best results; but this was caused by the lower rate at which this filter worked, as, in many instances, in consequence of the finer grain of material and frequent choking, the quantity passing through the bed was far less than that passed by the remaining filters. In the case of the experiments conducted at Barking-creek the rates of flow were maintained at equal speed. In the second table of Sutton results, however, the coke-breeze filter excelled all the others, the proprietary and sand filters being very close together.

From the above results it would appear that the burnt ballast filter has been overworked and requires a short period of rest, as a former result was exceedingly satisfactory.

In his report of the 18th July 1894, Dr. Jacob stated that the effluents from the various filters were quite fit to be discharged into the brook without further treatment. At the present time the coke-breeze filter is working satisfactorily and still remains the best.

### *Conclusions.*

The action of a filter is twofold. (1) It separates mechanically all gross particles of suspended matter and renders the effluent clear and bright. (2) It effects the oxidation of organic matters, both those in suspension and those in solution, through the agency of living organisms. It is the establishment and cultivation of these organisms which is to be aimed at in the scientific process of purification by filtration.

Three conditions are essential. Firstly, the organisms must be supplied with plenty of air; secondly, there must be present a base, such as lime, with which the nitric acid can combine; and thirdly, the biological action must take place in the dark, *i.e.*, in the body of the filter, and not in the water exposed to the light above the filtering material. Filtration on biological lines of sewage or other foul water containing in solution but little free oxygen and a large quantity of oxidisable organic matter therefore means :—

(1) That the filter, by cautious increments in the quantity of effluent, which in itself contains the necessary organisms, must be gradually brought to a state of high efficiency. This condition will be shown by the existence in the filtrate of a constantly increasing proportion of nitric acid.

(2) That the contact of the micro-organisms with the effluent to be purified must be effected by leaving such effluent at rest in the filter for a greater or less time according to the degree of purification required, the process being analogous to that of fermentation.

(3) That after each quantity of effluent has been dealt with the micro-organisms must be supplied with air, which is readily effected by emptying the filter from below, whereby air is drawn into the interstices. The filter must stand empty for an hour or more previous to another filling, and a longer period of aëration, say 24 hours, must be allowed every seven or eight days.

The life of a coke-breeze filter worked in this way is practically without limit.

From the general results obtained by these several trials under various actual working conditions, it is apparent that there is no difficulty in obtaining any desired degree of purification by means of a system of filtration conducted on biological principles. If a higher degree of purity be required than that indicated by the foregoing, it can be obtained by an augmentation of the filtering appliances at a comparatively small cost, as, where clay is obtainable, the method of construction employed in making the new burnt ballast filter bed at Sutton may be adopted, viz., by simply digging out the clay to form a pit about 3 ft. deep, and filling it up with the same clay after burning, and thus a cheap and efficient filter bed is obtained, the cost of the large filter bed at Sutton, having an area of 4,454 sq. ft. or rather more than one-tenth of an acre, being less than 100*l.*, including all charges.

By such a system the necessity for costly farms is entirely obviated. The results are completely under control, and the filters can be arranged to suit all requirements it is possible to contemplate.

### Discussion.

Dr. Bernard Dyer asked the author to give some further information as to the basis on which he measured the degree of purification. Had he actually determined the organic nitrogen or the organic carbon in the effluents, or simply applied the permanganate process? If that were the case the natural implication was that oxidation had taken place to a certain extent, but that no organic matter had been destroyed. The author had naturally avoided analytical figures as far as possible, but he thought it would be of advantage to the discussion if he would at least give this information.

Mr. W. J. Dibdin considered Dr. Dyer's question a most proper one, and gave figures derived from his last experiments. The results obtained by the albuminoid-ammonia method and the oxygen-absorption method were so uniformly consistent that he had in his concluding series of tables given the latter only.

Dr. R. Messel observed that the author had stated that the process of purification proceeded far more rapidly in the dark than in the light. This statement appeared to him to conflict with the results obtained by Pettenkofer at Iser.

Mr. E. G. Hooper asked for information as to the means of precipitation adopted. He agreed with Dr. Dyer that it was important not merely to know the percentage of work done, but the degree of organic matter absolutely removed. He understood that the solid portions of the sewage had been removed, but it was not quite clear to his mind whether some of the chemical agents added to the sludge had not produced some of the purifying effect in the effluent attributed to the action of bacteria.

Mr. S. Hall was glad to be able to confirm the author's statements, from results in experiments in sewage purification which he had carried out in 1886. He had himself obtained a purification of 63·4 per cent. in the laboratory, as compared with Mr. Dibdin's 62 per cent. for the best form of filter, and this in experiments extending from five minutes to three hours. His experiments, however, were made, not with sewage effluent, but with crude sewage taken from Abbey Mills.

Dr. Rideal said the author was to be congratulated on the very interesting and successful results he had obtained, they being far in advance of Dr. Drown's experiments. The subject seemed to be coming out of the engineers' hands and to be assuming the aspect of a purely chemical question. This was satisfactory, as chemists by their training were eminently qualified to deal with the matter from a biological standpoint. Mr. Dibdin had propounded the question, "What is the proper biological condition of these filters?" but had given no reply. Among other things he had mentioned the necessity for alternate air and work in the filter. It seemed to him, however, that in addition to these things it was necessary that certain organisms should be present in order to ensure proper bateriological conditions. Although the author had mentioned plate cultivations, he had given no details as to the specific organisms required. Perhaps the author would tell them if he had made any attempts on isolation or determination of the bacteria. Warington's experiments had established the fact that to ensure continuous nitrification a base must be present, and it may be that the satisfactory nature of these experiments, as compared with those in Massachusetts, was due to the lime treatment of the sludge, supplying alkaline salts to the nitrifying organisms. It was quite possible that this biological method might be extended to the treatment of sludge; in fact, he knew of several schemes for treating solid sewage matter by another set of organisms altogether, which were expected to effect the hydrolysis of the albuminoid matter, the simpler molecules so formed subsequently undergoing nitrification in the coke-breeze filter. With respect to the apparent contradiction of Pettenkofer's results, to which Dr. Messel had referred, he would point out that bacteria in the latter case were shown by Buchner to be most active in the superficial layer of water, and that the bacterial action of light in water does not extend to a great depth. He would like, however, to ask whether there was any definite information as to whether the nitrifying organisms of the filter-beds were really influenced by sunlight or not, as at present there seemed to be no direct evidence as to these special organisms.

Mr. W. D. Scott-Moncrieff thought it would be difficult to estimate the enormous value of these experiments in contributing towards the solution of the great sewage problem. The first bacteriological filter in England was put up at his own house in July 1891. Mr. Dibdin had been good enough to inspect it in the following year. Coke was the material employed, and from the biological point of view it was a most interesting material. In fact even Mr. Dibdin had hardly done it justice. Coke, while porous in the ordinary sense, was peculiar in also providing a number of interstices. The passing away of the fluid left these interstices locked, and when the water rose again the air was enclosed in them and provided the oxygen necessary for the purification of the filter. But there was one biological objection to the use of coke, namely, that its porosity led to the large absorption of the products of the biolysis of the organic matter. That pointed to the conclusion that a coke filter would require a long period of oxidation in order to break up those products. Mr. Dibdin's experiments at Barking confirmed this view; for he had found that eight hours in the twenty-four were required to restore the activity of the filter, which had been partly destroyed by the absorption of products inimical to the organisms. In installing such filters two cardinal conditions must be observed. First, the organic matter must be supplied fresh, so that putrefactive processes should not have occurred in it already; and second, the products of the organisms should be continuously removed. These conditions being secured, he was certain that chemicals were entirely unnecessary, except in so far as they might aid the work of the organisms. That meant saving London an enormous expense, and that the sludge ships might be sold as soon as this system was generally introduced. Great differences of opinion existed on this question, even amony chemists; the idea of the use of oxygen was one that the chemists would cling to till the very last, either for the direct oxidation of the organic matter or as an assistant to the organisms in doing the work. This was to a great extent true; but, as Dr. Rideal had said, because one set of organisms required it, it did not follow that all did. Probably the first action in these filter beds consisted in a certain number of organisms using up the oxygen in the sewage completely, and was followed by a zone of the material in which other organisms did all the work. With regard to the question of light and darkness, he thought the author had been somewhat rash in his statement, because it was well-known that the most active part of an ordinary filter was the upper portion, which was exposed to the light.

Mr. S. H. Johnson considered that the author had taken the proper way of determining the subject on a large scale, and it was satisfactory to know that there was a man at the head of the Chemical Department of the London County Council capable of so using the appliances which the resources of such a municipality could place in his hands. Mr. Dibdin was dealing with a practical question, and his experiments had been conducted satisfactorily from every point of view, chemical, biological, and engineering. No doubt it would be interesting to go into biological researches on the nature of the microbes concerned; but that was a wide question, requiring a lifelong study and special training. Mr. Dibdin had brought quite sufficient evidence of the changes before them, and had shown that these changes were not the result of chemical oxidation only, but were the life-work of organisms whose vitality was recuperated by oxygen after they had fed on the albuminoid bodies in the effluent. If the effluent was to be alkaline in character, it was necessary to remove the carbonates of lime, and that would require the addition of more lime than the microscopic quantities hitherto advocated by the author, though even then the process would still be a cheap one.

Mr. W. C. Sillar considered the process a most valuable one, especially where land for the treatment of sewage was difficult of obtainment, and because of the great improvement it would effect in the condition of our rivers. The author's figures were most valuable, and showed that the great sewage question was capable of a satisfactory solution in every locality. He would like to know Mr. Dibdin's opinion of the question of the alkalinity of the effluent. He himself approved of its being slightly acid, and that condition was generally considered by chemists to be the better.

Mr. Bertram Blount regarded the excellent working done by these filters, even in the cold months, as not only interesting in itself, but of great practical importance. Seeing that the purification of sewage by regulated filtration was eminently a biological phenomenon and dependent on the life-activity of micro organisms, it seem to him desirable to know whether the activity of these organisms was controlled by the temperature of their environment. If that was so, their activity would be greatest within certain narrow limits, and it followed that a filter would have the greatest efficiency at a certain temperature, which temperature might be difficult of attainment in our variable climate. It might be well that the activity of the organisms maintained the temperature of the interior of the filter above the outside temperature. Such a fact should be susceptible of proof, and possibly the author might have determined it, and could supplement his observations in that particular.

Mr. Scott-Moncrieff wished to mention an interesting fact bearing on that matter. On one occasion, when a slight fall of snow covered the whole of the ground round about his house, the only portion of the fall that was melted was that on the top of the filter bed, showing that the temperature was higher immediately beneath.

Mr. S. Hall asked if the crude sewage were acid or alkaline.

Mr. W. J. Dibdin replied that it was generally slightly alkaline.

Mr. W. F. Reid wished to know what was the minimum depth of coke breeze possible for efficient filtration. That would be an important point in many low-lying localities, such as Chertsey, where the necessity for pumping the sewage might possibly make all the difference between sewering a district effectually and not doing it at all. He would like to know, also, if any experiment has been made as to increasing the rapidity of the filtration by washing out the filter periodically. Also whether the author considered it absolutely necessary to oxidise the nitrogenous matter to nitric acid; was it not sufficient to convert it into salts of ammonia? If so, a totally different set of organisms would come into play, and they might exist under other conditions.

Mr. Gelvtorex said, with reference to some remarks of Mr. Dibdin's of the results of the filters under his (the speaker's) charge, he would like to explain that the low result of 13·0 per cent. was due to the fact that the filter had been only just started, and was not in a satisfactory condition It was composed of burnt ballast, ashes, and soil. They had since removed the latter component, and now the results from all four filters were practically equal. The best results, however, were got from the coke breeze. All the filters had been worked equally for the last 12 months, and the results were so good that they could pass the effluent straight into the brook under the certificate of the inspectors. Thus with four filters it was possible to deal with the sewage of 15,000 people without using an acre of land, except for the filters.

A member inquired if the free ammonia underwent oxidation, and was answered that it did to a certain extent.

Mr. Dibdin, in reply, regretted that time did not permit him to answer in full the various questions raised, all of which were important and interesting. Mr. Johnson had correctly surmised that they had carried out the investigation from a purely practical point of view. They wanted to know the minimum quantity of land required for efficient filter beds to produce an effluent free from odour, colour, and liability to after-putrefaction. Whether it contained fewer or more organisms, or more or less organic matter, was disregarded. Therefore it was not necessary to enter into an elaborate biological investigation, which would have been lengthy and expensive; in fact, if they had waited to illustrate all these bye-questions they would not have been one-tenth on their way by this time. He made that remark at once so that the meeting might appreciate the lines upon which he had worked. Dr. Dyer's question as to the measurement of the degree of purification had been answered. Dr. Messel had raised the question of the action of the organisms, and had been answered by Dr. Rideal. He could only say that they found the results better when the whole of the effluent was buried in the body of the filter, and that pointed to the fact that the organisms worked better in the dark—a view which was expressed by Warington, confirmed by the experiments of Marshall Ward. With respect to Mr. Hooper's suggestion that chemicals added to the sludge might have had some of the effect attributed to the filter, he did not think that was the case. Only two to four grains of lime and one grain of ferrous sulphate per gallon were added, and practically the whole of this was precipitated with the sludge and left the effluent neutral. Mr. Hall's figures were interesting and accurate, but as they referred to crude sewage they hardly concerned the paper in hand. Dr. Rideal had raised a host of questions—too many to deal with at that late hour. As to the alleged overworking of the polarite filter, he had pointed out in the paper that in the combined filter the sand did 42 per cent. of the work, and the polarite, &c. the remainder. Only a small portion, therefore, of the action could be attributed to it. The proper biological condition he took to be that condition when nitrification proceeded satisfactorily. One might, in a new filter, get a large percentage of purification for a short time; then that ceased and the filter required attention, but when it had settled down into a proper condition nitrification would proceed regularly, and a sweet effluent would be yielded. As to the special organism, he had started with the idea that it would be necessary to isolate it, but after a few weeks found that the bacteria present in the sewage answered the purpose very well. The addition of acid to the sludge with the object of keeping it only resulted in offensive odours. He liked to hear people talk of the treatment of sludge, as it gave great hopes for the future, but his experience of the matter had forced him to the conclusion that the less one had to do with it the better. The late Mr. Rhodes and himself made a biological experiment with it. They placed on end a 30-ft. iron cylinder and filled it with sludge. Mr. Rhodes hoped that the weight of the solid matters would carry it all down and leave a clear supernatant water. On inspecting it on a hot day, however, they found that the whole of the sludge was boiling away on the top, and that they could draw off clear water from the bottom. The whole matter was so offensive that they had to get rid of it at once. He was glad to hear Mr. Scott-Moncrieff's remarks. That gentleman was, as he had said, one of the first to take up this question, and he had done it in a very thorough manner. As to the absorption of the products of the organisms in the interstices of the coke, no doubt that took place, and they found it desirable to give the coke as much rest as possible, so that these organisms might get their share of the revivifying atmospheric oxygen. He quite agreed that deposition of the organic matters was necessary, and had stated so in the paper. Otherwise much more space would be required. But one must get rid of the sludge before dealing with the effluent. He was obliged to Mr. Johnson for his kind remarks. He could assure him, however, that he need not fear any necessity for adding more lime to the crude sewage. In fact, if they had the time they could do without the addition of chemicals at all, but the process was accelerated by the small quantity now used. Mr. Sillar's remarks left him absolutely nothing to answer. As to temperature, the biological action which took place in a manure heap was well understood, and the source of heat in manure was nothing more or less than the life processes of the organisms therein, so that in a filter this action was also a constant source of heat. The question raised by Mr. Reid as to the minimum depth for a filter bed was an interesting one. He could only say that every district must be dealt with on its own merits, and would advise them to try any depth that could be got, even if only six inches. As to the effect of washing the filter, possibly it might do good, but care must be taken not to wash out the organisms which had been cultivated in order to do the work, otherwise the filter would have to be reconstructed; and an old filter, properly revivified by rest worked better than a new one. The oxidation of the nitrogen into nitrates and nitrites was also a matter which must be settled by the requirements of the locality. If only rough filtration was wanted they need not carry the process so far as to get complete nitrification; they had in the filter a delicate apparatus which could be worked so as to secure the results actually required. In conclusion, he was very glad to have had an opportunity of placing these results before the Section, and for the very kind way in which his paper had been received. Their thanks were, however, really due to the intelligent policy of the Main Drainage Committee of the London County Council, headed by Mr. Idris and Mr. McDougall, who, as members of the Lea and Thames Conservancy Boards respectively, were fully alive to the importance of the question, and had actively supported him in carrying out the necessary experiments.

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SESSION 1895-96.

December 4th:—
1. Miscellaneous Communications.
2. Dr. G. H. Bailey. "Volatilisation of Salts during Evaporation."

*Meeting held Wednesday, November 6th, 1895.*

DR. GUSTAF SHACK-SOMMER IN THE CHAIR.

### CHEMICAL INDUSTRIES AS AUXILIARIES FOR THE PRACTICAL FARMER.

### CHAIRMAN'S ADDRESS.

"GREAT BRITAIN is singularly behind other civilised countries in the work of agricultural investigation." This was the emphatic pronouncement of Professor Warrington at the recent meeting of the British Association at Ipswich. Professor Green, at the same meeting, fully endorsed this statement and added that the farmer was apt to regard chemistry as comprising only the chemistry of soils, whereas it was of even greater importance to pay attention to the chemistry of plants, and generally to give the plant organism the same attention from various points of view that was now given as a matter of course to the animal organism.

It is to science then, and particularly to chemical science, that, as a last resource, the practical farmer has to look for his salvation.

After a lapse of more than 50 years the well-known "Familiar Letters on Chemistry," by Justus von Liebig, are making their influence felt. It was in those letters that the founder of agricultural chemistry first laid down its principles, and it is only now, after all these years, that the British farmer becomes alive to the importance of scientific farming.

Professor Warrington justly complains: "We are obliged, at the present time, to employ German analyses for all purposes of teaching or calculation," for we have none of our own in Great Britain. I hope you will forgive me for again calling attention to the fact, as I did on previous occasions when I addressed you on the subject of the Sugar Beet Industry, that continental farmers have not only applied the science of chemistry to ordinary agriculture, but, since the introduction of chemical industries in connection with their farms, they get better prices for their produce, with a remunerative use for the by-products.

This paper is not designed to be an agricultural one, but has been written with the purpose of pointing out to technical chemists where I believe there is a field of usefulness for their labour in Great Britain.

The prevention of the gradual depopulation of rural districts and the stemming of the steady migration of agricultural labourers into already overcrowded cities, has absorbed the constant attention of social and political economists for a great number of years past. It is not here in England alone that the tiller of the soil has been lured by higher wages, constant work, better food and clothing, and the attractions of a more crowded and perhaps more civilised existence away from his village homestead, but over all the continent of Europe there is much the same tendency to change the rural life for the urban one. I am so far not aware that any practical or serious effort has been made in England to deal with this tendency, more especially by offering to labourers anything which would compensate for the attractions of the cities. In other European countries, however, a determined policy has been adopted. Continental Governments are now encouraging—with all the influence they have at their command and also with substantial aid in subsidies—a more modern and advantageous system of agriculture, whereby farming is directed into such channels as will show the best results and most profitable return. The aid of chemical industries has been enlisted, and is proving to be of the greatest possible value. It is to them that continental farmers attribute the fact that they have not more severely suffered, or indeed been entirely crushed out of existence by the intense competition and low prices of Californian wheat, Persian barley, American pork, South-American cattle and Australian mutton.

One is inclined to ask why this country should be the only one where the development of agriculture is positively discouraged and industrial success made problematical through defective legislation. Time after time I have pointed to one industry alone, sugar beetroot growing, which I have proved might be adopted with the greatest possible advantage, and with every reasonable hope of success, since nature herself seems to favour its gowth in this country.

Whilst, however, those at the head of affairs are afraid to tackle unscrupulous bounties given by other countries, with the object of forcing their goods upon us to the extinction of our own industries, it is scarcely to be wondered at that the British agriculturist hesitates to invest his capital and labour in a new enterprise.

Not only must one accuse the "powers that be" of sins of omission, in permitting undue competition to cripple our struggling industries and to prevent capital being directed into healthy and natural channels, but, when we come to consider the feasibility of introducing fresh industries, I will go so far as to say that such laws, as we have positively prohibit the smaller farmers from adopting such means of revenue, as are open to his confrere on the continent. Not only so, but our laws seen to be framed with the object of debarring farmers from employing a large amount of labour, which would be kept on the homestead all the year round through the farmer becoming a manufacturer as well as a grower.

These auxiliaries to ordinary agriculture are termed in Germany "Landwirthschaftliche Nebengewerbe." Most of these employ a large number of labouring men and women all the year round.

Why this matter has not been seriously taken up by those members of Parliament who represent agricultural districts is somewhat astonishing. Individual efforts are frittered away in useless discussions over rents, rates and taxes, whilst an object lesson lying close at hand is sedulously avoided.

I must here pause for a moment to explain that there are two very important branches of agriculture, both of which are dependent for their success upon modern scientific treatment, which I purposely abstain from attempting to dilate upon in this paper. Each would require a paper of its own. I refer to the growing of sugar beetroot and the manufacture of dairy produce.

SEVEN YEARS' RESULTS OF EXPERIMENTS IN GROWING SUGAR BEETROOT.

| — | 1889. | | | | | 1890. | | | | | 1891. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | England. | Scotland. | Ireland. | Germany. | France. | England. | Scotland. | Ireland. | Germany. | France. | England. | Scotland. | Ireland. | Germany. | France. |
| Number of experiments .. | 2 | .. | 2 | .. | .. | 7 | 1 | 20 | .. | .. | 15 | 7 | 32 | .. | .. |
| Average weight of entire plant in grammes. | 1,002 | .. | 962 | 909 | 871 | 1,098 | .. | 1,365 | 830 | 535 | 1,252 | 997 | 1,283 | 890 | 468 |
| Average weight of roots alone in grammes. | 382 | .. | 411 | 577 | 584 | 788 | 406 | 730 | 489 | 370 | 704 | 406 | 713 | 480 | 317 |
| Quantity of sugar in 100 parts of the juice. | 15·76 | .. | 17·55 | 16·39 | 15·51 | 12·61 | 12·10 | 11·69 | 16·62 | 15·62 | 13·21 | 12·88 | 13·48 | 15·95 | 14·38 |
| Quantity of roots, without leaves, grown per acre. | 15·0 | .. | .. | 13·29 | 12·70 | .. | .. | .. | 12·90 | 11·20 | .. | .. | .. | 11·07 | 8·97 |
| Quantity of sugar per acre | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

| — | 1892. | | | | | 1893. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | England. | Scotland. | Ireland. | Germany. | France. | England. | Scotland. | Ireland. | Germany. |
| Number of Experiments.. | 20 | 17 | 25 | .. | .. | 22 | 22 | 2 | .. |
| Average weight of entire plant in grammes. | 1,125 | 831 | 810 | 792 | 564 | 1,447 | 1,191 | 673 | 697 |
| Average weight of roots alone in grammes. | 622 | 405 | 409 | 498 | 401 | 927 | 658 | 356 | 382 |
| Quantity of sugar in 100 parts of the juice. | 13·32 | 13·91 | 14·52 | 16·56 | 14·92 | 13·64 | 14·00 | 14·83 | 15·14 |
| | | | | | | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. |
| Quantity of roots without leaves grown per acre. | 13·85 | 12·75 | 14·05 | .. | 20·25 | 19 9 1 0 | 26 8 3 0 | 14 15 0 0 | 11 1 3 2 |
| Quantity of sugar per acre | .. | .. | .. | .. | .. | 2 13 0 10 | 3 14 0 3 | 2 3 3 0 | 1 7 0 4 |

| — | 1894. | | | 1895. | | |
|---|---|---|---|---|---|---|
| | England. | Ireland. | Germany. | England. | Scotland. | Germany. |
| Number of experiments.. | 29 | 2 | .. | 14 | 1 | .. |
| Average weight of entire plant in grammes. | 1,229 | 1,269 | 1,030 | 1,648 | 2,207 | 1,021 |
| Average weight of roots alone in grammes. | 670 | 700 | 613 | 920 | 1,155 | 545 |
| Quantity of sugar in 100 parts of the juice. | 14·40 | 14·65 | 14·39 | 14·93 | 15·30 | 16·14 |
| | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | Tons cwt. qrs. lbs. | |
| Quantity of roots without leaves grown per acre. | 14 2 1 25 | 15 0 0 0 | .. | 17 1 0 2 | 19 10 0 0 | .. |
| Quantity of sugar per acre | 2 0 2 16 | 2 3 3 22 | .. | 2 10 3 27 | 2 19 2 19 | .. |

On sugar beetroot, I have already read two papers before you, and published the results of many valuable experiments. My object to-day, however, is to deal with other root and bulb crops, viz., chicory and potatoes.

I think it is generally known that the beetroot industry is in no small measure indebted for its first impulses to the attempt of Napoleon I. to shut out all colonial produce from the continent, with a view to damaging the trade of England. (Decree of 21st November 1806.) Through the operation of the same edict, home-grown chicory first became an important article of daily use as a substitute for the sea-borne coffee, for, after trying many other vegetable substances, chicory was selected as being the best, and it has ever since remained as a substitute for, or an adulterant of, pure coffee.

About the year 1820 chicory was first imported into this country, and it very soon became one of the regular crops in Essex, Norfolk, Lincolnshire and Yorkshire, but of late years its cultivation has rapidly declined, the cause being apparently the onerous duties imposed by the Inland Revenue Department upon the grower in protection of the revenue. Chicory is perhaps the only substitute which can be profitably grown in England, yet at the same time it is subject to an excise duty. When one is reminded of this it seems lamentable that, in the present state of agricultural affairs, an impost should be placed upon any crop which could be raised profitably. The whole amount of the duty is comparatively a small one, still the British farmer would doubtless be thankful for small mercies.

Another reason advanced for the decline in this growth in England, is that it is exhaustive in its nature, and some landlords forbid their tenants for that reason to raise it; but surely with our present advanced knowledge as regards artificial manures this objection need no longer apply.

It has already been ascertained that chicory may be grown just as well in England as on the continent, and perhaps better, for in the open market English chicory brought somewhat better prices than the imported article.

The imports for 1894, according to the Board of Trade returns, were :—

| | |
|---|---|
| Raw or kiln dried chicory | 5,402 tons |
| Roasted or ground | 64 „ |

four-fifths of which were entered for home consumption.

| | |
|---|---|
| Home grown chicory for the year ended 31st March, all in Yorkshire | 117 tons |

The total amount looks comparatively small in figures, but when one realises that the total consumption of coffee in the United Kingdom is only 1,200 tons per annum, chicory at once assumes an important place in comparison.

The quantity of chicory grown in the United Kingdom in the years 1867 to 1894 :—

| Year ending 31st March. | Weight. | Rate of Excise Duty per Cwt. |
|---|---|---|
| | Cwts. | £ s. d. |
| 1867 | 20,614 | 1 4 3 |
| 1868 | 17,355 | „ |
| 1869 | 11,842 | „ |
| 1870 | 12,525 | „ |
| 1871 | 15,666 | „ |
| 1872 | 11,168 | „ |
| 1873 | 9,131 | 0 12 1* |
| 1874 | 7,895 | „ |
| 1875 | 5,549 | „ |
| 1876 | 5,072 | „ |
| 1877 | 4,704 | „ |
| 1878 | 4,375 | „ |
| 1879 | 3,311 | „ |
| 1880 | 3,181 | „ |
| 1881 | 2,365 | „ |
| 1882 | 2,869 | „ |
| 1883 | 2,803 | „ |
| 1884 | 2,952 | „ |
| 1885 | 3,701 | „ |
| 1886 | 4,449 | „ |
| 1887 | 3,116 | „ |
| 1888 | 2,906 | „ |
| 1889 | 1,707 | „ |
| 1890 | 2,574 | „ |
| 1891 | 2,596 | „ |
| 1892 | 2,789 | „ |
| 1893 | 2,594 | „ |
| 1894 | 1,648 | „ |
| 1895 | 2,336 | „ |

* From 1st May 1872.

The cultivation of chicory is somewhat allied to that of carrots. It is sown about the end of April, and about four lbs. of seed go to the acre. The roots are drawn in November, and yield from 1 to 1¼ tons of dried root per acre.

The process of manufacture is a very simple one. The root after being harvested is cut into slices or small cubes and dried in kilns. It is then roasted in cylinders precisely like coffee, either by itself or with the addition of one to two per cent. of fat. The roasted chicory is then ground in the coffee mill and sorted by sieves into separate grades. It is then placed in a damp cellar or warehouse to absorb moisture, this having the effect of enriching the colour, the result being a dark brown tough crumbly powder similar in appearance to ground coffee, and so well known to the public as chicory.

As a chemist I could not for a moment recommend chicory as a dietetic. It contains no nutritive substance, nor can it be classed amongst those other food accessories known to chemists as stimulants or condiments. It does not tend to stimulate digestive secretions in the same way that coffee does, nor has it any effect on the nervous system. Indeed it may be classed as simply an adulterant and nothing more. Still there is a commercial demand for it, and we are not so much interested in its dietetic properties as in its money-making value. There is a demand for the article, and there is no reason why that demand should not be supplied by the British farmer.

All the processes in manufacture are such as would afford employment to unskilled labour, and tend to keep the population round the farmsteads during the slack season.

Chicory is devoid of any equivalent to caffein, the stimulating agent of coffee, and according to H. Schultz in Brunswick contains :—

| | |
|---|---|
| Water | 87·50 |
| Raw proteïne | 1·19 |
| Raw fat | 0·66 |
| Non-nitrogenous extractible matter | 8·44 |
| Raw fibre | 0·90 |
| Ash | 1·31 |
| | 100·00 |

By analysis made under my direction—

A sample of *Foreign Dried Chicory Root* contained—

| | |
|---|---|
| Saccharose | 2·90 per cent. |
| Invert sugar | 14·20 „ |

*Belgium Dried Chicory Root* contained—

| | |
|---|---|
| Saccharose | 13·40 per cent. |
| Invert sugar | 12·75 „ |

While *English* contained—

| | |
|---|---|
| Saccharose | 1·80 per cent. |
| Invert sugar | 15·60 „ |

And *Green Chicory Root* grown in England contained—

| | |
|---|---|
| Saccharose | 0·95 per cent. |
| Invert sugar | 4·65 „ |

with an average weight of 235 grammes each root.

The sugar contained in the dried root caramelises in roasting, and the strong colouring power of the caramel and its aromatic smell are the only justifications for its use.

From the consideration of an agricultural crop of comparative small value I now come to one which is of much greater importance to farmers as well as to numerous chemical industries, at all events on the continent of Europe if not in the United Kingdom. I mean the potato crop.

From this well-known bulb starch is extracted, starch sugar is made, and last, but not least, a potent spirit is distilled.

### Table A.

### Cultivation of Potatoes.

| — | Acreage. | | | Yield in Tons. | | |
|---|---|---|---|---|---|---|
| | 1891. | 1892. | 1893. | 1891. | 1892. | 1893. |
| United Kingdom | 1,286,126 | 1,265,386 | 1,251,556 | 6,090,047 | 5,633,954 | 6,540,593 |
| Germany | 7,219,232 | 7,236,626 | 7,501,061 | 18,260,119 | 27,538,741 | 31,759,099 |
| Austria-Hungary | 3,891,110 | 3,988,109 | 4,003,413 | 8,474,491 | 12,336,116 | 11,721,463 |
| France | 3,687,058 | 3,734,976 | 3,777,391 | 10,987,785 | 13,317,734 | 11,651,183 |
| | 1883 7.<br>Average. | | | | | |
| Russia | 3,713,310 | 5,355,393 | 5,667,357 | .. | .. | 23,418,966 |
| | 1866. | 1880. | | | | |
| Belgium | 423,351 | 492,412 | .. | 2,439,752 | 4,571,347 | 4,041,734 |
| Italy | 447,408 | 479,000 | .. | 727,320 | 754,378 | .. |

Although the potato crop is generally considered to be a paying one in the United Kingdom, still it remains a fact that an insufficient quantity is grown to supply the actual demands for human food alone, consequently a large quantity has to be imported annually from the continent.

Notwithstanding this remarkable fact, it is shown by the preceding table (A), that the acreage under cultivation in these islands is still diminishing! Whereas, on the other hand, our continental neighbours are increasing the acreage under this crop.

The decline in the acreage of the crop of the United Kingdom is all the more astounding since the agricultural returns, given in Table B, show conclusively that this crop is more prolific on our soil than on any other. Germany is the only country which in any way approaches Great Britain in yield, and is even then 20 per cent. less than the United Kingdom, and 50 per cent. less than Great Britain, while France, Russia, Austria, and Hungary follow in the order named.

Table B.

International Comparison of the Potato Crop according to the Harvest Statistics of the German Empire for 1893–4

| — — | Germany. | Austria. | Hungary. | Italy. | France. | Great Britain and Ireland, exclusive of Isle of Man and Channel Islands. | Russia. | United States of America. |
|---|---|---|---|---|---|---|---|---|
| | 1893. | 1893. | 1892. | 1892. | 1892. | 1893. | 1893. | 1893. |
| Potato crop in tons................ | 31,800,838 | 8,219,507 | 2,733,202 | 755,369 | 13,335,271 | 6,546,995 | 23,418,956 | 4,907,882 |
| Yield per acre in lbs............... | 9,421 | 6,671 | 5,374 | 3,500 | 7,932 | 11,629§ | 6,826 | 4,187 |
| Average weight in lbs. corresponding to each inhabitant. | 1,430 | 764 | 393 | 55 | 773 | 383 | 532 | 175 |

§ The average yiel l per acre in Great Britain alone was 6·59 tons.

Potatoes necessary for sowing according to the figure published in the statistic of the German Empire 1893–94, 2,000 kilos. per hectare equal to 1,773 lbs. per acre. That means the seed is 18 per cent. of the crop, 1 ton produces 5·4 tons.

In Germany considerable attention has been given to raising seed potatoes, but more particularly with the object of procuring varieties which are specially adapted for the production of alcohol and starch.

In France the annual area sown is about 3,342,000 acres, and the produce about 10,100,000 tons, of which about 100,000 tons are exported. Quite two-fifths of the French product, or some 4,000,000 tons, are annually used in France in the manufacture of starch and alcohol.

Table C will still further emphasize these interesting figures, and show us the relative importance of the crop in Germany and Great Britain, for, while in Germany $11\frac{1}{2}$ per cent. of the cultivated acreage is under this crop, only $1\frac{1}{2}$ per cent. is the ratio for Great Britain.

Table C.

On every 100 acres under cultivation in Germany for agricultural and garden produce :—

| There were — Acres planted with | In 1873. | In 1883. | In 1893. |
|---|---|---|---|
| Grain and leguminous plants | 59·79 | 60·05 | 60·94 |
| Potatoes ...................... | 10·59 | 11·11 | 11·57 |
| Beetroot for feeding purposes. | 1·26 | 1·40 | 1·67 |
| Sugar beetroot ............... | 0·68 | 1·28 | 1·51 |

On every 100 acres of cultivated land in Great Britain :—

| There were — Acres planted with | In 1874. | In 1884. | In 1894. |
|---|---|---|---|
| Corn crops ..................... | 30·2 | 26·1 | 24·1 |
| Potatoes ....................... | 1·7 | 1·7 | 1·5 |
| Turnips, swedes, and mangolds | 7·8 | 7·3 | 7·1 |

These islands, therefore, take a unique position, inasmuch as they are the only European State in which, during the last ten years, the cultivation of the potato has declined.

Potatoes, like chicory, are an exhausting crop, which the following analysis will show.

Dr. Emil Wolff gives the following figures:—

Table D.

Potatoes contain in 1,000 parts.

| Water. | Nitrogen. | Ash. | Oxide of Potassium. | Oxide of Sodium. | Lime. |
|---|---|---|---|---|---|
| 750 | 3·4 | 9·5 | 5·8 | 0·3 | 0·3 |

| Magnesia. | Phosphoric Acid. | Sulphuric Acid. | Silicic Acid. | Chlorine. |
|---|---|---|---|---|
| 0·5 | 1·6 | 0·6 | 0·2 | 0·3 |

These figures are interesting, inasmuch as they show us to what a large extent potassium, phosphoric acid, and nitrogen enter into the crop, and these constituents of course in scientific farming must be replaced in suitable manures.

Without giving the intermediate years, I may state that in 1885, 1,346,023 acres yielded 6,374,242 tons in the United Kingdom, against 1,221,544 acres and 4,662,147 tons in 1894.

Curiously enough the import of potatoes has declined even more rapidly than the growth, which of course manifestly shows us that potatoes, as a food, are losing their hold upon the public taste in these islands. Probably the increased wealth of the wage-earning classes has much to do with this, and year by year they are living on more expensive foods, such as meat, fish, &c. Still, we must steadily bear in mind the fact, that the whole of the potatoes grown and imported are consumed as food, for so far as I can ascertain no single factory exists for the conversion of potatoes into any of the well-known commercial products. Since writing the above I find that a potato starch factory is about to be erected in Fifeshire.

The imports in 1873, 1883, and 1893 were respectively in round numbers 375 tons, 257 tons, and 141 tons.

What is lost to this country, not only in not producing what is actually required for food, but in the much greater loss entailed through having no manufactories of the kind referred to, is; perhaps, incalculable.

I have now to call your attention to some of the more prominent manufactures connected with this root. Starch is the one I naturally first select, as it is not only an important article of commerce in itself, but is also the basis of the other products, such as starch sugar and potato-spirit, to which I shall afterwards refer.

In England rice and Indian corn are the only raw materials used in our starch factories, for wheaten starch has long since gone out of use for laundry purposes, both the above giving a better lustre, besides 100 parts of rice starch are as efficient for that purpose as 115 parts of wheat starch.

Potatoes contain about 20 lbs. of starch while wheat gives 60 lbs., maize 66 lbs. and rice about 86 lbs. in every 100 lbs. weight.

Were starch, glucose or spirit factories established in the more remote agricultural districts of the United Kingdom, the manufacturers would of course not only reap the benefit for themselves of being in the midst of a district from which they could draw cheap supplies of raw product, but would, at the same time, confer a lasting benefit upon the agricultural community around them.

Potatoes grown within a reasonable radius of the factory would doubtless compete favourably with imported rice and and maize; moreover, as I have pointed out, the refuse and by-products from the factories are not lost, but through cattle feeding enrich the land from which they sprang. (*See* Table on by-products.)

These and similar industries are fostered and encouraged on the continent, and thus agricultural and manufacturing prosperity march hand in hand.

As the process of potato-starch manufacture is entirely a mechanical one, very little skilled labour is demanded, and this is especially the case with respect to starch made from potatoes, which is probably one of the simplest methods of manufacture conceivable, neither elaborate contrivances nor scientific chemical processes being requisite as in many allied manufactures. Indeed, though the manufacture of starch from wheat, maize, or rice may be described as a simple one, they give way to that made from potatoes, since the gluten in the grains has to be got rid of, whereas in potatoes this is nonexistent. The process of starch making from potatoes may be described in a few words. The potatoes are carefully washed and cleaned in a suitable

ANALYSIS OF THE BY-PRODUCTS AND RESIDUE FROM STARCH-MAKING, BY PROFESSOR DR. EMIL WOLFF.

| — | — | | Dry Substance. | | | Nitrogenous Matter (Raw Protein). | | | Raw Fat (Ether Extract). | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lowest. | Highest. | Average. | Lowest. | Highest. | Average. | Lowest. | Highest. | Average. |
| 1 | Potato pulp | Residue from potato starch manufactory | 4·7 | 22·4 | 14·4 | 0·4 | 1·9 | 0·9 | 0·01 | 0·12 | 0·08 |
| 2 | ,, ,, pressed | | .. | .. | 35·3 | .. | .. | 1·9 | .. | .. | 0·1 |
| 3 | ,, ,, dried | | 76·9 | 88·0 | 81·9 | 2·6 | 10·2 | 7·2 | 0·6 | 3·5 | 0·8 |
| 4 | ,, mud | | .. | .. | 4·5 | 1·8 | 1·9 | 1·8 | .. | .. | 0·02 |
| 5 | Thickened wash waters | | .. | .. | 4·3 | .. | .. | 2·9 | .. | .. | 0·04 |
| 6 | Wheat grain proper | Residue from wheat starch making | 21·5 | 32·5 | 26·0 | 2·3 | 6·6 | 4·4 | 1·55 | 2·6 | 2·2 |
| 7 | ,, residue, wet | | 8·2 | 13·4 | 10·8 | 1·1 | 1·6 | 1·4 | .. | .. | 0·6 |
| 8 | ,, ,, dried | | .. | .. | 85·8 | .. | .. | 14·9 | .. | .. | 1·06 |
| 9 | Impure gluten | | .. | .. | 30·0 | .. | .. | 4·6 | .. | .. | 0·5 |
| 10 | Pure dried gluten | | .. | .. | 88·4 | .. | .. | 69·0 | .. | .. | 5·0 |
| 11 | Rice residue, wet | Residue from rice starch manufactory | .. | .. | 4·0 | .. | .. | 1·1 | .. | .. | 0·02 |
| 12 | ,, ,, pressed | | 38·1 | 51·7 | 44·2 | 8·6 | 14·2 | 12·3 | 0·2 | 2·4 | 1·3 |
| 13 | ,, ,, dried | | .. | .. | 86·1 | .. | .. | 18·1 | .. | .. | 2·9 |
| 14 | ,, proper | | .. | .. | 25·0 | .. | .. | 2·1 | .. | .. | .. |
| 15 | Cake made from rice | | .. | .. | 88·0 | .. | .. | 7·2 | .. | .. | .. |
| 16 | ,, ,, ,, gluten | | 88·5 | 89·8 | 89·1 | 14·2 | 45·4 | 44·8 | 1·3 | 3·3 | 2·3 |
| 17 | Maize residue | Residue from Indian corn starch manufactory | .. | .. | 30·0 | .. | .. | 5·2 | .. | .. | .. |
| 18 | ,, in cake form | | 78·7 | 91·3 | 88·5 | 12·9 | 22·8 | 17·3 | 2·5 | 11·5 | 7·8 |
| 19 | ,, in meal form, but wet. | | .. | .. | 88·3 | .. | .. | 22·7 | .. | .. | 8·6 |
| 20 | ,, in meal form, but half dry. | | .. | .. | 59·2 | .. | .. | 11·2 | .. | .. | 1·7 |
| 21 | ,, in meal form, dried. | | 85·1 | 88·9 | 87·4 | 14·3 | 25·2 | 18·1 | 0·5 | 11·9 | 6·3 |
| 22 | Rye residue | Residue from rye starch making | .. | .. | 30·0 | .. | .. | 6·1 | .. | .. | 1·5 |

| — | — | | Non-nitrogenous Matter. | | | Fibre. | | | Average per cent. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lowest. | Highest. | Average. | Lowest. | Highest. | Average. | Ash. | Water. |
| 1 | Potato pulp | Residue from potato starch manufactory | 3·6 | 15·0 | 10·6 | 0·5 | 3·6 | 2·0 | 0·8 | 85·6 |
| 2 | ,, ,, pressed | | .. | .. | 29·1 | .. | .. | 3·5 | 0·6 | 64·7 |
| 3 | ,, ,, dried | | 52·3 | 76·4 | 63·7 | 0·5 | 17·8 | 6·5 | 3·7 | 18·1 |
| 4 | ,, mud | | 2·2 | 2·6 | 2·4 | .. | .. | .. | 0·2 | 95·5 |
| 5 | Thickened wash waters | | .. | .. | 0·8 | .. | .. | 0·05 | 0·45 | 95·7 |
| 6 | Wheat grain proper | Residue from wheat starch making | 13·1 | 18·0 | 15·4 | 2·7 | 4·6 | 3·4 | 0·6 | 74·0 |
| 7 | ,, residue, wet | | .. | .. | 8·3 | 0·2 | 0·4 | 0·3 | 0·2 | 89·2 |
| 8 | ,, ,, dried | | .. | .. | 68·1 | .. | .. | 1·0 | 0·8 | 14·2 |
| 9 | Impure gluten | | .. | .. | 24·4 | .. | .. | 0·1 | 0·4 | 70·0 |
| 10 | Pure dried gluten | | .. | .. | 12·5 | .. | .. | 0·4 | 1·5 | 11·7 |
| 11 | Rice residue, wet | Residue from rice starch manufactory | .. | .. | 2·8 | .. | .. | .. | 0·1 | 96·0 |
| 12 | ,, ,, pressed | | 21·9 | 39·1 | 29·5 | .. | .. | 0·5 | 0·6 | 55·8 |
| 13 | ,, ,, dried | | .. | .. | 61·8 | .. | .. | 2·1 | 1·2 | 13·9 |
| 14 | ,, proper | | .. | .. | 22·7 | .. | .. | .. | 0·3 | 75·0 |
| 15 | Cake made from rice | | .. | .. | 79·7 | .. | .. | .. | 1·1 | 1·2 |
| 16 | ,, ,, ,, gluten | | 29·1 | 35·8 | 32·4 | .. | .. | 3·9 | 5·7 | 10·9 |
| 17 | Maize residue | Residue from Indian corn starch manufactory | .. | .. | 24·0 | .. | .. | .. | 0·8 | 70·0 |
| 18 | ,, in cake form | | 51·1 | 66·5 | 57·9 | 1·5 | 8·6 | 4·5 | 1·0 | 11·5 |
| 19 | ,, in meal form, but wet. | | .. | .. | 49·7 | .. | .. | 5·9 | 1·4 | 11·7 |
| 20 | ,, in meal form, but half dry. | | .. | .. | 45·0 | .. | .. | 0·6 | 0·7 | 40·8 |
| 21 | ,, in meal form. dried. | | 53·6 | 68·8 | 60·7 | 1·0 | 1·7 | 1·3 | 1·0 | 12·6 |
| 22 | Rye residue | Residue from rye starch making | .. | .. | 18·9 | .. | .. | 2·7 | 0·8 | 70·0 |

ANALYSIS OF THE BY-PRODUCTS AND RESIDUE FROM STARCH-MAKING—*continued.*

| — | ——— | | Average per Cent. Digestible Compounds. | | |
|---|---|---|---|---|---|
| | | | Nitrogenous Matter. | Raw Fat. | Non-nitrogenous Extract Compounds. |
| 1 | Potato pulp | Residue from potato starch manufactory. | 60 | .. | 90 |
| 2 | „ „ pressed | | 65 | .. | 90 |
| 3 | „ „ dried | | 65 | .. | 90 |
| 4 | „ mud | | 70 | .. | 90 |
| 5 | Thickened wash waters | | 70 | .. | 90 |
| 6 | Wheat grain proper | Residue from wheat starch making. | 88 | 46 | 92 |
| 7 | „ residue, wet | | 80 | 50 | 90 |
| 8 | „ „ dried | | 80 | 50 | 90 |
| 9 | Impure gluten | | 80 | 50 | 80 |
| 10 | Pure dried gluten | | 80 | 50 | 80 |
| 11 | Rice residue, wet | Residue from rice starch manufactory. | 80 | 60 | 90 |
| 12 | „ „ pressed | | | | |
| 13 | „ „ dried | | | | |
| 14 | „ proper | | 70 | .. | 70 |
| 15 | Cake made from rice | | 70 | .. | 70 |
| 16 | „ „ „ gluten | | 80 | 70 | 70 |
| 17 | Maize residue | Residue from Indian corn starch manufactory. | 70 | .. | 70 |
| 18 | „ in cake form | | 70 | 60 | 70 |
| 19 | „ in meal form, but wet | | 70 | 60 | 70 |
| 20 | „ in meal form, but half dry | | 80 | 60 | 90 |
| 21 | „ in meal form, dried | | 80 | 60 | 90 |
| 22 | Rye residue | Residue from rye starch making. | 80 | 50 | 90 |

apparatus which removes all the earthy and extraneous matter, and are then pulped. The starch grains thus exposed are washed with water through a sieve on which the pulp is retained. The mixture of starch grains and water is then cleared and run off; the water is separated firstly by centrifugal hydro-extractors and then by air pumps, and the residuum of water is then evaporated in hot-air stoves. The fibrous matter of the potato which is detached from the starch vessels contains albumen, raw fibre, fat, starch, dextrin, grape sugar and other nitrogenous and mineral matter, and is used for cattle feeding when mixed with a suitable proportion of oil-cake. About 8 per cent. of this is obtained from 100 parts of potatoes. This cake is about equal in nutritive qualities to the residuum from sugar beetroot, and is a valuable cattle food. It is somewhat short of albuminous matter, but this can be made up by mixing with oil-cake. The water which is used in the process of starch manufacture is allowed to stand, so that the starch particles may settle; it is then run on to pastures where it acts as a liquid manure, conveying phosphoric acid and nitrogen, which being absorbed by the soil enriches it for future crops.

Starch-sugar or glucose is produced artificially from starch by the action of malt extract or diluted acids. It is formed naturally in the processes of digestion through the action of saliva, pancreatic juice and other similar fluids.

Glucose is found in great abundance in flowers and fruits and is the basis of honey. Within the last decade or two glucose has become a very important article of commerce. It is used to a large extent by confectioners, brewers, jam boilers and other manufacturers. It has little or no sweetening power, but it is useful and cheap as a preservative and is also a thickening medium and prevents crystallisation in sugar.

It is also used to a large extent for the purpose of mixing with low class must, and to replace malt in the brewing of beer (the latter only in England where it is legal, 28 lbs. being equivalent to one bushel of malt). The glucose thus used is not made as was reported in one of the Liverpool papers some time ago, from linen rags or wood fibre, but it is produced either from Indian corn or from potatoes, and chiefly from the latter in Germany.

To manufacture glucose, starch is boiled with diluted sulphuric acid, when after a little while all the starch turns into soluble starch $(C_6H_{10}O_5)_n$ amidulin. A drop of iodine then poured into a sample of the liquid will turn the same violet, shewing that it is still starch, but gradually in course of time conversion into the different modifications of dextrin takes place. We can then distinguish—

A.—Dextrin (amylodextrin) $(C_6H_{10}O_5)n$ from the above by the purple red reaction of iodine.

B.—Dextrin (amylin) $(C_{12}H_{20}O_{10})n$.

Then amylon (maltose) $(C_{12}H_{22}O_{11})$ and lastly the two dextroglucoses $(C_6H_{12}O_6)$ are formed.

The boiling has only to be sustained long enough to convert the whole mass into starch-sugar.

The glucose of commerce is not perfectly inverted. It is not invert-sugar proper, but a mixture of invert-sugar and dextrin. If, in the process of manufacture, the boiling of the acid mixture is stopped immediately after iodine ceases to show the well-known purple red reaction, and the acid be at once neutralised, we get the liquid starch syrup or glucose of commerce, but if the acid mixture is boiled until all the dextrin is converted, then the neutralised liquid, after being decolourized and partly evaporated, will on cooling crystallise and form solid starch, sugar, or glucose, which is so well-known to brewers and others as the substance resembling wax.

The originator of the present mode of making glucose is no doubt, Mr. Manbré, who invented his well-known high pressure apparatus for the conversion of starch to starch-sugar, which, in its original and modied forms is to be found in every glucose factory to-day. The total conversion of starch into starch-sugar takes a considerable time, say, with a 2 per cent. solution, about 24 hours. If the operation, however, is conducted in closed vessels under high pressure, then the higher temperature so obtained aids the conversion and completes it in a much shorter time than without these artificial aids. A high pressure, moreover, enables the manufacturer to use a minimum quantity of sulphuric acid (which is the best converter), and this is of very great importance inasmuch as the residue is consumed for feeding purposes. Diastase or maltin, which is just as effective as sulphuric acid for converting starch into starch-sugar, is found in barley and similar cereals at the period of germination, and is used for that purpose at a comparatively low temperature in place of diluted sulphuric acid in the brewing and distilling trades, but not in the manufacture of starch-sugar.

The following table (F.), which is extracted from the Board of Trade returns, shows that the imports of glucose are considerable, and the inference may be drawn that there is a large field open for English enterprise and capital in this direction. To the best of my knowledge glucose only for the brewers' purposes is manufactured in England, while the water-white glucose, so much appreciated by jam boilers and confectioners as a thickening ingredient in their manufacture, is all imported from abroad.

TABLE F.

STATEMENT showing the quantity and value of glucose imported into the United Kingdom during the year 1894.

*Commercial Department, Board of Trade*, 18*th Sept.* 1895.

| Country whence Imported. | Quantity. | Value. |
|---|---|---|
| | Cwts. | £ |
| Germany | 99,273 | 58,073 |
| Holland | 4,866 | 3,266 |
| Belgium | 102 | 56 |
| France | 20,504 | 10,914 |
| United States of America | 937,329 | 469,886 |
| Total | 1,062,074 | 542,195 |

I now approach the last division of my paper, namely that on the manufacture of potato spirit.

There is no civilised country without distilleries and breweries. The taxation of these industries has been found to be a ready mode of raising revenue, the manner in which it is levied has had a most important influence on the nature and development of these industries in all countries. One of the most marked differences between the fiscal legislation of England and that of other European nations is, perhaps, the total disregard shown here, and consequent discouragement of individual skill and application as applied to manufactures, such as I have dwelt upon. English authorities place every obstacle in the way of manufacturers who are desirous of adopting any improved methods in their businesses or of giving more careful attention to their material during the process of manufacture. The persistent resistance of the authorities to the introduction of new methods or improvements of any kind is a well-known fact, presumably because they know that their officers in most cases are without the knowledge necessary to enable them to understand the process, and they fear that the greater knowledge of the brewer or distiller would enable him to hoodwink their officers, who are there to watch and to check his proceedings. One of the consequences of this is that brewers and distillers do not see the necessity of employing well trained scientific men to manage their undertakings, and so rule-of-thumb management still reigns supreme. I am inclined to think, from what I can gather, that in the whole of the eleven distilleries in England and Wales, not more than four scientifically trained chemists could be found, whereas on the continent, all large establishments employ two or three, in some cases even four, trained chemists. How the action of our Government influences the employment of technical staff for industrial purposes, no better proof is needed than to point to the increased demand for scientific assistance by brewers since the introduction of the Beer Act of 1880, when the malt tax was abolished, and a tax on the materials used was substituted. It then became evident to the brewer that without scientific brewing he could not attain the standard prescribed by the excise, and brew thirty-six gallons of wort of the gravity of 1,057 degrees for every two bushels of malt or corn or of 56 lbs. of sugar. The decrease of small breweries after the passing of this Act was extraordinary. It had been generally accepted that beer could be brewed in small quantities at a profit. Possibly competition was not so keen in those days, but a rude awakening awaited the smaller brewers, for instance in Walsall, where before 1880, 175 small breweries were established; to day I believe not more than half the number are in existence.

In Germany and Austria the bent of legislation appears to have been directed not only with a view towards raising revenue, but at the same time influencing manufacturers to adopt scientific principles in their businesses, and in rewarding them by making small concessions, which enable them to reap the benefit of their own skill and superior knowledge should they manage to get a better result than their neighbour. Moreover, the socialistic influence is so strong as to give the small distiller an advantage in the duty over the larger one, as I shall show. This arrangement has had the result of encouraging materially small farm distilleries consisting of merely one or two mashing tubs, the necessary fermentation vats, a pot-still, or more generally, a patent-still. In Germany small agricultural distilleries, which distil from farinaceous substances, and use the residue for feeding their own cattle, undertaking to put all the manure of their cattle on their own fields, while working only from October 1st to June 15th, pay only part of the duty as follows:—

If they do not ferment more than—

1050 litres vat space per diem = 231 galls. ...... 6/10 part.
1500 " " = 330 " ...... 8/10 "
3000 " " = 660 " ...... 9/10 "

of the duty charged on the vat space.

In case the distiller and the farmer are not identically the same person, and if the residue is not used on the farm on which the distillery is situated, but cattle are fattened on the distillers account or on contract for other people, the distiller must return the manure to the farmer and so reap the benefit of being classed as a "farm distiller." Indian corn may not be used for spirit making in Germany at a distillery where the benefits of "farm distilleries" are taken advantage of, exception has been made in such years when it seemed advisable, because the staple food of the masses, potatoes were very scarce and consequently expensive.

In Austria so-called "farm distilleries" are refunded part of the duty in proportion to their size, the smaller their capacity, the greater the financial help given them, so as to counterbalance the disadvantages they suffer when compared with larger works. Practically the smallest still in England allowed by law is 400 gallons capacity.

The object in limiting the size of the still to 400 gallons is to restrict the manufacture of spirits to fewer persons. It was considered that the revenue from spirits would be more secure, and that the expense of supervising and collecting it would be less, if the trade were confined to a few individuals possessed of capital.

The Act of Parliament 43 and 44 Vict. 1880, says:—

"No person shall be entitled to have a licence granted to him for a distillery or be permitted to make entry of a distillery unless the same be situated within a market town, or within the distance of a quarter of a mile from such town, unless fit and proper lodgings or rooms for the residence of the officers to be placed in charge of such distillery, conveniently situated and approved by the collector and at a reasonable cost, not exceeding ten pounds a year, be provided."

Consequently farm distilleries are unknown in the United Kingdom, and farmers here are deprived of the advantages which help continental farmers over many other agricultural difficulties. The number of proof gallons of plain foreign spirit which paid duty on coming into the United Kingdom was, in 1893, 888,572 gallons, and in 1894, 1,176,118 gallons. We may safely assume that most of this was distilled from potatoes.

We have it, from the evidence given before the Royal Commission, that potato spirit, when imported into England, is the very purest spirit that can be produced, being much more easily purified than other spirits, giving off fusel-oil very readily. Nevertheless neither potatoes nor roots of any kind are used in this country for distillation. Purified spirit, no matter from what material it is made, is ethylic alcohol, and ethylic alcohol only, therefore potato is preferred as raw material, when the spirit produced from it is required to be in a state of high purity.

The popular prejudice against potato spirit is entirely without scientific foundation, as, for all practical purposes, it is fully equal to that made from cereals. The erection of distilleries in remote agricultural districts would be an immense boon to the farming interest, and would of course aid in supplying the home demand, which at present is met by large imports from the continent.

It now remains for me merely to summarise what I have put before you, and point out that the British farmer and manufacturer may work hand-in-hand to establish a number of industries which await their mutual attention, and which, as I have shown, are now yielding both profit and employment to our continental neighbours. I have passed in review the following :—

The manufacture of—
chicory,
starch,
glucose, and
potato-spirit,

all of which would help the farmer to make both ends meet, and would enhance the value of the land in consequence. At the same time additional work would be found for those who are now unemployed in the winter months, and a rational use made of much land that is now left uncultivated

# Manchester Section.

ROOMS OF THE CHEMICAL CLUB, VICTORIA HOTEL.

*Chairman:* George E. Davis.
*Vice-Chairman:* Peter Hart.

*Committee:*

**G. H. Bailey.**
**R. Forbes Carpenter.**
**R. S. Dale.**
**C. Dreyfus.**
**H. Grimshaw.**
**J. M. Irving.**
M. J. Langdon.
**I. Levinstein.**
**W. H. Perkin, jun.**
**Sir H. E. Roscoe.**
E. Schunck.
**W. Thomson.**

*Hon. Local Secretary:*
**J. Carter Bell,**
**Bank House, The Cliff, Higher Broughton, Manchester.**

SESSION 1895–96.

December 6th.—Dr. J. Lewkowitsch. "Contributions to the Analysis of Fats."

*Meeting held Friday, November 1st, 1895.*

MR. GEORGE E. DAVIS IN THE CHAIR.

Mr. George E. Davis before proceeding with his opening address, referred in very high terms to the able manner in which Mr. Forbes Carpenter had filled the chair during the past year, and on behalf of the Section congratulated him on his recent appointment as Chief Inspector under the Alkali Acts.

## CHAIRMAN'S ADDRESS.

The office of Chairman of any Section of this Society has become no sinecure. We have all of us in this Manchester Section been treated with so many admirable annual addresses, that there seems but little for a new chairman to say. I must, however, in the first place, thank you for your confidence in placing me in the honourable position of chairman, and I hope you will join with me in endeavouring to maintain the position now held by the Manchester Section, by furnishing interesting papers and communications, and contributing to the discussions. But while on this subject, I am reminded by the general secretary of the necessity for economy, and the publication committee is urging the desirability of effecting, not only considerable condensation in the reporting of all discussions, but where practicable the condensation of the papers themselves for publication. It has been pointed out that the limit of condensation is reached, so far as the Journal and Patent Literature is concerned, and that if space is still to be saved there is no resource but to cut down the sectional matter. Of course, there would not be that need for economy if the membership were more numerous, and I hope every member of this Section will do his best to bring into the fold all those sheep that are still outside. It is only by thus adding to the revenue that the efficiency of the Journal can be maintained ; it will be a bad day for the Society when the efficiency of the Journal has to be sacrificed to the want of funds.

With these few remarks I will pass on to the subject of my address, which I have ventured to describe as :—

### "A QUARTER OF A CENTURY IN THE HEAVY-CHEMICALS TRADE."

Your worthy Vice-Chairman has been known in this connection for a much longer time than this, and he may have much more to tell you someday, but there have been developments in my time sufficiently interesting to all of us, to go over carefully together and to show that the past twenty-five years has been a period of ceaseless and unusual activity. To take first of all the vitriol manufacture as being one in which improvements have been made, mainly in development of details as compared with the drastic changes in other brances of manufacture, order has been developed out of chaos, and the tabulation of working results has led to the correct proportioning of plant. Twenty-five years ago, only a few of the Glover towers then erected could be said to be working satisfactorily, and the capacity of the Gay-Lussac absorbers was not adjusted even by rule of thumb. I have in mind a Gay-Lussac of 1870, taking the exit gases from 70 tons of Mason's ore weekly ; it was four feet square and the same height as the vitriol chambers, whereas we know now that two towers each 50 feet high and 10 feet square would not be more than sufficient to deal with this quantity of nitrous gases. It is by improvements in this direction that the cost of vitriol manufacture has been so much cheapened, it having been brought down to a figure which would have been thought impossible even a decade ago, the figure of 12*s.* 6*d.* per ton for 123° Tw., having been reached over a long period in certain works. With a better understanding of the nature of the processes, the pyrites is much better burned than it used to be, and the "smalls" are treated in a more scientific manner than by the old process of balling, so that in the whole round of this manufacture there seems to be but two sources of waste capable of being stopped, viz., the waste steam used for driving the blowing engine and the waste heat of the Glover acid run. The main improvements in this manufacture may be very readily summarised, correct proportioning of plant to the work to be done in it ; ample room for the recovery of the nitrous gases, and construction of the plant so as to reduce repairs to a minimum, especially with regard to working details. No doubt the greater portion of the improvement of the last few years is distinctly traceable to the federation of most of the existing works dealing with heavy chemicals, who have wisely not sought to make big dividends by unduly increasing the price of their commodities, but have endeavoured to level up the condition of each works to that of the best, so that the consumer has benefited along with themselves.

The labour question is one I do not wish to touch upon, except briefly, and to say it is one which might well be discussed at our monthly meetings. There are so many disturbing elements, such as size of works, locality, mechanical conveniences, supervision, irregular payments, bonuses, &c., that a paper on all its bearings might be made very instructive and interesting to all engaged in the chemical industries.

To take the next step in the alkali manufacture, viz., that of salt cake, the past quarter of a century has not only seen great developments in details of the usual process, but in the case of the Hargreaves process a new departure entirely. This process has not, however, made very much headway, and seeing that salt cake has this year been selling at 12*s.* per ton, and costing to make by the old process at least 30*s.*, there does not seem to have been enough in it to induce manufacturers to discard the usual process for its adoption. But what have been the developments and improvements effected in the ordinary process? Let us take the salt cake furnace as the first step. In 1870, that form of furnace in which the HCl gas was mixed with the products of combustion, generally known as the "open furnace," was most employed. The gases leaving the furnace at a very high temperature caused difficulties with the condensation, and the demand for a stronger acid for use in the manufacture of bleach has led to the universal employment of the "close" or "blind" or "muffle" furnace, as it is called in different localities. Nevertheless, the "open roaster" was very economical in fuel. In one works where this class of furnace was used exclusively, the following fuel bills were obtained per ton of salt cake made:—

| — | Pots. | | | Roasters. | | | O. V. Pans. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cwt. | Qrs. | Lb. | Cwt. | Qrs. | Lb. | Cwt. | Qrs. | Lb. |
| 1871 | 2 | 2 | 7 | 4 | 3 | 7 | 5 | 3 | 14 |
| 1872 | 2 | 2 | 14 | 4 | 3 | 14 | 6 | 3 | 14 |
| 1873 | 3 | 0 | 21 | 3 | 2 | 21 | 4 | 20 | 0 |
| 1874 | 3 | 1 | 21 | 3 | 3 | 7 | 4 | 2 | 7 |

which shows about 7¼ cwt. for the pot and roaster together per ton of salt cake made. The acid used for the decomposition of the salt was run direct from the chambers at 100° Tw. and boiled up in the pans to 140° Tw., at which strength it was used. But this quantity of fuel was the moiety of that used in the "close" or "blind" roasters, and as the introduction of the "Glover" or concentrating tower had totally eliminated the fuel formerly employed under the vitriol pans, it became necessary for the blind furnace advocates to look to their laurels. The pioneer in this direction was Mr. Gamble in his Hardshaw Brook works, where a plus pressure furnace worked by a Siemens gas producer was erected. During six months of 1874, 3,176 tons of salt cake were made with 1,846 tons of burgy, which works out to 11·6 cwts. of coal to the ton of salt cake. Then came the Deacon plus pressure furnace fired with ordinary slack, which has now been so perfected by attendance to details that the total fuel used for both pot and furnace does not exceed 6½ cwt., or ¾ cwt. less than used to be employed for the open pot and roaster. Again, 25 years ago there was scarcely a salt cake plant which did not have a wash tower attached to each condenser, from which a large volume of weak acid at 2° or 3° Tw. was run into the nearest stream or sewer; to-day the wash tower is a *rara avis* and absolutely unnecessary.

There is no doubt that the plus pressure furnace gives a greater yield of acid than the ordinary form, but the improvement has been much exaggerated. At the same time the greater complication of the plus pressure system has led to better building and increased supervision of the manipulation, turning what was at one time "rule of thumb" into "rule of three."

The amount of salt used per ton of salt cake has not undergone any material change during the past 25 years; it varies very considerably, and I have figures over long periods from various works showing from 17 cwt. where weak salt cake is made from well-drained salt, to 19 cwt. where rich salt cake is made.

But though the improvements in the salt cake and vitriol manufacture may have been effected by careful attention to details alone, this cannot be said with reference to the manufacture of chlorine. My first acquaintance with a chlorine plant was of a very interesting kind. A water-wheel turned a pair of edge runners grinding up native manganese in water to form a mud, which was levigated; the excess of water was run off, and the mud scooped out and fed into steam-jacketed stone stills furnished with agitators, from which the chlorine was evolved, and turned into chambers as we do now. The next step in advance was smaller stills, in which the manganese was placed on perforated tables and acted upon by the strong hydrochloric acid, and these continued in use until the advent of the Deacon and Weldon processes.

The enormous waste in the manufacture of chlorine at this period may be judged from the figures I will put before you. The manganese, being finely ground, was not all acted upon by the acid; the stills were upon a beck-side, and a 2-in. water pipe was employed to clean them out after each operation, and as it was seldom that the stills were worked below 10 per cent. of real HCl in the still contents, the yield was often very bad indeed. In fact, during a period of three months, the working account stood thus:—

| | Tons. |
|---|---|
| Salt decomposed.................... | 1,220 |
| Manganese used (70 per cent.) ..... | 202 |
| Bleach (35 per cent.) ............... | 194 |
| Muriatic acid sold (26°)............ | 237 |

This record, which is a bad one, shows that a very large quantity of acid must have been lost, either in the still waste or in the condenser wash-towers. The difference between 1870 and 1895 may be appreciated from the remarkable statement that from 1,220 tons of salt by the Weldon process we now expect to get at least 600 tons of bleach.

If we investigate the above working more closely we can find approximately how much acid was lost in this case by imperfect condensation (wash-tower water). Each still was charged with 11 cwts. of 70 per cent. manganese and 112 cub. ft. of muriatic acid of 26° Tw. Twelve of these stills produced nine tons of full strength bleach with the greatest regularity, while, theoretically, the quantity of manganese employed should have yielded 10 ton 14 cwt.; what was not dissolved was washed away with the still waste, and by the wash water used to cleanse the still. The quantity of 25 per cent. HCl charged into each still was 70 cwt., while, neglecting free acid, 52 cwts. only theoretically was required. This may be taken as a very fair record of "open roaster" working of salt cake.

With better condensation of the muriatic acid in close roasters so the production was improved, and as in some works the stills were steamed until only 20 per cent. of the total acid remained free, it came to be considered that from 4 to 5 tons of acid at 25 per cent. would make a ton of bleach. As a matter of fact, in a series of records I made in 1871, a series of stills which should theoretically have required 52 cwts. of 26° Tw. acid, really had 70 cwts. administered, and much of this was lost by failing to combine with the manganese. But the still waste, on an average, contained far more free acid than this, and I think I shall not be far off the mark when I say that altogether half the acid which ought to have been utilised was wasted in those days. But it was not the acid question that threatened the bleach industry in the earlier years of this quarter century, it was the rise in the price of manganese, and the process now so generally adopted (invented by Gossage and developed by Weldon with the aid of Bramwell, Gamble, and others) was not so much a revolutionary process for the manufacture of chlorine, as a process for the recovery and regeneration of the manganese dioxide employed in the stills.

Like all new processes, the details were not all perfected in a trice, but by 1873 a very fair degree of efficiency had been reached, and the amount of salt per ton of bleach had been reduced in some cases to 50 cwts. The general average was above this, and it will be seen on calculation that worked as it was up to the time of Mr. Weldon's death, a better result was impossible. But times of adversity have ever quickened human ingenuity, and the low selling price of salt cake (12*s.*) when its cost price was nearer 30*s.*, without reckoning general expenses, has caused manufacturers to look into the details of the chlorine process much more closely than they otherwise would have done.

On the 10th of April 1883, I had the pleasure of bringing before a meeting of this section a paper on "Economy in the Manufacture of Bleaching Powder," in which was described a method of neutralising the "base" of recovered manganese, with the free acid of the still. This paper was severely criticised during the discussion which took place upon it, the gist of the arguments being that it was impracticable, yet, gentlemen, this is the very thing that keeps the Weldon process alive now, as it is scarcely possible to make ends meet by the old Weldon process, in which all the free acid of the stills is neutralised with limestone dust. It is only fair to the memory of the late Mr. Weldon to say that he patented a process upon somewhat similar lines in 1873 (a fact of which I was unaware when I read my paper in 1883), but that he had not made it successful is amply shown by the trials being discontinued before 1874, and though I had the entree to many works between then and 1883, I had never heard of any attempt to work the process. In fact, the speakers in the discussion—well-known men in the chlorine trade—did not think the modifications I then suggested would lead to economy, but what has been actually the case? It now takes less than 40 cwt. of salt to make a ton of bleach, the base of the mud being brought down from 0·65 to 0·25 or less, before the mud is brought into contact with the fresh acid.

And we may now ask—have we reached the limit of economy so far as vitriol, saltcake, and manganese bleach are concerned? I think not. The continual loss on salt cake will sharpen men's wits, and though vitriol cannot possibly be cheapened much, there is yet something to do in the matter of salt cake, and much with manganese bleach. Should salt cake ever become a remunerative manufacture *per se*, it will be a decided disadvantage to lessen the production of it, and those who can make it pay in times of adversity will reap a rich harvest in more prosperous years.

The improvements required in details in connection with manganese bleach are many. In one direction, that of chemical engineering, there is a good field open. If one had to start to build an absolutely new works now, no doubt much saving could be made, not only in the arrangement of the plant, but in construction of parts liable to breakage and repair; and on the chemical side there is still the improvement of the quality of the mud to consider, the reduction of the base from 0·25 to nil, the production of much stronger acid and mud for the stills, while the utilisation of the chlorine now running away combined with calcium, is a subject not quite unworthy of attention. With regard to this last problem, it may be safely said that there is no process known to us at present whereby the chlorine of the chloride of calcium can be profitably utilised. Then again, there is no need to lose any manganese, soluble or insoluble, in the sulphate of lime mud from the neutralised liquor settlers, if proper arrangements be made, and though this loss has now been brought down to about 28 lb. per ton of bleach, yet it is worth consideration by others, as I have been able to recover the whole of the manganese in this waste product at a very small cost indeed. It is only by the multiplication of small economies that improvements are now built up, the startling improvements being very few and far between.

I have already alluded to the fact that from 40 cwt. of 90 per cent. salt we now expect to produce a ton of bleach by the manganese process. The items that go to form this quantity may not be uninteresting, serving as they do to show the direction in which possible improvements may be looked for:—

| | NaCl, 90 per Cent. Cwt. |
|---|---|
| *a*. Chlorine required for a ton of bleach—<br>7·6 cwt. = 38 per cent.; equal to 90 per cent. salt | 14·0 |
| *b*. Chlorine forming $MnCl_2$ | 14·0 |
| *c*. Chlorine combined with base (0·63)—<br>0·63 × 14 = | 8·8 |
| *d*. Lost as free acid in still liquors | 1·9 |
| *e*. HCl escaping from condensers—<br>1·0 per cent. of that evolved | 0·4 |
| *f*. NaCl in salt cake—<br>14·5 cwt. at 4 per cent | 0·5 |
| | 39·6 |

or 35·6 cwt. of absolutely pure salt.

Of these items, *a* and *b* are absolutely fixed for a sample of 35 per cent. bleach when working with 90 per cent. salt; *c* depends upon the "base" of the manganese mud, and 0·63 is about as low as an average of about a dozen "blows" will be; *d* depends upon the manipulation, upon the stillman in fact, and very little improvement can be expected here, while the remaining losses *e* and *f* if totally eliminated would only decrease the quantity of salt required by 1 cwt., and this is not likely.

We may now leave the manganese process, which has served to illustrate the gradual perfection of details, and turn to what is known as the "Deacon" process. In this process we have no base to satisfy, and no chlorine lost in forming a metallic chloride, neither is there any loss in still liquors; but despite all this, the earlier manufacturers by the Deacon process did not get any more bleach per ton of salt than by the manganese process. The reason was that only the pot acid could be employed, or only about 60 per cent. of the whole HCl evolved, and of this less than 60 per cent. on an average was converted into chlorine in the decomposer, and still less found its way on to the powder shelves; as the acid condensed in pipes and cisterns, the acid (12° Tw.) from the acid tower, the wash tower water, and the run from the vitriol drying tower all contained considerable quantities of chlorine, so that from the theoretical quantity of salt only 36 per cent. was converted into Deacon bleach, while a reference to the items already referred to will show that $\frac{14}{39\cdot 6}$ or 35·3 per cent. is now capable of attainment by the manganese process.

But the Deacon process has also undergone improvement in details. In the early days, and in one works using the process 2,100 tons of bleach were made by the use of 24 tons of copper sulphate; later on, however, it was found possible to produce 130 tons with 3¼ cwt. of copper scale dissolved in hydrochloric acid, a tremendous saving so far as copper was concerned. But the most recent improvements in the Deacon process lie in the direction of converting into chlorine the hydrochloric acid which passed through the decomposers as a degrading and unnecessary accompaniment, and this has been so successfully accomplished that the quantity of salt required to produce a ton of bleach has been reduced in some works to an average of less than 20 cwt., and by treating the roaster acid in a special manner the quantity of salt has been reduced during short periods to 15 cwt., or within 7 per cent. of the theoretical. This is attained by the withdrawal of water from a mixture of this substance with hydrochloric acid, the agent employed being strong sulphuric acid. Isham Baggs was the pioneer of this process of treating aqueous hydrochloric acid, and though it is not generally known, the reaction has been applied in several cases to my knowledge with entire success. It must not be thought, however, that the lower consumption of salt just mentioned for the improved Deacon process is all profit for the producer of bleach. Not at all, the repairs are very heavy, and the concentration of the large quantity of vitriol employed to extract the water is certainly a factor to be reckoned with. As a matter of fact, I proposed this very process to Messrs. R. Bealey and Co in 1878, and again to the Netham Chemical Co., and fully appreciated the objections that were urged against it, though later experience has shown the balance of advantages to be in its favour, but I still think to-day that the improvement has been considerably over-rated, and that it is capable of further development. In stating the details of this process, I think it may be safely reckoned that 100 tons of bleach will require 80 tons of salt, and the weak sulphuric acid from the hydration process will amount to 360 tons, which requires concentrating to its original volume, or 175 tons. In pans of the description employed for this operation 3 lb. of water are usually evaporated per lb. of coke, so that the coke bill will be not less than 60 tons, for 100 of bleach, and every one will know that a vitriol concentrating plant to consume that quantity of fuel is a pretty extensive one and liable to heavy repairs and renewals. I think I have now devoted sufficient time to the chlorine manufacture, but perhaps you will expect me to say something upon the latest developments, viz., the nitric acid process and the electrolytic processes. As to the nitric acid process I am sorry my lips are sealed for the present, but I hope on a subsequent occasion to give you a paper on the subject. It may interest you to know that most, if not all, the hindrances to the successful working of the process have been overcome, and that bleach has been made in quantity and sold, and the purchasers have been very well satisfied with it. Of course, time will show whether I am correct, but I believe that the nitric acid process will have to be reckoned with by those using older processes.

With regard to electrolytic methods, we have much to learn yet, and it is the opinion of many that those who seek to employ electrolysis as an industrial operation, will have to follow the lead of those who have carried their works to the highest waterfalls they could discover. Our excellent Journal will give the seeker after this kind of knowledge, more information than I could possibly compress into this address, but I may add that on the surface electrolysis of salts does not appear satisfactory, when the factory at Farnworth, near Bolton, is closed, and the electrolytic factory at St. Helens is producing caustic by means of the Le Blanc process. The electrolysis of the alkaline chlorides will burn a few fingers yet, though if the cost of the current could be considerably reduced, and if several practical details could be trained into absolute obedience the outlook would be more hopeful.

I may now pass on to the caustic soda manufacture, and with it the production of soda ash and soda crystals. In the Le Blanc process there has been no radical change, but there has been the same development of details that has characterised all other chemical industries. The old hand black ash furnace has been almost civilised out of existence, in fact, it is only retained in those works where local conditions render such a mode of working possible, the higher cost for wages, the heavier fuel bill, and the inferior decomposition are all tending to drive it into the limbo of forgotten things.

Twenty-five years ago I was introduced to the old hand black ash furnace, working with a mixture of salt cake, *slaked lime*, and slack, which gave a black ash in no way differing from that made with limestone; by-and-bye the lime balls were discontinued, and limestone balls took their place with no deterioration in the quality of the product, and I think I can safely say that, besides the almost universal introduction of the revolving furnace the Le Blanc process, up to the point of the production of vat liquor has remained stationary during the whole of the quarter of a century. There was as good black ash made 25 years ago as there is to-day, and quite as good vat liquor. From this point, however, there have been gradual developments, and the chemistry of the process is much better understood, and generally under the supervision of trained chemists as contrasted with the oversight usually accorded to all processes 25 years since.

It will amuse you to hear related how in 1876, a firm of manufacturers actually boiled down causticised soda liquor in contact with the fire gases of a black ash furnace, during which operation, 35 per cent. of the caustic was recarbonated, the manager of that department pointing out the large quantity of "salts" deposited, as a proof of the improvement (?) he had instituted. In the early days of the quarter century it was difficult not to make money; with 60 per cent. caustic at 16*l.* per ton and bleach at the same figure any sort of production was profitable, but now-a-days, even the theoretical yield will not always save the manufacturer from financial losses. The manufacture of soda ash by means of the old Le Blanc method, has been nearly driven out by ammonia-soda, and before very long the soda crystal trade will be entirely dependent upon ammonia soda for its raw material. In the manufacture of soda-crystals there would seem but little room for improvement, but when they are made upon the enormous scale of to-day, labour-saving appliances and efforts to prevent waste will always tell in the manufacturers' favour. Money spent judiciously in saving labour, in avoiding heavy and constant repairs, or in preventing possible waste, will give the manufacturer much more profit and more peace of mind than is usually reckoned on, and works fitted up in the best manner will always keep ahead of those struggling concerns which can never make up their minds to spend money until it is too late.

The days of struggling companies are numbered, and all those aspiring to become chemical manufacturers should leave the trade alone unless they are prepared to spend the capital necessary to put up the works, not only equal to the best existing works, but better, profiting by the experience of all who have gone before. And more particularly is this true of caustic soda making, which has had a long period of depression with only a few rifts in the dark clouds surrounding the industry. When salt cake was low in price, then caustic was low too, but some little advantage was gained during the low values obtainable for ammonia soda-ash, seeing that this product was being sent from Fleetwood to Widnes to undergo causticisation with lime and manufacture into caustic. The improvements in the caustic manufacture during the past 25 years have not been many, and mainly lie in improved appliances and in methods for the economy of fuel, but the processes are better understood now than they were then, which is amply proved by the fact that it was then considered a feat to produce 70 per cent. caustic regularly, while 74 per cent. was only made by one firm, others who had tried having given it up as being too big a job for them. The fuel consumption, which was at least seven tons per ton of 70 per cent. caustic, has now been brought down to less than four tons, and even better results have been accomplished by means of the system of multiple evaporation, which had been so long employed in the sugar industry with success.

But I believe the caustic soda trade is about to undergo a revolution. It is about to be made on a large scale at the ammonia-soda works by Loewig's process, viz., by roasting carbonate of soda with oxide of iron, whereby the carbonic acid is expelled and a ferrite of soda formed which is subsequently decomposed by contact with water. From all the information I have been able to gather I do not see how the ton of caustic soda is to cost less than a ton of Leblanc soda, in a plant where all possible economies have been effected, especially if the system of multiple evaporation has been adopted. It is true that the liquors from the Loewig process may be directly obtained of 75° Tw., but this strength can be obtained in the Leblanc process by exhaust steam where multiple evaporation is adopted, 40 lb. of water per pound of coal being the evaporative effect, causticised liquor of 25° Tw. containing only eight parts of water to each part of 70 per cent. caustic.

But the revolution I am expecting does not lie in this direction. Ammonia soda treated by the Loewig process will yield 77 per cent. caustic, and this, ton for ton, will be produced as cheaply as a ton of 70 per cent. Leblanc caustic, and further, there is no doubt that in time it will be sold as cheaply as 70 per cent. caustic is now; customers will prefer the 77 per cent. article, and the chief demand will be for that quality, which ordinary Leblanc makers will find it difficult to supply without a complete alteration of their plant. Of course, 77 per cent. caustic can easily be made by reducing the salt contents of the salt cake to a minimum, as is done at Newcastle, by decomposing the salt in the ordinary pot and furnace, and finishing the roasting in the Mactear furnace; another operation, it is true, but costing little on the scale upon which the operations are carried out. Then again, if the sulphides are removed by zinc oxide from the vat liquors there will be only those sulphur compounds in the finished caustic which are due to the hyposulphite co-existing with the sulphide, a quantity which in fresh vat liquors is very small indeed. This shows, I think, that the rivalry between the two processes will be a very keen one.

And now what is the outlook in the alkali trade? There are wars and rumours of wars. Leaving the nitric process for bleach and the electro processes for bleach and caustic to take care of themselves, as no doubt they will furnish subjects for another address, I may allude to two processes which, in my opinion, deserve careful consideration. I have investigated both of them at some length, and in future years they may be found capable of being worked to advantage. I allude to the phenoloid process and to the carbon process, both of which produce soda ash.

The phenoloid process, which is one for the conversion of sulphate of soda into carbonate of soda in the wet way, is the outcome of an observation of Mr. J. West Knights. He found that although hydrate of lime would not decompose salt cake in solution in the ordinary manner, yet the decomposition took place in the presence of those phenoloid bodies found in coke-oven oils and the tar from blast furnaces. If we designate those phenoloid bodies as cresylic acid, an alkaline cresylate will be formed together with sulphate of lime. The alkaline cresylate is decomposed by carbonic-acid gas, yielding carbonate of soda and the phenoloid bodies for use over again. I have made many experiments upon the process, and have succeeded in getting almost absolute decompositions and a fine quality of soda crystals. The recovery of the phenoloids is no difficult task and the raw material cheap enough at the present time.

But what I believe to be *the* process of the future is one which has been patented several times over. The reactions are all possible in the laboratory and most of them have been worked on the large scale, but the strings want all drawing together by one hand. I may briefly describe it as follows:—salt is first to be converted into salt cake by the Hargreaves process, the hydrochloric acid gas being condensed in the usual way. Without moving the saltcake from the cylinders, and at the temperature of the finished cylinders, water-gas is passed in until the sulphate of soda has become converted into sulphide, water being formed in the operation, which is condensed out and leaves a concentrated carbonic oxide. The carbonic oxide and excess of hydrogen are then burned into carbonic acid, and water and this gaseous mixture is passed through the sulphide of sodium until it has become converted into carbonate of soda the temperature having been kept sufficiently elevated to prevent the deposition of water on the contents of the cylinders. The reactions taking place in this cycle of operations may be summarised thus:—

I. $2NaCl + SO_2 + H_2O + O = Na_2SO_4 + 2HCl$.

II. $Na_2SO_4 + H_{10} + 5CO = Na_2S + 4H_2O + 5CO + H_2$.

III. $CO + H_2 + O_2 = CO_2 + H_2O$.

IV. $Na_2S + CO_2 + H_2O = Na_2CO_3 + H_2S$.

Finally the $H_2S$ is burned to $SO_2 + H_2O$ and is employed again in the first process.

This process has been patented by several people; none of them have worked out the details, but I believe it will become a method for the manufacture of soda ash which will be as much in advance of ammonia-soda, as ammonia-soda is already in advance of Leblanc alkali, and for the following reasons: In the first place, theoretically the only raw materials employed are coal, water and salt, and it must be remembered that hydrogen and carbon have the lowest combining equivalents of substances at present employed in the chemical industries. All other materials used in the decomposition are subject only to working losses. Secondly there is a minimum of labour, as the product is not handled from the time of charging the salt into the cylinder to that of unloading carbonate of soda; thirdly, there is no waste product, such as alkali waste in the Leblanc process and chloride of calcium in the ammonia soda process; fourthly, the yield of carbonate of soda from the salt must be a nearly theoretical one if the process is to work at all; and fifthly, the temperatures required for the decompositions are gradually decreasing ones, the temperature of the finished salt cake being higher than that of the finished sulphide, while the carbonate of soda is discharged at a comparatively low temperature. When this process is combined with the method of producing chlorine by the oxidisation of hydrochloric acid either with air or with nitric acid it may verily be described as a "fuel" or "carbon" process, and when we consider that the waste heat of the several operations can be utilised in evaporating brine, or in many other ways sufficiently well known, I think it goes without saying that there is more hope for financial success than in any process where the fuel is first burned to raise the steam used in a steam engine to drive a dynamo.

There are, however, several details in present process the study of which would help the alkali maker—I believe it is quite possible to arrange a mechanical salt cake pot from which the hydrochloric acid gas could be evolved comparatively cool and pure and by sending this alone through the cisterns, and the roaster gas direct into the condensers, letting the flow of liquid acid pass through the cisterns for concentration, a much stronger muriatic acid would be obtained, giving a less volume of still liquors to deal with, and giving off chlorine more easily.

Then again, there is certainly need of reform in the operation of absorbing the chlorine by lime. The process generally adopted of leaden chambers is certainly not worthy of the age we live in. I shall be told of course, that many methods have been tried and failures have resulted, but I still retain my opinions. During the absorption by lime, a considerable amount of heat is developed, I once placed a maximum registering thermometer upon the lime in an ordinary powder chamber during the winter, and then again during a hot summer—the results were very instructive:—

| —— | Winter. | Summer. |
|---|---|---|
| | F. | F. |
| Before turning in Cl. | 62 | 70 |
| After two hours | 72 | 100 |
| „ four hours | 75 | 120 |
| „ eight hours | 82 | 122 |
| „ twelve hours | 82 | 122 |

Now the only way the heat of the reaction can escape is by its being imparted to the gaseous contents of the chamber and subsequently cooled by contact with the sides and top. In winter time this is possible, but when the sun is shining fully upon the exposed leadwork the heat is dissipated but very slowly. In cold weather the usual allowance of 280 square feet of lead surface per ton of bleach made per week seems to be sufficient, but it is certainly inadequate in summer. In most of the mechanical contrivances for the absorption of chlorine by lime this heat dissipation has been overlooked. Hargreaves was, I believe, the first to take notice of it, and to provide for its regular abstraction, but his apparatus has never come into use. In an apparatus I was called upon to inspect last year the iron chamber which formed the shell of the apparatus became so hot in twenty minutes after turning in the chlorine that the hand could not bear contact with comfort. If mechanical means could be employed, the packing operation would not be the laborious work it is at present. Witnessing the operation of "packing" carries us back to the days when boys were trained to ascend chimneys for the purpose of clearing them of soot. Contrast that with the method of sweeping chimneys to-day, and you will see the boon to be derived from the adoption of mechanical means for the making and packing of bleaching powder.

I fear I have already devoted too much time to the alkali manufacture, as there are many other articles comprised under the term "heavy chemicals," but this address would hardly be complete if I did not refer to several industrially new products in which a large trade has sprung up during the past quarter of a century in connection with this industry. Monohydrated and anhydrous sulphuric acid; strontium salts; manganate of soda, chromic acid, &c., have all either been started within this period or have undergone such extensive developments as to be called new industries. There are three substances I would allude to specially, viz., the manufacture of chlorates of soda and baryta and the decomposition of alkali waste for the production of sulphur. In 1874 chlorate of soda was not a commercial article in the ordinary sense of the word. Calico printers were using large quantities of the potash salt for the production of aniline black, but the low solubility of this salt led to the demand for a more soluble chlorate. The first chlorate of soda made in quantity was produced by treating a solution of chlorate of potash with tartaric acid which precipitated bi-tartarate of potash, leaving chloric acid in solution, and this was subsequently neutralized with soda ash, forming chlorate of soda. It was then attempted to produce the acid by treating a hot solution of chlorate of potash with sulphate of alumina and sulphuric acid, alum crystallising out and leaving as with the tartaric acid, chloric acid in solution. A third method was the treatment of a chlorate of potash solution with hydrofluosilic acid, but all these methods gave way before the process of treating the calcium chlorate and chloride with salt-cake, separating the liquor from the calcium sulphate by means of the filter-press and further treating by evaporation, fishing and crystallization. When sodium chlorate could be made profitably and in quantity, the manufacture of barium chlorate was an easy matter, the process now followed being an excellent example of the reaction of soluble salts upon each other. I have often thought that these reactions have been too much neglected, and that there is a wide field open to the experimenter. A similar reaction, in which chloride of potassium and nitrate of soda internet forming nitrate of potassium and common salt is well-known as an industrial operation, and now the action of sodium chlorate and barium chloride is an addition to this class of decompositions. Barium chlorate is made by a process devised by one of the members of this section, Dr. Grossmann. Sodium chlorate and barium chloride are dissolved in water and boiled up to 100° Tw. During the evaporation an impure sodium chloride falls, and is fished out after settling awhile, the 100° Tw. liquor being run into cones to crystallise. The degree of completeness of this reaction may be gathered from the following analysis of the mother liquor from the crystals :—

| — | 69½ Tw. at 60° F. | |
|---|---|---|
| | Grms. per Litre. | Eqs. |
| BaO........................ | 136·12 | 1·78 |
| $Cl_2O_5$ ........................ | 150·29 | 1·98 |
| $Cl_2$ as chlorides ............... | 113·80 | 3·10 |
| $Na_2O$ (weighed as $Na_2SO_4$) ... | 242·80 | 3·40 |

This mother liquor is returned to the process whereby the salt is eliminated and the barium chlorate crystallises out.

The manufacture of sulphur by the passage of carbonic acid gas through cream of vat waste is a process of only a few years standing, but it serves to show the rapidity with which all seemingly profitable methods are now developed. To look over the patents concerning this subject alone which have been granted during the past 50 years shows us how very near some of the older experimenters were to the goal, and they would probably have succeeded had they paid sufficient attention to details and taken advantage of all things which science has shown to be theoretically possible.

As regards other heavy chemicals, there have been great advances in the manufacture of all. Taking sulphate of ammonia as an example ; while a ton of sulphate required from 18 to 25 cwts. of fuel in 1876, the same quantity is now produced with less than 6 cwt., the modern stills being more compact, costing less, and needing far less labour than the old style. Amongst other manufactures there is one I should like to mention, specially as it is entirely a growth of the quarter century under review, and had already received considerable development—the production of benzol from coal-gas. Several works have been established for this industry and the result has been to stem the fluctuation in price and the rapidly advancing value of the article, and to enable it to be put upon the market at a price undreamt of in the earlier days of its production. Benzol which had been sold at as much as 12*s*. 6*d*. per gallon has changed hands at as low as 10*d*.

Just before the establishment of this industry, attempts had been made to recover the gaseous products passing away from coke ovens, but at first the nature of the oils recovered was not understood so well as was the case after their investigation had been undertaken by Mr. Watson Smith, then a member of this Section, and published in the Journal of the Society. It has been shown that the products condensed from the ordinary bee-hive ovens differ very considerably from the products from closed ovens, and this applied to both the aqueous portion and the oily product. In closed ovens we get ordinary gas tar and ordinary ammoniacal water, but from the bee-hive the ammoniacal water contains all the ammonia as "fixed" ammonia, and the tar and oil is specially characterised by the absence of products of the benzene series and by its richness in phenoloids other than true carbolic acid. In the products recovered from blast furnaces, the tarry condensate is of very similar composition to that from open or bee-hive ovens, but the ammoniacal water is quite distinct, being entirely a solution of sesquicarbonate (or even more highly carbonated) so that the whole of the ammonia is evolved by simply boiling, without the addition of any lime whatever.

In subjects strictly chemical, the manufacture of cyanides is now occupying a considerable share of attention. I believe there is ample opportunity for any one in this branch of industry, as crude thiocyanates are abundant and cheap, and the use of cyanides is extending for purposes of gold recovery. At present there is no satisfactory way of transforming thiocyanates into cyanides without great working losses, and the industry is one of the few that is not yet overdone with competition.

I would fain say a few words respecting the shale oil industry. Details here have been so much improved that the old methods of distillation are quite obsolete, with improved retorts the production has been increased with less labour than heretofore, and we must all sincerely hope that this very large manufacture will have, in the future, a more prosperous career than has fallen to its lot lately. At one time 22 lb. of sulphate of ammonia per ton was considered a good yield, but the introduction of steam into the retorts has brought it up to over 60 lb., and thus agriculture has been greatly benefited, though it is a noteworthy fact that the continental farmer has so far seen the benefit of using sulphate to a greater extent than our own farmers have.

The flashing point of burning oil has been a very vexed question ; the present limit is, no doubt, too low, and I had hoped that our legislators would have interfered to have protected the consumer from the dangerous oil now in the market. Owing, however, to a wrong interpretation having been placed upon the motives which induced several to agitate for a reform, I understand that the matter is now dropped—I am sorry for it.

During the past quarter of a century the chemical engineers have been exceedingly active, and the forms of apparatus that can now be purchased as stock articles exceeds the ideas of even the greatest enthusiast of 25 years ago. If the fathers of the chemical industry had been in possession of the really beautiful apparatus of to-day, it is more than probable that many of the processes only known by being entered at the Patent Office, would have been successfully developed, and would have left us in our day with fewer unrealised possibilities. The apparatus for the economical production of water-gas is very ingenious, but it is slumbering because it has come before its time and there are many other appliances of which the same may be said. The greatest impetus given to chemical engineering has been, however, through the medium of the coal-tar colours, and the finer forms of this class of machinery are as yet specialities of the foreign manufacturer, as the demand in England is in no wise to be compared to that emanating from the colossal establishments of Germany. But the severe competition we are now passing through in all branches of the chemical industries, will make it a *sine quâ non* that the latest improvements and the newest types of machinery be immediately adopted.

And now I would ask your attention for a moment to consider how new processes, and the recovery of waste products may affect any particular industry. Twenty years ago I began to interest myself in the recovery of the soda used for boiling esparto grass in the paper mill. The quantity was worth recovery, seeing that it amounted to 10 per cent. of real alkali upon the grass boiled, and the question of river pollution even in 1876 was a condition of things to be reckoned with. The quantity of soda and organic matter kept out of the rivers per week by the Porion evaporator cannot amount now to less than 500 tons weekly, the operation leaving a handsome profit to the users. I have no doubt that other systems are keeping out of the water-courses of Great Britain a like amount, but I have no accurate figures concerning them. Though esparto soda-pulp was the half-stuff of the paper-maker 25 years ago, the importation of mechanical wood pulps had commenced, and extensive trials were being made of soda wood-pulp. Soda straw-pulp had just become an established industry, and all these required chlorine for bleaching purposes. Later on, however, Tighlman's sulphurous acid process became established, and now immense quantities are made in England or imported into this country under the name of "sulphite pulp" and this has reduced the quantity of bleaching powder and caustic soda per ton of paper, used in paper mills, to a very marked extent.

The recovery of glycerin from the residues of the soap-maker may fairly be said to be an industry established during the past quarter of a century. The pioneers of this recovery had many failures, which a good knowledge of chemical engineering would have led them to avoid, and the simplicity of the process to-day compared with that of 1876 serves as a very good illustration to show the advances we have made, not only in appliances, but in the supervision and in the method of conducting our operations. One industry begets another, and there is no telling where we may stop. The nitro-glycerin manufacture demanded an increased supply of glycerin, the soap-maker supplied it; the glycerin maker required improved evaporators and stills, which the chemical engineer quickly produced, and the knowledge gained in one industry may often be employed in another, in analogous operations, for, after all, it is only by practical contact with chemical operations on the large scale that facts are impressed in such a way that the knowledge of them and of their application becomes readily available when required. "An ounce of practice is worth a pound of theory," and in no place is this more true than in the chemical industries.

Before concluding, I desire to make serious complaint respecting the teaching of industrial chemistry in this country. I am in a position to plead for the numbers of embryo chemists who have studied long and hard to reach a standard of competence in their profession, not merely as theoretical chemists, but as practical analysts, most of them with a view to entering works of some special kind or other. Now, my complaint is, that but few of them have been so educated as to be of any immediate use to the manufacturer. When a student goes fresh from college to apply for a situation, he is generally met with the enquiry: "Where have you been before?" If he has never seen the inside of a factory, he has very little chance of employment, but the annoying part is, that if he has mentioned a course of study at a foreign university it is a passport at once. One of my young friends applied to a large firm a short time since after five years of English college study, and was told: "We always give preference to a chemist who has been trained in Germany." Is not this an absolute condemnation of existing English methods? And does it not call for immediate change and amelioration? For my own part I am strongly of opinion that sufficient attention is not given to chemical engineering, as it is often found that engineers make better superintendents than do chemists, the latter not being so essentially practical as the former are bound to be. I do not advocate, by any means, a college with a set of vitriol chambers attached, or a complete ammonia-soda outfit, but I do advocate the establishment of a chair of chemical engineering at some one or more of our teaching institutions, which shall be filled with a good practical man, well paid, and giving his whole time to the duties of his chair, without being obliged by force of circumstances to employ his time (to the detriment of his pupils) in giving and preparing expert evidence or of casting about for some other method of increasing his income.

I would have you remember that the first name proposed to be given to our Society was that of the Society of Chemical Engineers, but as this cognomen met with so much opposition from the professional element it was deemed advisable to adopt one not so liable to sectional criticism, and which would embrace every one having an interest in the chemical industries. I think that the name finally adopted, contributed to our success, but I cannot help expressing the opinion that our Society has been saved by the prompt establishment of its Journal, which has been carried on with such vigour, as has been shown by no other scientific journal in the world. I would, in passing, beg you to remember that the practical establishment of our Journal was due entirely to Mr. Ludwig Mond, who, when the subject was hanging fire, proposed and headed a guarantee fund to allow the venture to be undertaken; and so successful did the Society become during the first year, that the guarantors were never asked for a single penny. When I first brought forward the subject of a Journal, and presented two pattern copies, one after the style of the Journal of the Chemical Society, and the other of the size and style of the Athenæum, the question was asked: "What is there to print?" It is easy to answer the question now, by an extract from the General Secretary's letter already mentioned. "The limit of *condensation* is reached so far as the Journal and Patent Literature is concerned," and "if space is still to be saved there is no resource but to *cut down* the sectional matter." Our Journal, gentlemen, takes a leading place amongst the notable features of the past quarter of a century.

Mr. R. F. Carpenter, in moving a vote of thanks to the Chairman, said he regretted this was the last night he would be with them. He thanked Mr. Davis for his generous words. It was his chief regret that his new duties would largely sever him from the Manchester Section, to which he was held by so many pleasant ties. He hoped, however, to be able to be present at some of their meetings in the future.

Mr. Levinstein, in seconding the vote, said he felt sure they were all indebted to the Chairman for an address so full of information. Seeing that he (the Chairman) was not only one of the founders of the Section, but of the Society, he could only congratulate him upon the position he now occupied. He fully endorsed the Chairman's remarks and congratulations to Mr. Carpenter on his departure to fill his new and higher office.

## Nottingham Section.

University College, Nottingham.

*Chairman:* F. J. R. Carulla.
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*Treasurer:* S. J. Pentecost.
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J. T. Wood, 29, Musters Road, West Bridgeford, Nottingham.

SESSION 1895-96.

*Meeting held Wednesday, November 6th, 1895.*

MR. F. J. R. CARULLA IN THE CHAIR.

### CHAIRMAN'S ADDRESS.

The solicitude, care, and expense that are bestowed on the production of the Journal of our Society are matters that have often been prominently brought before us, and most forcibly by our late President at Leeds. That this costly publication, which is the chief aim for which we are banded together, deserves preservation, will, I think, not be denied by anyone who can appreciate its value. Yet whilst such a statement may be perfectly correct, there is evidence enough to show that the possibilty of the disappearance of the earlier volumes is not a contingency to be disregarded. It may be true that the Journal of the Society of Chemical Industry is not quite in such jeopardy as the rain map of the British Isles published by Mr. Joseph Atkinson in 1811 or 1812, of which Mr. G. J. Symons, to his great vexation in 1865, could not obtain a copy for the purpose of a report on rainfall to the British Association. Yet it might well happen that the very profusion of our issues should tend to their destruction, and a note of warning may not be useless. The disposition to regard such publications as that of our Society in the light of ordinary newspapers, and to throw the old numbers aside so soon as the new ones appear, is much greater than would be credited by many persons.

The reality of the risk to which I am referring will best be appreciated by the following facts. Having offered to me, not long ago, some of the early volumes of our Journal by a bookseller, I was willing enough to purchase them, but wishing to make room on somewhat crowded shelves I submitted for sale a number of transactions of other scientific and technical societies, all of modern date, hoping to get an offer, if not for all, for at least some of them. Imagine my surprise on finding that it was impossible to effect a sale at any price. Hence the idea occurred to me that I might obtain the books, and benefit some present owner, who had no use for them. It was soon made evident, however, that if economy were my object the sooner I retraced my steps the better it would be, for one of the first replies that came to hand was from a former member, who held the work in such esteem that, although a monthly number was missing from one of the years, he wanted 50 per cent. more than the bookseller did for a complete set. Ordinarily this might have discouraged me, but the experience only made me more ardent in the quest, as I anticipated some results of interest that might at some fitting time be brought before you, little thinking, however, that you would so honour me as to make it possible to bring the subject forward on an occasion like the present.

Upwards of 600 inquiries were sent out, including those to past members, to executors, and to booksellers in localties where the Journal has been well distributed.

One very salient point in the 31 offers that were made to me was the rare occurence of complete series. Quite two-thirds were of Journals in an incomplete state. You must not conclude, however, that the remaining third of the offers were necessarily of consecutive and complete sets, although they were so regarded by their owners. Without examining the books I should not like to vouch for the accuracy of the statement. What ideas some people entertain of completeness was well shown by a series consisting of the first three volumes, which I bought on that understanding. As the books were bound there was a certain amount of security that they would be right, but to my annoyance I found that the Index to Vol. I. was bound up with Vol. II., and that the other two volumes had no indexes at all. However, everything comes to those who know how to wait, and even such defects will be remedied when the General index is published.

Binding the volumes no doubt affords the greatest security that any particular series will remain complete. Nevertheless, the case of one executor who had Vols. I., IV., V., and VI., Vols. II. and III. having been lent and lost, shows how, even with the greatest care, a valuable collection may be irreparably damaged, for I may state that Vol. II. is much more difficult to make up than Vol. I.

A former member wrote to me saying that he had not been careful to preserve his copy of the Journal, else it would have been at my service; another, that "he never kept them." Clearly such replies indicate the existence of a sufficiently numerous class who, as already stated, regard such publications as ours merely in the light of a newspaper, and whose action, if not checked, may lead eventually to the practical disappearance of some of the volumes. There are those to whom an old book has no value; everything they read must be up-to-date, and they simply regard as wasted any space taken up by old literature, however valuable it may have been in its time. It is certainly an anomaly that the Bible finds a place in many such homes. Doubtless all this is due to the press and hurry of modern work, which seems to leave little opportunity for historical research, even of a technical character—so much so, that it has actually been proposed a statute of limitations should be in operation to prevent a new patent from being invalidated by reason of similar ideas published more than a certain number of years previous to its grant. But, whatever side one may take on such a question, nothing can detract from the value of scientific and technical records.

No more notable instance of the interest that may attach to an old record could be given—especially to the Nottingham Section of this Society, within whose domain, as it were, the memorials of the great Cavendish are enshrined—than what was quoted by Lord Rayleigh and Prof. Ramsay in their paper on Argon, read not very long ago before the Royal Society. The unstinted admiration that these no less eminent investigators bestow on the work of Cavendish tempts me to give the quotation referred to, which is from his paper on "Experiments on Air," in the Philosophical Transactions of 1785.

The passage is this: "Having by this means condensed as much as I could of the phlogisticated air, I let in some solution of liver of sulphur to absorb the dephlogisticated air, after which only a small bubble remained unabsorbed, which certainly was not more than $\frac{1}{120}$th of the bulk of the phlogisticated air let up into the tube; so that if there is any part of the phlogisticated air of our atmosphere which differs from the rest, and cannot be reduced to nitrous acid, we may safely conclude that it is not more than $\frac{1}{120}$th part of the whole."

This residue, Rayleigh and Ramsay do not doubt, contained the gas Argon, with which their name is inseparably connected.

And now let me anticipate the possibility of someone remarking that such old knowledge may be very interesting for the scientific historian or to the antiquary, but that it has little bearing on practical questions. Everyone, however, will be disposed to admit that much old knowledge which may have been resting on the shelves will have been required when it was decided, as in the case of the new cruiser "Minerva," to sheath the under-water portion of the vessel "with teak of a thickness of $3\frac{1}{2}$ inches, which will be coppered, in order that she may be able to keep at sea for a lengthy period without docking for cleaning purposes." (*Daily Telegraph*, September 23, 1895.)

No more remarkable instance of the application of old knowledge to modern requirements could, however, be adduced than that of the Harvey plates—the most recent development in protective armour for ships, and which marks an epoch in our methods of defence. You are probably aware that the process of their manufacture is an application or modification of one of the oldest methods of making steel with which we are acquainted, namely, that of cementation. But to show the remarkable similarity of the two processes, the ancient and the modern, I will take the oldest book that comes to hand, and read you from it an account of the practice of our grandfathers. This is how Mr. J. Holland described the process in 1842:—

"The furnace . . . consists of two oblong receptacles or troughs . . . composed of the best firestone, four or five inches thick. . . . The bottom of the trough is covered to the depth of two or three inches with roughly granulated charcoal of the best quality; upon this as many bars of iron, side by side, are laid as the surface will accommodate; over these a stratum of charcoal, and then another layer of iron. . . . The whole is then covered thickly with river sand or earth that will not easily vitrefy. This is to prevent the charcoal from burning away. Every unnecessary aperture is then carefully closed, and a hard coal fire lighted (the flames of which completely surround the troughs) and kept up with a considerable degree of intensity night and day for about a week, a little more or less, according to the degree of carbonisation required." (Manufactures in Metal.)

Now listen to an account of the Harvey cementation process for armour plate as given in the Journal of the Iron and Steel Institute. (No. 1, 1892, p. 458.) "In this process an armour plate, consisting originally of very mild steel, is cemented in such a manner as to produce a face of very hard steel, the steel becoming gradually less hard from the face towards the unaltered soft back. Such a plate of mild steel, containing from 0·10 to 0·35 per cent. of carbon, is placed upon a bed of finely-powdered dry clay or sand, deposited upon the bottom of a firebrick compartment erected within the heating chamber of a suitable furnace. The compartment is then gradually filled up with granular carbonaceous material, which, having been rammed down upon the plate, is in turn covered with a stratum of sand, and upon this there is laid a covering of heavy firebricks. The furnace is raised to an intense heat, which is kept up for such a period of time as may be required for the absorption, by the metal adjoining the upper surface of the plate, of an additional 1 per cent. of carbon. The temperature of the heating chamber outside the treating compartment is raised to about that required to melt cast iron, and is kept for a greater or less length of time, according to the depth of the stratum of steel which it is intended to charge with an excess of carbon." 120 hours is the time mentioned in one case to charge the surface of a 10½-inch plate with 1 per cent. of carbon.

Does not the modern account read very much like a paraphrase of the older one? And yet by this reflection I am far from wishing to detract from the Harvey process. My intention is only to show what close connection there is between the new and the old, for certainly not in his wildest dreams could the inventor have realised originally the results that have been obtained, true though it may be that all this has been accomplished by the experienced aid of chemists and engineers such as Ellis, Tressider, and others. Anyone familiar with the character of blister steel, which is the product of the old Sheffield cementation process that has been described, must be astounded in view of the results that have been obtained by Harvey's adaptation of the method.

"On December 15, 1894, some Krupp Harveyed nickel-steel plates were tested (at Pola), with results which surpassed those obtained at any previous tests. The plates were only 5½ inches thick, and their resistance proved equal to that of a 9½-inch plate of the older kinds." (Journal of the Iron and Steel Institute, No. 1, 1895, p. 486.) Again, in some trials described in the same article, made at Indian Head, after an 18-inch Harveyed steel plate had been accepted by the authorities, a shot was fired at it with the intention of completely demolishing it. This is described as consisting of a 13-inch Carpenter shell of 1,100 lb., driven by 489 lb. of powder, and discharged with a velocity of 1,810 feet per second, with a striking energy of 25,000 foot-tons, and involving a calculated perforation of 24·88 inches of iron and 19·90 inches of steel, its impact being only 32 inches to the left of the first shot. This mighty blow, directed against a plate that had already been well punished, made a crack 3 inches wide some distance from the top; and the shell, after penetrating 10 inches, was broken to fragments, failing thus to force a passage through 8 inches of the thickness. When it is considered that such a shot would have gone right through 24 inches of the older iron plates the result is indeed marvellous, and shows the unmistakable value of the new material.

There is no necessity to dwell on the obvious lesson that such facts teach, for the importance of a knowledge of what has been done before to all workers, either in the purely scientific or in the technical field, is so well recognised that the cry for an index that shall include all the scientific papers and memoirs that have ever been published seems to become louder as the task becomes more difficult of accomplishment.

But now let me ask what would be the use of a complete index of all scientific papers if these are inaccessible, or if, like some of the books of Euclid, they are altogether lost? We are therefore back again to the question of how to preserve our literature, for indexes will be of little use without it. The scheme I would suggest is the formation of some department, either in our own central offices or by the assistance of a friendly bookseller, where a register should be kept of persons or institutions wishing to buy the Journals of our Society and also of persons who have them for sale. There is no necessity to elaborate details of how this could be done. As someone said, the great thing is to know what to invent, and so the great thing is to know what to organise. Organisation in itself is nothing, for strikes can be organised to the complete loss of a particular trade.

Naturally, by such a scheme the value of the Journals would fluctuate just like shares do now on the stock exchange. With purchasers in the ascendant, prices would rise; with sellers more numerous, their value would fall. As a matter of fact, however, this would hardly be an altogether new experience, for as you may know, both the British Association and the Physical Society have reduced the price of some of their volumes, whilst the Iron and Steel Institute, on the other hand, have thought well to raise the publishing price of the earlier journals. In any case the variations in value brought about by supply and demand would have to be reckoned with in such a scheme as that suggested. The attempt to establish fixed prices would foredoom it to failure. Here, then, is a means for those who look upon the journals simply as newspapers to dispose of them, doing themselves no harm and benefiting others who put a more permanent value on the publications.

That there should not already be such a clearing house, as we might call it, not for our Society alone, but as a general institution for all similar societies, is somewhat remarkable when one considers the large sum that is annually spent simply in the mechanical *production* of the numerous transactions of scientific bodies—a sum that, as you know, does not include the money value of the labour of the authors themselves. How large this total must be will be gathered by glancing at the cost of the publications of a few societies with which our own pursuits are in some way connected.

| Society. | Period. | Yearly Cost. |
|---|---|---|
| | | £ |
| Institution of Civil Engineers......... | 1994-95 | 8,200 |
| The Royal Society ..................... | 1893-94 | 3,450 |
| Chemical Society....................... | 1894-95 | 3,086 |
| Royal Agricultural Society............. | 1894 | 3,051 |
| Society of Chemical Industry ......... | 1894 | 3,048 |
| The Society of Arts ................... | 1894-95 | 2,300 |
| Institution of Mechanical Engineers .. | 1894 | 1,300 |
| Iron and Steel Institute............... | 1894 | 1,150 |
| Institution of Electrical Engineers.... | 1894 | Nearly 1,000 |
| | Total....... | 26,585 |

The figures in some cases are only approximate, as—in order that if used for comparison they may be fair—I have estimated the cost of distribution where it was not clearly indicated in the accounts. Some societies, like our own, include this item under publishing expenses, whereas others put it under the head of postages.

We have thus the imposing sum of 26,585*l.* spent annually by only nine societies in the production and distribution of their publications. Can it be a futile task to attempt to save works put together at such cost and with so much care, from mutilation and oblivion?

Of course these considerations will also to a large extent apply to the productions of the scientific and technical press, which is so active amongst us that scarcely any branch of industry fails to have its representative organ, some indeed having more than one. But some of these again, presumably through the exigencies of modern process-printing, use such thick and heavy paper that in a very short time the accumulated weight of a series renders its possession a matter of no little moment. One must suppose that this thick and heavy paper is considered indispensable, else how do publishers fail to see the danger there is that after the accumulation of a lengthy run a subscriber may be tempted from sheer want of space to cease getting the paper altogether?

I am assuming that no technical journal to which its conductors attach any value is printed on that paper—which should be known by some other name, and which we are told is largely used by the daily press—paper that in a few decades is destined to fall into dust. A serious task is being prepared for the general historian of future ages who may have to examine such crumbling records. I do not know with what justice this breaking up of the paper has been attributed to the use of chloride of lime in its manufacture, seeing that sodium hyposulphite is available to the paper-maker for the removal of the last traces of the chloride. (See Chem. Trade Jour., Vol. XVII., p. 274: "A Visit to the Holyoke Paper Mills.") But whatever the cause of this falling to pieces may be, a problem is here presented worthy of the ingenuity of some of our members.

As it is quite possible that documents may have been printed on paper of this kind that deserve a better fate than that which awaits them, it is interesting to learn that Mr. Edward Curtice has devoted his attention to a new process which has for its object the reproduction of printed matter of any kind without the expense of again setting up the type.

The description of the process as yet available reads very much like that of a style of "printing invented by Baldamus in 1841, brought over to England by William Siemens in 1844, and given up by him in 1846, after which date the process was carried on by an assistant named Appel, on his own account for some years, with varying success, showing it at the International Exhibition of 1851. It was, however, ultimately superseded by other processes, and it does not seem to have ever realised commercially the anticipations of its inventors and promoters." (Life of Sir William Siemens, by William Pole, p. 58.)

Mr. Curtice, however, assures me that his process is quite original, as, having need for such a method of printing in his business, he advertised in various newspapers in France, Germany, and Austria, as well as in the English trade papers, for hands to help him. He had many replies, and at least forty admitted that they could do it. Each of these forty were tried one after the other, but not one was successful, although given from two to five weeks' time. It is clear therefore that there is something original in what Mr. Curtice has done, and also that his labours have not been made easier by the quality of modern paper. In a private letter he says: "We are still working out experiments as to the chemical properties of the various papers printing is done upon. The large amount of wood pulp and lime in the papers, and foreign matters (other than oil and lamp black) in the inks, caused us (and do now) many difficulties." Old knowledge has evidently been of little assistance to Mr. Curtice, and yet we are told that so long ago as "in October 1841 the proprietors of the Athenæum Journal received, from a correspondent at Berlin, a reprint of four pages of their number of 25th September, containing some woodcut illustrations. The copy, both of the letterpress and of the engravings, was so perfect a facsimile that if had reached them under other circumstances they would never have suspected that it had not issued from their own office. They urgently applied for explanation, but all they could learn was that this and similar reprints of other illustrated works had been made by a new process, which was kept a profound secret." This was that of Baldamus, to which Mr. Edward Woods gave the name of "Anastatic Printing" (*op. cit.*).

The invention of Mr. Curtice has therefore all the appearance of the re-discovery of a lost art, and forcibly impresses the lesson that technical records should be preserved so that the labour of discovery may not have to be repeated when methods of working that have been discarded are again for any reason required. From the specimens of the new printing that, by the kindness of the inventor, I am able to lay before you, it will be seen that no harm is done to the originals, and also that both sides of a printed paper can be copied in facsimile. I hope it may be possible eventually to obtain for the benefit of the society precise details of the process and of the chemicals employed.

Returning to the subject of the paper used for technical publications the following comparative table may be of interest. There is no attempt at extreme accuracy in the figures, but they are sufficient for practical purposes. The table gives in parts of a mm. the thickness of a leaf of each of the periodicals named, and also the weight of 100 sq. cm. of the paper in parts of a grm.

| Journal. | Thickness of 1 Leaf in Parts of a Mm. | Weight of 100 Sq. Cm. in Parts of a Grm. |
|---|---|---|
| Journal of the Soc. of Chem. Ind.. | 0·072 | 0·715 |
| Chemist and Druggist .......... | 0·075 | 0·735 |
| Ironmonger .................... | 0·075 | 0·779 |
| Journal of the Chemical Society.. | 0·085 | 0·794 |
| Chemical Trade Journal ......... | 0·087 | 0·765 |
| Zeitschrift für Elektrotechnik, &c. | 0·091 | 0·987 |
| Journal of Gas Lighting ......... | 0·092 | 0·842 |
| Cassier's Magazine.............. | 0·098 | 1·200 |
| Journal of the Society of Arts.... | 0·099 | 0·762 |
| The Lancet (1890) .............. | 0·100 | 0·736 |
| Industries and Iron.............. | 0·112 | 0·926 |

It is interesting to note that the Journal of our Society occupies the first place in the above list, not only because the paper used for it is the thinnest, but because it is also the lightest in weight. In the latter respect, however, comparisons must not be drawn too closely, as the weights are of single sheets, and not averages of a great number like the thicknesses are.

The figures are nevertheless near enough to give a fair idea of what can be done in the way of loading. For instance, were the Journal of our Society printed on the paper used for Cassier's Magazine, the issues of seven years would take up the space that 10 now do, and their weight would be very nearly doubled. We owe thanks to our Publication Committee for their watchfulness in this respect, as it is evident that the important question of the choice of paper must have received their closest attention.

As it is proper on these occasions to consider any ideas that may suggest themselves tending in any way to benefit either the Sections individually or the Society as a whole, I gladly mention a further scheme, the adoption of which should greatly add to the privileges of membership. The idea is one of the least difficult to carry out, and can be put in a few words. It is simply that those members who possess books on chemistry or the allied sciences that they are willing to lend to other members should send their names in, and that a catalogue should be printed for distribution to the members of the Section. Most of us will probably own some books connected with our common studies which, although we may value, yet would be willing to lend out, assuming the probability of their safe return within a reasonable time. Such a scheme is not chimerical, as is sufficiently proved by the fact that a lengthy article on how such a library could be formed and worked appeared in the *Nineteenth Century* of last June under the title of "The Gentle Art of Book-Lending," the idea in that case being to apply the scheme to general literature, the federation being formed by the community at large. Mr. Geo. Somes Layard, the author of the article referred to, had evidently no cognizance of the scheme already put into operation by the Derby Society of Engineers at my suggestion, and a notice of which appeared in the Derby *Daily Telegraph* of October 19, 1894, which reads as follows:—

"A scheme was adopted for the formation of a library to which any members willing to lend books can contribute. Mr. Carulla explained that he could not say whether the idea was original or not. . . . . The scheme provides that the books may only be borrowed by those members whose names are on the last printed list of the Society. Any member wishing to borrow a book must send a letter and stamped envelope to the owner of the book for reply as to when and where he may call or send for it. A catalogue of the books with the names of owners will appear in the annual report."

Mr. Layard's article is, however, altogether too kindly to dispose one to enter into any polemics with him as to the origination of the scheme. I gladly welcome him as a co-worker in a field which, as he well shows, is practically fallow, but which is fertile with wonderful possibilities.

It will be at once obvious that such a scheme can be more easily applied to technical than to general literature. I mean because of the little trouble that is likely to be given to the owners of such works, which would not be frequently borrowed. Yet what a satisfaction it would be, say to a member of our Section, to know that any particular work on a subject in which he might become interested was readily accessible to him. That such privileges are valued every country fellow of the Chemical Society will bear me out in saying. The ability to borrow books, by rail or parcel post, from the library at head-quarters, is certainly not one of the least valued advantages of belonging to the Chemical Society. The only difference between the two cases would be that we would borrow from each other instead of from a central library, but the formalties would be practically the same. One must ask for the book wanted by letter, and pay the carriage both ways, in the case of the Chemical Society, and this is precisely what would have to be done by borrowers if the scheme now proposed were carried out.

In the catalogue of the Derby Society of Engineers no attempt has been made to divide the books into categories. All the books whose names are printed are on absolute loan. You may know, however, that the Chemical Society, like the authorities of other libraries, has many books that can only be seen on the premises, and are not lent out. That such distinctions would be unnecessary in our case is highly probable, and it is more to the purpose to learn how small a risk of loss is run under a strict system, where particular rules are enforced for the return of books at their proper time. Mr. Layard mentions that "only two volumes were missing in ten years after the introduction of dockets in the Dublin University library; at Ghent, out of 16,307 volumes lent, only 20 were lost or injured, and these were all replaced by the borrowers; whilst at Bruges, during 19 years, only one was lost and one damaged." These facts go some way to show that the risk of losing our books would be very small, assuming the adoption of proper checks to control the effect of carelessness on the part of borrowers. No one could complain of this. You may remember that Cavendish was so precise in his habits that when he took a book from his own library in Dean Street, Soho, he entered his name as an ordinary borrower. Although this practice has been characterised as an extreme one (Picton: "The Story of Chemistry," p. 214), when it is considered that he lent books to scientific men on recommendation, it may have been very wise and proper to strictly adhere to this check even when taking books out for his own use. It would indeed be no great hindrance to a Section to engage to pay for any lost books if their value could not be recovered from the borrowers. Such a practice would open the book cases of many timid owners who otherwise might object to lend their treasures.

I have been greatly encouraged to make the suggestions embodied in the foregoing remarks by a leading article which appeared in the *Publishers Circular*, reviewing the proposal made by Mr. G. S. Layard, and to which allusion has been made. No authority could be better entitled to a hearing as to how such a scheme might affect the publishing trade. The editor heartily wishes success to the scheme, adding: "Whatever tends to foster a taste for reading deserves support, since blessings will follow, not merely to those who buy and read, but to those who write, publish, and sell. We shall be glad to hear more of Mr. Layard's co-operative scheme of reading." No one is better aware than chemical manufacturers (especially alkali makers) of the dire effects of changes in processes and methods. It was therefore with some diffidence that I, as an outsider, ventured on suggestions that, if carried out, must in one case greatly alter, to the benefit of our members, the distribution of the Journals; and in the other, much facilitate the circulation of valuable books that we may possess. If these desirable objects can be attained, not only without injury, but rather with benefit to the publishing trade, it is a pleasure indeed to me to have been able to propose the schemes by which they can be brought about. That their realisation would materially increase our privileges as members of this Society, and therefore probably be the means of largely adding to the number on our lists, would appear certain.

Before concluding, permit me to congratulate Birmingham on the proposed re-establishment of a section of this Society in that city. That the place where Roebuck invented leaden chambers, and where sulphuric acid was first manufactured by their means; the town in which Priestley passed eleven years of his life, and where his memory is so revered; the district from whose midst Boulton and Watt revolutionised the industries of the world by contributing the power for their present immense development, and where Watt was the first, as is now admitted, to establish the true composition of water; the resting place of William Murdock, the first maker of a locomotive and the practical inventor of gas lighting; the birthplace of the Siemens' process by which that miracle of modern engineering, the Forth Bridge, has been made possible—that such a locality with a fame so incomparable should long remain without a Section of the Society of Chemical Industry, is an anomaly impossible of long continuance. That, like the Phœnix, a new Section may arise with renewed vigour from the embers of the old one, will be the hope of everyone who wishes well to our Society. No Section outside of London can have better facilities for contributing valuable communications to our transactions than one in Birmingham, crowded as that city is with varied and numerous industries, most of them connected with some branch of chemistry in which this Society is interested. That the revived Section may make all the progress the opportunities of its situation justify us in expecting, and that its proximity to ourselves may be the means of mutually helping each other rather than be the occasion for any rivalry, unless of a friendly character, will, I feel sure, be the hope of you all, as it is most sincerely my own.

Prof. F. Clowes moved a vote of thanks to the Chairman for his address.

Mr. J. M. C. Paton, in seconding the vote, said how constantly the importance of knowing what had been done before cropped up in business, and gave instances of anticipation in the case of patents. He considered that few could so index a journal that readers could find what they required without much cross-indexing. In the case of an engineer's office he knew in Nottingham, where there were 20,000 large drawings and probably double that number of smaller ones, after some 12 to 15 years indexing was found to be quite ineffectual. He thought that any indexing on a large scale would be liable to the same objection. If one took what one conceived to be the salient idea of any title from the Society's Journal, it was quite likely that one would not find it in the index under that particular word, and further search would be necessary under other parts of the title.

The Chairman, in reply to Mr. Paton, said that he thought that there should be something in the nature of a statute of limitations in regard to patents, so that anticipation should not be able to be pleaded if the idea had been out of use for, say, 30 years.

## Yorkshire Section.

Room 6, Queen's Hotel, Leeds.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*

H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
T. Fairley.
N. Farrant.
A. Hess.
W. Leach.
W. Mc'D. Mackey.
A. G. Perkin.
C. Rawson.
Geo. Ward.
Thorp Whitaker.

*Hon. Local Secretary and Treasurer:*
H. R. Procter, Yorkshire College, Leeds.

SESSION 1895-96.

December 2nd:—
- Messrs. H. R. Procter, F.I.C., and H. Towse. "Notes on Some Indian Kip Cures."
- Mr. A. G. Perkin, F.R.S.E. "Note on a Method of Subliming Alizarine."
- Messrs. J. Pronde and W. H. Wood:—
  1. "On the cause of Change in Colour of Soaps containing Indigo."
  2. "On the Solubility of Indigo in Oils."

January 27th:—
- Messrs. F. W. Richardson, F.C.S., and H. B. Aykroyd. "On Sulphides, Sulphites, Thiosulphates, and Sulphates, their Estimation in Presence of each other."
- By the same Authors. "On Cachou de Laval."

*Meeting held at the Yorkshire College, Leeds, on Monday, November 4th, 1895.*

MR. T. FAIRLEY IN THE CHAIR.

## SPONTANEOUS COMBUSTION OF OILS SPREAD ON COTTON.—II.

BY W. MCD. MACKEY.

In the paper I gave last session (Vol. XIII. 1164) I pointed out, as the results of experiments on olive and cotton-seed oils, that the free fatty acids derived from these oils are more liable to develop heat, and eventually to fire when spread on cotton, than the neutral oils from which they have been derived. I also pointed out the important bearing this has on insurance risks, as recovered cloth oils and distilled oils consist in the main of free fatty acids.

In this paper I deal mainly with a simple form of apparatus I have devised for the rapid determination of the liability to spontaneous combustion of oils spread on cotton, and in Table I. I give the results of a number of experiments on cotton-seed and olive oils, on the free fatty acids derived from them, and on various trade oleines. The apparatus consists of a piece of iron-wire gauze (24 to the inch) 5 inches square, made into a roll, the two edges that meet slightly overlapping. A piece of copper wire twisted round the roll serves to keep it in shape. Inside the roll are placed 7 grms. of cotton wool. I use the ordinary bleached cotton wadding—previously soaked with 14 grms. of the oil to be examined. The roll containing the oily cotton wool is placed upright in a water-jacketed oven, the water having previously been brought to the boiling point; a thermometer, the bulb of which is inserted in the cotton wool, protrudes through a loosely fitting cork in the opening at the top of the water-oven to allow the temperature to be read. The door of the oven having been shut the water is kept boiling and the temperature noted from time to time. I have, so far, adopted no special apparatus to regulate the air supply; it finds its way in by the usual opening in the oven door.

Table I.

| No. | A.<br>Oil examined. | B.<br>Temp. in 1 hr. | C.<br>Temp. in 1 hr. 30 min. | D.<br>Temp. in 2 hrs. | E.<br>Maximum Temperature. | | F.<br>—— |
|---|---|---|---|---|---|---|---|
| | | ° C. | ° C. | ° C. | ° C. | h. m. | |
| 1 | Cotton-seed oil fatty acids (pure) ..... | 151 | 215 | .. | 215 | 1 25 | .. .. .. .. |
| 2 | Olive oil fatty acids (pure)............ | 104 | 210 | .. | 335 | 1 50 | .. .. .. .. |
| 3 | ,, ,, ,, another sample | 113 | 194 | .. | 208 | 1 40 | .. .. .. .. |
| 4 | ,, ,, ,, (same as 3) | 98 | 108 | 203 | 272 | 2 30 | .. .. .. .. |
| 5 | "95 % oleine"...................... | 102 | 192 | .. | 212 | 1 44 | Free fatty acids, 56·5 %. Unsaponifiable, 4·9 % |
| 6 | ,, ,, (same as 5) ........... | 102 | 203 | .. | 218 | 1 35 | ,, ,, ,, ,, ,, ,, |
| 7 | "98 % oleine"...................... | 110 | 180 | .. | 180 | 1 30 | ,, ,, 98·1 %. |
| 8 | Cotton-seed, pure ..... | 100 | 164 h. m. | .. | 234 | 1 35 | ,, ,, 0·5 %. |
| 9 | ,, ,, ..... The same | 111 | 272 (1 25) | .. | 272 | 1 25 | ,, ,, ,, |
| 10 | ,, ,, ..... sample | 109 | 224 (1 15) | .. | 224 | 1 15 | ,, ,, ,, |
| 11 | ,, ,, ..... | 111 | 225 (1 35) | .. | 279 | 1 40 | ,, ,, ,, |
| 12 | Cotton-seed oil (pure)................ | 105 | 228 (1 25) | .. | 228 | 1 25 | ,, ,, 0·0 %, (neutralised with soda and washed). |
| 13 | White Australian oleine.............. | 97 | 104 | 116 | 230 | 2 25 | .. .. .. .. |
| 14 | ,, ,, (same as 13) .. | 96 | 103 | 113 | 308 | 3 10 | .. .. .. .. |
| 15 | Oleine................................ | 95 | 102 | 194 | 228 | 2 7 | Free fatty acids, 7·4 %. Unsaponifiable, 20·7 % |
| 16 | "93 % oleine" (French) ............. | 95·5 | 100 (1 35) | 104·5 | 142 | 3 15 | ,, ,, 63·5 %. |
| 17 | "97 % oleine"....................... | 95 | 98·5 | 100·5 | 181·5 | 4 14 | ,, ,, 75·1 %. ,, ,, 22·9 % |
| 18 | Australian oleine ..................... | 94·5 | 98 | 105 | 190 | 3 0 | ,, ,, 90·3 %. ,, ,, 2·2 % |
| 19 | Belgian oleine ........................ | 92 | 94 | 94 | 297 | 5 20 | ,, ,, 90·0 %. ,, ,, 6·4 % |
| 20 | Oleine ................................ | 94·5 | 96 | 97·5 | 105·5 | 5 15 | ,, ,, 4·7 %. ,, ,, 35·8 % |
| 21 | Olive oil ............... | 96 | 97·5 | 97·5 | 102 | 4 15 | ,, ,, 0·0 %, (neutralised with soda and washed). |
| 22 | ,, (same as 21) .. From same sample | 95·5 | 97 | 97·5 | 103 | 4 0 | ,, ,, ,, ,, ,, ,, |
| 23 | ,, ............... | 95 | 97 | 97 | 104 | 5 0 | ,, ,, 1·0 % (roughly). |
| 24 | ,, (same as 23) .. | Not noted | Not noted | 96 | 103 | 5 30 | ,, ,, ,, ,, |
| 25 | 75 % olive fatty acids (same as 3 and 4) mixed with 25 % American mineral. | 95 | 98 | 100·5 | 111·5 | 4 45 | .. .. .. .. |

Column E is not of much importance. In some cases the cotton fired, the thermometer being taken out when the temperature was observed to rise rapidly; in other cases, when probably firing would have taken place could the air have penetrated with sufficient rapidity to support active combustion, the temperature, after a rapid rise, began to go down, the experiment then being stopped. In column E. I have given the last recorded or the maximum temperature attained in each case.

The columns of importance are C. and D. Any oil that disappears from column D. (*i.e.*, has either fired or attained a maximum temperature of over 200° C. before the expiration of two hours) may be regarded as dangerous; indeed, the first 15 experiments I consider may be taken to show that the oils in question are dangerous.

Nos. 16, 17, 18, and 19 are doubtful. The Belgian oleine, No. 19, for instance, though not rising above 100° C. in 4 hours, fired in 5 hours 20 minutes.

Nos. 20, 21, 22, 23, 24, and 25 may be taken as types of safe oils, the temperature in these cases not rising much above that of the bath, and, after 4 to 5 hours, declining.

The last, No. 25, is curious as showing how a very dangerous oil, as shown in Nos. 2 and 3, becomes safe when 25 per cent. of a heavy hydrocarbon oil is mixed with it.

Table II.

| No. | Oil examined. | Temperature in 1 Hr. | Temperature in 1 Hr. 30 Mins. | Temperature in 2 Hrs. | Maximum Temperature. | | |
|---|---|---|---|---|---|---|---|
| | | ° C. | ° C. | ° C. | ° C. | Hrs. | Mins. |
| 1 | Cotton seed fatty acids (pure) .................. | 120 | 157 | 150 | 160 | 1 | 40 |
| *2 | Cotton seed fatty acids (pure) (same as 1)...... | 143 | .. | .. | 143 | 1 | 0 |
| 3 | Olive oil fatty acids (pure)...................... | 92 | 114 | 134 | 152 | 2 | 45 |

* In this case 7 grms. oil were used—not 14, as in all the other experiments.

With regard to the concordance of the results obtained, it may be mentioned that I have given here the results of all the experiments made with this apparatus; thus Nos. 2, 3, 4—5, 6—8, 9, 10, 11, 12—13, 14—21, 22, 23, 24 form groups by which the reliability of the methods may be estimated.* Nos. 2, 3, and 4 show the greatest discordance.

On Table II. I give the results of three experiments on the same lines, but substituting animal wool for cotton.

Most of the experiments, the results of which I have given, were entrusted to Mr. R. E. Middleton, and my thanks are due to him for the care with which he carried them out.

### Discussion.

The Chairman (Mr. T. Fairley) said that he thought that the quantity of material used in Mr. Mackey's experiments was rather too small to give a good idea what would happen in practice. He, himself, had made similar tests by heating in a large covered pan immersed in hot brine, four ounces of cotton wool placed in a porcelain vessel and treated with the oil, and watching until inflammation took place. Referring to Mr. Mackey's observation that neutral oils were safer than those containing free fatty acids, he believed that Messrs. Price had a patent for adding soap or alkali to oils in order to diminish their liability to spontaneous combustion.

Dr. J. Lewkowitsch thought that it would be better to have a second thermometer surrounded by cotton wool in the air-bath in order to get more certainty as to the effect produced by the oxidation of the oil, and to define as accurately as possible the conditions under which the tests were to be made in order that the results of different observers might be comparable. He thought that it would be preferable to make the tests (as he had done) by exposing large balls of oiled wool to the air at the ordinary temperature.

Mr. F. W. Branson said that a small, regulated circulation of air through the bath might be advantageous.

Mr. C. Rawson agreed with this suggestion, and pointed out that a regular circulation could readily be obtained by means of an air-pump or aspirator. He considered that a nearer approximation to the conditions obtaining in actual work would be obtained by using a small quantity of oil in proportion to the amount of wool. He asked also whether any relation existed between the inflammability of the oils and the heat evolved by them on treatment with sulphuric acid.

Mr. H. R. Procter made a similar inquiry regarding the iodine numbers of the oil.

Mr. T. Holgate said that in his experience heaps of oily cotton waste frequently took fire during exposure to the sun, especially when moistened with rain, and that the fires always began at the outer edges of the heap, and were not preceded by any warning smoke or smell.

Mr. J. Wardle said it was a fact that since the imposition by the insurance companies of the more stringent regulations regarding cloth oils now in force the fire waste in woollen mills was diminished both with regard to the number and the severity of fires, but it was not known whether this very welcome improvement was due to the better oils required. Mr. Mackey's tests had confirmed the fact already known to the companies that an admixture of mineral oil diminished the liability to spontaneous combustion, yet the insurance companies objected to the use of hydrocarbon oils for other reasons. The mineral oils seemed to spread themselves about a building much more than the ordinary fatty oils, and not only facilitated the spread of a fire, but, from the volumes of black smoke evolved by their combustion, rendered it very difficult to extinguish. In one case within his experience a fire was traced to a sheet of blended material having been left in contact with a steam pipe.

Mr. T. Pemberton said that when olive oil was used with mungo the material became greasy in the pack, and hard. He thought that since the insurance companies had introduced the new regulations mineral oils of higher flash point were used for diluting the black oils.

Mr. W. McD. Mackey, in reply, said that he had wished to devise a method which would give a result in two or three hours, while Mr. Fairley's experiments lasted as long as two days. He wished also to keep the method as simple as possible, and thought that it was better for each experimenter to standardise, as it were, his own apparatus, by taking cotton-seed oil, for example, as a standard of a dangerous oil and neutral olive oil as a standard safe oil. In reply to Mr. Rawson, he explained that the fatty acids mentioned in the table had been prepared by himself from the same oils as were used in the experiments given. He had not made any experiments as to a connection between the heating of the oils by oxidation and Maumené's test or the iodine numbers. Referring to Mr. Wardle's remarks, he said that it was difficult to determine the relative importance of the different factors which had to be taken into account in forming an opinion as to the safety of an oil, but he hoped that his method would furnish some information as to one of them.

## Scottish Section.

*Chairman:* John Clark.
*Vice-Chairman:* J. B. Readman.
*Committee:*

G. Beilby.
R. Cox.
J. Gray.
D. Harris.
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T. L. Patterson.
Sir R. Pullar.
H. Rose.
P. Rottenburg.
E. C. C. Stanford.
D. R. Steuart.

*Hon. Secretary and Treasurer:*
J. Stanley Muir, Chemical Laboratory, The University, Glasgow.

SESSION 1895-96.

December 3rd.—Mr. R. Tervet. "Destructive Distillation."

*Meeting held in the Philosophical Society's Rooms, 207, Bath Street, Glasgow, on Tuesday, November 5th, 1895.*

DR. JOHN CLARK IN THE CHAIR.

### CHAIRMAN'S ADDRESS.

I take this opportunity of thanking you for the great honour which you have conferred upon me by selecting me as Chairman of the Scottish Section of this Society. In the past this position has been held almost exclusively by manufacturing chemists, and I trust that the change which has been made on this occasion will not have a prejudicial effect on the prosperity of the Section.

It is now fully 14 years since the Society of Chemical Industry was inaugurated in the interest of the chemical trade, and for the purpose of bringing together those interested in the various manufactures in which chemistry plays an important part. This object has been very much assisted by the number of sections established throughout the country, and by the Journal of the Society, which not only gives a faithful record of the work of the different sections, but at the same time provides members with an outline of the advances in the various departments of chemical industry throughout the world. That such a society was very much wanted is clearly demonstrated by its large and ever-increasing membership, amounting to about 3,000, and by the condition of its finances. I am also pleased to observe that arrangements have been made to increase the usefulness of the Journal by the issue of a Collective Index, embracing the whole contents from the first Annual General Meeting to the close of the current year, which will greatly facilitate reference and render its stores of valuable information more readily accessible. The Scottish Section has added largely to the membership of the Society, and contributed many valuable papers to the Journal. These contributions have not been quite so numerous during the past year as formerly, but I ascribe this to natural causes, and just as periods of depression in trade are followed by increased prosperity, so I trust the deficiency of papers in one year will be made up by subsequent superfluity.

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* Olive oil neutralised (by addition of soda and washing, or by dissolving any fatty acid in alcohol) and the free fatty acids derived from the same sample might be used to standardise an apparatus. Cloth oils would range themselves between these extremes.

The Society of Chemical Industry was started in 1881, and in the same year the present Alkali and Works Regulation Act came into force. This may be a mere coincidence, but it is just possible that the passage of the Act had something to do with the formation of the Society. This Act is much more stringent than the preceding Act of 1863, and in addition to the enforced registration and inspection of all alkali works, and a variety of others enumerated, all new works before they can be started require a certificate from the inspector under the Act that the plant and apparatus are efficient for carrying out the objects of the Act, and in all works the inspector has power to insist on the best practical means of preventing the discharge of noxious and offensive gases, or for rendering them harmless, which is really of more importance than the limits which have been fixed for the escape of certain noxious gases. There can be no doubt that legislation in this direction was very much required in the public interest, and has resulted in a very considerable diminution in the escape of acid vapour. According to the Alkali Inspectors' Report for 1894, the average escape from all the works in England and Scotland is 0·089 grain of hydrochloric acid per cubic foot of gases passing up the chimney, with an escape of 1·736 per cent. of the HCl produced, and 1·266 grains of sulphuric acid per cubic foot of gas from the sulphuric acid chamber. These figures are very satisfactory, and indicate that the average escape is very much below the requirements of the Act, which are 0·2 grain hydrochloric acid per cubic foot, with an escape of 5 per cent., and 4 grains sulphuric acid per cubic foot from the sulphuric acid apparatus, but it is questionable whether these figures include the low-level escapes, which are generally responsible for the complaints which are occasionally made against chemical works.

Apart from their unpleasantness and possible injury to the health, acid gases are objectionable on account of their injurious action on the vegetation of the neighbourhood, but the chemical works are not the only nor in all cases the worst offenders in this respect. Mr. Davis has calculated that glass works, using 50 tons of salt cake per week, evolve 30 tons of sulphuric acid, whereas chemical works using 120 tons of pyrites and 100 tons of salt, evolve only 3 tons of sulphuric acid and 2 of HCl, even allowing for the maximum escape under the Act; and yet the glass works do not come within the scope of the Alkali Act.

It must also be borne in mind that coal smoke contains a considerable quantity of acid in the form of $SO_2$ and $SO_3$, the amount, according to the late Dr. Angus Smith, varying from $\frac{1}{4}$ to $\frac{1}{2}$ grain per cubic foot, and when a large quantity of coal is burned within a limited area the smoke contains sufficient acid to render it injurious to vegetation. Black smoke is more disagreeable and more objectionable than smoke which has been rendered colourless by burning, as it pollutes our dwellings and obscures the light, and it is considered by some to be more offensive to vegetation, as the black portion prevents the $SO_2$ from escaping so readily, and seems to retain a certain amount of acid; but even with complete combustion the amount of acid is not reduced, nor its injurious effect on vegetation entirely counteracted.

The production of black smoke, or, as it is commonly called, the smoke nuisance, has engaged the attention of various authorities for a number of years, and in 1890 a committee of experts was appointed to inquire into the best means of procuring an abatement, but as yet very little progress seems to have been made. This, however, is not surprising, as the subject is one of great difficulty. So far as the consumption of coal for the production of steam in boilers is concerned the introduction of mechanical appliances are more or less effective in the prevention of black smoke, but even if these were universally adopted the remedy would be very partial, as there are certain kinds of furnaces and household fires to which mechanical stokers could scarcely be applied. Various remedies have been suggested for the latter, but unless our citizens are prepared to use gas fires or burn coke in suitable stoves the problem of getting rid entirely of black smoke in large cities seems to me to be as far from solution as ever.

Considerable progress has been made in the direction of purifying our rivers, and the authorities in Glasgow are to be congratulated on the success which they have achieved in the treatment of the sewage of the eastern portion of the city, whereby about eight million gallons of foul and stinking sewage are daily converted into a clear, inodorous effluent of good colour by precipitation with sulphate of alumina and lime, and subsequent aeration.

Analyses show that in addition to the matter in suspension about two-thirds of the organic impurities are removed from the sewage by this treatment. The effluent is not chemically so pure as the water of the Clyde as it reaches Glasgow, but it looks well, and there can be no doubt that when the whole of the sewage and refuse discharges of the city and suburban districts are purified to the same extent, the unpleasant odour and filthy appearance of the river below Glasgow will disappear. Considering the quantity of sewage which is discharged into the Clyde all along its course, the purity of the river as it reaches Glasgow is very remarkable. I have had occasion to make a number of analyses of water from the Clyde at different points above Glasgow, and although the samples sometimes contained a notable quantity of black matter in suspension, due to coal-washings, I have never been able to detect any appreciable quantity of sewage. The following analysis of water from the Clyde below Cambuslang, made in 1894, may be taken as a fair specimen :—

| | Grains per Gallon. |
|---|---|
| Free or saline ammonia | 0·011 |
| Albuminoid or organic ammonia | 0·015 |
| Oxygen absorbed by oxidisable organic matter | 0·290 |

The sample contained a little black matter in suspension, which accounts for the proportion of oxygen absorbed. This condition of the Clyde is due to the natural process of purification which is constantly going on in our rivers. Formerly this was regarded as a species of oxidation, and attributed to the presence of dissolved air or oxygen, but it is now believed to be due to the action of microscopic organisms.

As an example of the rapidity with which sewage matter disappears in streams, I would lay before you the analyses of two samples of water from the River Irvine which I made some time ago, No. 1 taken immediately below Kilmarnock, and No. 2 about five miles further down the river:—

| —— | No. 1. Grains per Gallon. | No. 2. Grains per Gallon. |
|---|---|---|
| Free or saline ammonia | 0·560 | 0·014 |
| Albuminoid ammonia | 0·146 | 0·012 |
| Oxygen absorbed by organic matter | 0·800 | 0·320 |

The re-appearance of fish in the docks below Glasgow seems to show that the purification of the sewage of the eastern portion of the city has already effected considerable improvement in the purity of the river, although the improvement is not very visible to the eye, but this may be due in some measure to the discoloration produced by the sulphide of calcium of alkali waste liquor or drainage on the iron salts discharged from different works.

The total quantity of iron liquor discharged from the copper and galvanising works is estimated at about 300 tons per day, containing about 12 tons of iron. The iron in this liquor exists mostly in the form of ferrous chloride, and it has been found at Manchester that when the waste iron liquor is mixed with the sewage it facilitates the precipitation process, and when present in sufficient quantity the further addition of iron salt is unnecessary. The ferrous salts, however, are not so suitable for the precipitation of sewage as their corresponding ferric salts, as they do not yield such a clear effluent; and the ferric salts are, in my opinion, inferior to the basic ferric salts, as they require more lime to neutralise the acid.

It has been shown by Barrow's experiments with Salford and other sewages that basic perchloride of iron, which he calls clarine, is an excellent sewage precipitant, and this has been fully corroborated by experiments with Glasgow sewage on the large scale made on four consecutive days at the Bridgeton sewage works in November last with basic perchloride of iron made by McCulloch's process. The following are the results of my analyses of average samples of the sewage and effluent :—

Analyses of Sewage and Effluent during Four Days on which McCulloch's Basic Perchloride of Iron was employed as Precipitant at Bridgeton Sewage Works.

Grains per Gallon.

| Date. | Oxygen Absorbed. | | Albuminoid Ammonia. | | Calour (Loch Katrine = 10). | | Oxidisable Organic Matter removed per Cent. | Albuminoid $NH_3$ removed per Cent. | Colour removed per Cent. |
|---|---|---|---|---|---|---|---|---|---|
| 1894. | Raw Sewage. | Coke Effluent. | Raw Sewage. | Coke Effluent. | Raw Sewage. | Coke Effluent. | | | |
| November 7....... | 1·57 | 0·42 | 0·42 | 0·175 | 44 | 25 | 73 | 58 | 43 |
| „ 19....... | 2·20 | 0·54 | 0·59 | 0·224 | 50 | 33 | 75 | 55 | 34 |
| „ 20....... | 1·61 | 0·58 | 0·51 | 0·168 | 40 | 36 | 64 | 67 | 10 |
| „ 21....... | 1·66 | 0·60 | 0·54 | 0·224 | 31 | 24 | 64 | 60 | 22 |
| Average ...... | 1·76 | 0·53 | 0·49 | 0·197 | 41 | 29 | 69 | 60 | 27 |

These results prove that basic perchloride of iron can purify sewage quite as well as the sulphate of alumina now in use, and the method patented by McCulloch for the manufacture of basic ferric salts from their corresponding ferrous salts, on the principle of the sulphuric acid process, by churning a neutral solution of the ferrous salt with a minute quantity of peroxide of nitrogen and a large volume of air, offers a simple and inexpensive means of converting the waste iron salts, which are at present discharged into the river, into excellent sewage precipitants, and thereby considerably cheapening the cost of purification. I am not aware of the exact proportion of iron salt used in the above trials, but some laboratory experiments which I made seem to indicate that oxide of iron and alumina can replace each other weight for weight.

Judging from the works registered under the Alkali Act, the number of works in which chemical processes are carried on seems to have increased during the 14 years in which this Society has been in existence, but the chemical trade generally has not been in a very flourishing condition, and some of our manufactures have been carried on with little or no profit.

Since the introduction of ammonia soda the salt decomposed by that process has gradually increased till, in 1894, it reached 361,603 tons as against 434,298 tons decomposed by the Leblanc process, or, in other words, about 47 per cent. of the total production; and as it is generally considered that the life of the Leblanc process depends mainly on the manufacture of bleaching powder, each new chlorine process as it makes its appearance is anxiously scanned to ascertain whether it is likely to become a serious opponent. Great things were expected from the Weldon-Pechiney and Donald processes, but the progress of the former is slow, owing perhaps to the expensive nature of the plant, and the latter has been a failure so far; but there is another modification by Scott and Vogt for producing chlorine from nitric and hydrochloric acids which is free from several of the objections to the Donald process, and which, judging from experiments on a small working scale, gives promise of greater success. Efforts have also been made to supersede both the ammonia and Leblanc processes by the decomposition of salt by electricity. Such a process seemed to be almost impracticable in consequence of the great difficulty of separating the products of the reaction, but a considerable quantity of soda and bleach has been already produced by Castner's modification, the main feature of which consists in the use of a moving body of mercury which forms an amalgam with the sodium and prevents its recombination with the chlorine. The future of this and other electrical processes will be watched with keen interest.

Whatever may be the outcome of the alkali struggle, it is to be hoped that the further production of alkali waste will soon be rendered unnecessary, as the enormous heaps in the neighbourhood of the Leblanc Works are very objectionable, and cause considerable trouble in consequence of the drainage to which they give rise for many years after the waste has been laid down.

The rivalry in the alkali trade gives us some idea of the dangers to which chemical manufacturers are exposed, and these assume a national importance when they are accompanied by the possibility of some industry being transferred to a foreign country. Formerly our natural advantages gave us such complete command of the chemical trade of the world that it required no special effort to retain it, but the history of the coal-tar industry has opened our eyes and proved to the astonishment of many that natural advantages can be counterbalanced by scientific knowledge and skill properly applied.

The success of the Germans in the production of coal-tar products undoubtedly originated in their superior facilities for acquiring a knowledge of organic chemistry, and the value of this branch of chemistry has been so far recognised in this country that some additional special courses of lectures on organic chemistry are now delivered at various institutions, and very recently the Schorlemmer Organic Laboratory has been opened in Manchester; but at the time when Hoffman and Perkins discovered the beautiful coloured derivatives of anilin the teaching of organic chemistry was very limited. In Glasgow, at any rate, it was confined to about half a dozen lectures at the end of the session, and I think I had the honour, in 1868, while I was assistant to Prof. Penny in Anderson's College, of delivering the first course of day lectures devoted exclusively to organic chemistry. It is not, however, by mere theoretical knowledge, but by scientific research, and the practical application of our theoretical knowledge to some special department, that discoveries will be made, and the influence of organic chemistry will be felt on the manufactures of the country.

If our position in the domain of organic chemistry can be judged by the number of original papers on organic subjects which are published in this country, we are far behind some of our neighbours. This is largely due to the greater number of workers on the continent, and to the system which prevails in various German universities of insisting upon some original research as one of the requirements for a science degree, on the ground that it is of more value than mere examination.

My experience of students has been that they are not much disposed to undertake original investigations, and I am of opinion that it is only by the appointment of professors who will devote themselves exclusively to organic chemistry, and by offering inducements to students to engage in original research, that we can hope to regain some of the ground that has been lost.

I would also add, that the future of the chemical trade in this country would be much more secure if our manufacturers would avail themselves more largely of the services of highly-trained chemists who are capable of undertaking original research instead of being satisfied with mere ability to perform a certain amount of routine work, on the ground of economy, as there can be no doubt that this is a short-sighted policy and one which is bound in the long run to prove a national misfortune.

The distillation of shale affords a striking example of what can be accomplished by the well-directed application of science. For a number of years this industry has been in a critical condition, and it is only by the introduction of improvements, and careful attention to details, that our manufacturers have been able to compete with the superior natural advantages of the American and Russian producers. It is generally admitted that the burning-oil made from shale is safer than petroleum, on account of its higher flash-point, and in view of the number of lamp accidents which take place annually, it is to be hoped the Government will soon recognise the necessity of adopting the recommendation of the Society, and raise the flash-point of burning oils to 100° F., as any step in this direction would undoubtedly be a benefit to the public.

There is another industry, viz., sugar refining, which is in an unhealthy state, owing to foreign competition and the development of beet sugar. In a report on the progress of the sugar trade made in 1888, Dr. Giffin showed that whilst in 1853 beet sugar formed only one-eighth of the total production of the world, in 1887, it amounted to nearly one-half, and that not only had the importation of beet sugar into the United Kingdom largely increased, but what is of still greater importance to our home industry, this increase was chiefly in the form of refined beet sugar. The exportation of this refined beet sugar is largely due to what is known as the bounty system, which enables the continental beet sugar manufacturer to export a certain proportion of his sugar at a profit even when the price is very low, and renders it impossible for our refiners to compete on equal terms. No doubt this has resulted in cheap sugar, which is a benefit to the public and to those manufactures in which sugar is used, but it has had a very serious effect on our refining industry. A few words regarding the position in Greenock will render this more apparent. In 1881 there were 11 refineries in Greenock with an average capacity for treating 465 tons of sugar per week, and the actual amount of sugar refined during the year was 264,805 tons. At present there are only six refineries of an average capacity of 600 tons per week, and two others, making about 500 tons of brewing and other sugars. Since 1882 four refineries have been dismantled and the machinery broken up as old metal. Another refinery which has been kept in repair and ready to start for the last 17 or 18 years is being dismantled, and a work capable of refining 1,000 tons per week was stopped last year, but is ready to start again should a favourable opportunity occur. These facts, for which I am indebted to Mr. T. L. Paterson, indicate very plainly that sugar refining in this country is in an unhealthy state, and this condition is due solely to the system of bounties to which I have alluded. As the exponents of free trade we cannot, and do not object to foreign competition, but it seems only reasonable that something should be done to prevent an important industry from being crushed by the unfair advantages which foreign governments give to our competitors in the form of bounties.

One of the most interesting features of the chemical trade is the large increase in the production of sulphate of ammonia which is so important to agriculture. Many attempts have been made to convert the nitrogen of the air into ammonia, but none of these have been commercially successful, and this valuable fertilizer is still obtained as a bye-product from coal and shale. In 1886 the total amount of sulphate of ammonia produced in the United Kingdom was 106,610 tons, and this quantity has been increased to about 160,000 tons. According to the alkali inspectors reports these quantities were obtained from the following sources:—

| — | 1886. | 1894. |
|---|---|---|
| | Tons. | Tons. |
| Gas works | 82,480 | 113,634 |
| Iron works | 3,950 | 10,075 |
| Shale works | 18,080 | 32,891 |
| Coke and carbonising works | 2,200 | 3,448 |
| Total | 106,610 | 160,018 |

The increase is largely due to improvements in the method of extracting ammonia from shale, and to the recovery of the ammonia contained in the gas from iron works, but the total amount is a mere fraction of what is annually lost in the combustion of coal.

In addition to ammonia there is another nitrogen compound, viz., cyanogen, produced by the destructive distillation of coal. The presence of cyanogen compounds in coal gas is attributed—

1. To the action of ammonia on red-hot carbon which produces cyanide of ammonium and hydrogen or marsh gas—

$$C_2 + 4NH_3 = 2NH_4CN + 2H_2, \text{ or}$$

$$3C_2 + 8NH_3 = 4NH_4CN + 2CH_4.$$

2. To the action of carbonic oxide on ammonia at a high temperature, $CO + 2NH_3 = NH_4CN = H_2O$.

3. To the action of carbon disulphide on ammonia at a high temperature, $CS_2 + 2NH_3 = NH_4CNS + H_2S$.

From these reactions it would appear that the cyanogen exists in the coal gas exclusively in the form of cyanide and sulphocyanide of ammonium, but if this is the case it behaves peculiarly, for although cyanide of ammonium is readily soluble in water very little of it is removed by scrubbing the gas with water. This is said to be due to the decomposition of the cyanide of ammonium into carbonate of ammonia and free hydrocyanic acid by the carbonic acid, which is always present in crude coal gas. Leybold found cyanogen equal to about 4 lb. of ferrocyanide in 10,000 cub. ft. of gas, of which nearly 95 per cent. was in the gas after it left the scrubber. When lime is used to purify the gas the cyanogen is lost, and if iron is used the cyanogen is converted largely into sulphocyanide, in which form it is not so readily available, but when the gas, after it leaves the scrubber, is brought into intimate contact with precipitated oxide of iron, suspended in an alkaline solution as recommeded by Knublauch, the cyanogen is easily obtained as ferrocyanide, almost free from sulphocyanide. A considerable quantity of ferrocyanide has been made from coal gas in this way, and I understand one large gaswork produces about a ton per day. This process is so simple and inexpensive that it will probably receive more attention in the future, and I should not be surprised if cyanogen, like ammonia, came to be considered a valuable bye-product in the manufacture of coal gas. The various methods of producing cyanides have been engaging a considerable amount of attention in consequence of the increased demand for the extraction of gold and the importance of reducing the cost, and this desirable result would probably be hastened if each gaswork would convert the cyanogen in the gas into ferrocyanide, which could easily be done without interfering with the ordinary process of manufacture.

## New York Section.

*Chairman:* Alfred H. Mason.
*Vice-Chairman:* Arthur McGeorge.
*Committee:*
T. Lynton Briggs.
G. T. Bruckmann.
V. Coblentz.
H. Comer.
H. Endemann.
S. W. Fairchild.
Jas. Hartford.
E. G. Love.
T. Lungwitz.
John McKesson.
Thos. J. Parker.
J. H. Wainwright.
D. Wesson.
*Hon. Treasurer:* R. C. Woodcock.
*Hon. Local Secretary:*
Hugo Schweitzer, 159, Front Street, New York, U.S.A.

*Meeting held on Monday, 11th November 1895.*

MR. A. H. MASON IN THE CHAIR.

## THE HISTORY OF MY PROCESS OF NICKEL EXTRACTION.

BY LUDWIG MOND, F.R.S.

Since I promised to your chairman, shortly after my arrival, to read a paper to you before leaving this country, I have considered what subject I could bring before you that would be of sufficient interest, considering that I am unprepared to illustrate it by experiments or diagrams.

I have decided to give you an account of the history of my process of extracting nickel from its ores, as an instance of an investigation undertaken in pursuit of pure science, which has led unexpectedly, in a few years, to an important industrial application.

I have often been asked by scientific men how I came to discover nickel carbonyl. I will tell you the story.

Soon after I had satisfied myself that the ammonia-soda process was far cheaper than the Leblanc process for producing carbonate of soda pure and simple, it became evident to me that a time would come when the Leblanc process would produce carbonate of soda as a by-product of the bleaching powder manufacture, which it would have to dispose of at any price it would fetch. I therefore undertook a series of experiments with the object of producing bleaching powder as a by-product of the ammonia-soda process. You all know that the usual form of this process consists in treating a solution of common salt in which caustic ammonia has been dissolved by carbonic acid, with the result that bicarbonate of soda is precipitated while a solution of ammonium chloride is formed. In the ordinary course of things this solution of chloride of ammonium is distilled with caustic lime, yielding gaseous ammonia, which returns to the process, and a solution of calcium chloride. Some investigators had endeavoured to produce chlorine from the chloride of calcium obtained by evaporating these solutions; others had proposed to substitute magnesia for the lime in distilling the solution of ammonium chloride, and to produce chlorine or hydrochloric acid from the $MgCl_2$ obtained by evaporating its solution.

I gave my attention to producing the chlorine direct from the ammonium chloride, separated from the solution, in which it is originally obtained, by refrigeration.

Ammonium chloride when vaporised is, as is well known, dissociated into ammonia and HCl; thus, if the vapour of $NH_4Cl$ is passed over a metallic oxide this oxide is converted into a chloride, and the ammonia passes on together with the steam formed by the reaction.

I found that nearly all metallic oxides, with the exception of the alkalis and alkaline earths, and even a large number of metallic salts, were acted upon in this way by $NH_4Cl$ vapour, and that a large number of the metallic chlorides so formed would give up their chlorine and be re-converted into oxides by submitting them to the action of air at a suitable temperature. I found that of all the substances investigated oxide of nickel yielded the best results, and that the next best were obtained by magnesia mixed with a certain amount of chloride of potassium. For obvious reasons I preferred the latter in working the process industrially, which has now been successfully at work for several years on a very considerable scale in our Winnington Alkali Works.

In developing this process I had to construct a plant for volatilising $NH_4Cl$, which I found an extremely difficult problem, as the vapour of this substance not only acts on oxides and salts, but also violently attacks the large majority of metals. I succeeded in lining iron vessels with glazed tiles in such a way that they would withstand this action, but I required valves for changing from the current of ammonium chloride vapour to hot air and *vice versâ*, which had to be very tight to prevent a large loss of ammonia.

I found that nickel was one of the few substances suitable for the construction of these valves, and that it was not at all attacked by ammonium chloride vapour. On the laboratory scale these nickel valves worked perfectly, but when I applied them on a manufacturing scale I found them to be acted upon and very soon to become leaky. The faces became covered with a black crust, which, on examination, was found to contain carbon.

The source of this carbon seemed mysterious, the only difference between the work on the small scale and that on the large scale being that on the small scale we swept the ammonia out of the apparatus before admitting the hot air by means of pure $CO_2$, while on the large scale we used the gases from a lime kiln, containing a few per cent. of CO. This led us to study the action of CO on nickel.

We found this metal to have the remarkable property of splitting off carbon from CO at a moderate heat, transforming it into $CO_2$.

About the same time I was engaged with my collaborator, Dr. Langer, in trying to find a method for eliminating the CO from hydrogenous gases, which we wanted for use in our gas battery. We tried to avail ourselves for this purpose of the remarkable property of nickel we had just discovered, and found to our satisfaction that by passing gases containing hydrogen, CO and a certain quantity of steam over finely-divided nickel at a temperature of 400° C. we could completely convert the CO into $CO_2$, obtaining its equivalent of hydrogen, which was just what we wanted.

This led to a more elaborate study of the action of CO upon nickel, with a view of determining whether a definite compound of nickel and carbon was formed. We found that a small quantity of nickel decomposed a very large quantity of CO, so that we could obtain a product containing only 15 per cent. of nickel and 85 per cent. of carbon, the nickel in which was only partially soluble in acids.

In the course of these experiments finely-divided nickel, formed by reducing nickel oxide at 400° C. by hydrogen, was treated with pure CO in a glass tube, at varying temperatures, for a number of days, and was then cooled down in a current of CO before it was removed from the tube. In order to keep the poisonous CO out of the atmosphere of the laboratory, we simply lit the gas escaping from the apparatus. To our surprise we found that, while the apparatus was cooling down, the flame of the escaping gas became luminous and increased in luminosity as the temperature got below 100° C. On a cold plate of porcelain put into this luminous flame, metallic spots were deposited similar to the spots of arsenic obtained with a Marsh apparatus; and on heating the tube through which the gas was escaping we obtained a metallic mirror, while the luminosity disappeared.

At the first moment we thought that there must be an unknown element in our nickel giving rise to the production of this effect, but when we examined the mirrors we found them to consist of pure nickel. As it seemed so very improbable that so heavy a metal as nickel should form a readily-volatile compound with CO, we purified our CO as perfectly as possible, but still obtained the same results.

We now endeavoured to isolate this curious and interesting substance by preparing the nickel with great care at the lowest possible temperature, and treating this nickel with CO at about 50° C., and thus we gradually increased the amount of the volatile nickel compound in the gases passing through the apparatus. We absorbed the excess of CO by cuprous chloride solution, and thus obtained a residue of several cubic centimetres, containing the volatile nickel compound mixed with a little nitrogen. By passing this gas through a heated tube we separated the nickel, obtaining an increased volume of gas, and found in this a quantity of CO corresponding to about four equivalents for one equivalent of nickel.

By further improving our method of preparing the finely-divided nickel and by passing the resulting gas through a refrigerator, cooled by snow and salt, we at last succeeded in liquefying this compound, and were able to produce it with ease and facility in any quantity we desired.

Thanks to the kindness of Dr. Torry, of Harvard University, I am able to show you a small quantity of this nickel carbonyl, which he prepared within a few days after he saw my first publication on the subject. It is a colourless liquid boiling at 43° C. and which solidifies at −25° C., forming needle-shaped crystals. It is soluble in alcohol, petroleum, and chloroform; it is not acted upon by dilute acids or alkalies, and can be readily distilled without decomposition. But on heating the gas to 150° C. it is completely dissociated into its components, pure CO being obtained and the nickel being deposited in a dense metallic film upon the sides of the vessel in which it is heated.

For a long time, while we were engaged in investigating the physical and chemical properties of this interesting substance—which was without parallel in the history of chemistry—and while we were endeavouring to obtain other similar compounds with other metals, I had myself no suspicion that this substance, which was until then only obtainable by very careful and elaborate laboratory manipulations, should ever become available for industrial purposes. But the longer we went on preparing it for our investigations, the more easy we found it to prepare it in quantity, after we once knew exactly the best conditions for so doing. After that I came to the conclusion that it ought to be possible to make use of the ease with which nickel is converted into a volatile gas by CO, while practically all other metals, and notably cobalt (which is so difficult to separate from nickel by other methods), was not acted upon by this gas, for separating nickel from cobalt and other metals on a manufacturing scale, and for obtaining it in a very pure state.

I erected a plant on a large scale near Birmingham, and after several years of hard work, during which the apparatus has had to be several times reconstructed so as to fulfil all the conditions of this rather delicate process, we have succeeded in our object, and now have for some time produced nickel at the rate of a ton and a half per week from the Canadian nickel copper matte imported into England. This matte, which contains about 40 per cent. of nickel, and an equal quantity of copper, is carefully roasted to drive out the sulphur as far as possible, and is then subjected to the action of hydrogenous gases, either water-gas or producer-gas, rich in hydrogen, in an apparatus which is called the "reducer," the temperature of which is under perfect control, so that 400° C. is never exceeded. From this apparatus the substance, which is now reduced to the metallic state, is taken through air tight conveyors and elevators into another apparatus, called the "volatiliser," in which it is subjected, at a temperature not exceeding 80° C., to the action of CO gas.

This apparatus consists of an iron cylinder, divided into numerous compartments by shelves, and provided with a stirring device, which gradually moves the material from the top to the bottom, while the CO gas passes through in an opposite direction. The CO gas, which should be as rich as practicable, we prepare by passing pure $CO_2$ through incandescent coke: the pure $CO_2$ we make by passing the flue gas of a boiler or of a fire through a solution of carbonate of potash, and subsequently boiling the solution. The CO gas, charged with nickel carbonyl, leaving the volatiliser, is passed through a series of tubes or chambers, heated to about 180° C., in which the nickel is deposited in various forms, according to the speed of the gas current, the richness of the gas, and the existing temperature. The CO gas, thus almost completely freed from the nickel, is taken back by means of a blower into the volatiliser, where it takes up a fresh quantity of nickel and is constantly used over and over, so that the quantity consumed is limited to the very small amount of unavoidable loss through leakage of the plant.

The material under treatment is repeatedly taken from the volatiliser to the reducer and *vice versâ*, by means of air-tight conveyors and elevators, until the amount of nickel volatilised begins to fall off. It is then roasted again to remove the sulphur, which it still contains, and is treated by sulphuric acid to dissolve part of the copper. The residue, containing nickel, some copper, and the other impurities of the matte, is again subjected to the previously described treatment until the nickel has been extracted as far as practicable; and the ultimate residue, still containing a few per cent. of nickel, is melted up into matte again.

I have here a few samples of the various forms in which the nickel is obtained by this process. If the nickel is allowed to deposit slowly at a carefully regulated temperature, it can easily be obtained from the gas as a coherent metallic film, so that it is possible to coat any substance which can stand heating to 150° C. with a perfect covering of metallic nickel, and also to make articles of metallic nickel for direct use. I have here a knife-handle made in this way, and the finest delineaments of a mould can be perfectly reproduced in this manner.

I believe that the great facility with which hollow nickel goods can be made in this way, which at present either cannot be made at all, or only by the use of very powerful hydraulic machinery, will give a great impetus to the manufacture of nickel utensils for domestic purposes, the use of which is so very desirable from a sanitary point of view. The cost of the process, if carried out on a sufficiently large scale, is, as you will readily perceive, inconsiderable, as the consumption of material is very small, and the expenditure consists mainly in carefully superintending the various operations.

What gives me the greatest satisfaction in relation to this investigation is, that I believe I have succeeded in working out a purely chemical process for extracting nickel from its ores, which will be cheaper and simpler than any electrolytic process that can be used for the same purpose. Of late years, there has been a tendency to take chemical operations out of the hands of the chemist and to thrust them into those of the electrician, in the belief that the simplest way of obtaining a chemical change consists in the pulling apart a chemical compound by electrical energy, and subsequently putting its constituents together again in the forms that are desired. I know there are many chemical operations which will always be carried out to much greater advantage by the old chemical methods, and I have no doubt that newer methods will be found, of which nobody thinks at present, based upon purely chemical reactions, such as the process which I have brought before you to-night, which will effect the chemical changes we want to produce at a smaller expense of energy than can be done by electrolysis.

### Discussion.

Prof. Peter P. Austen asked what other metals had been experimented upon with reference to the formation of carbonyls.

Mr. Mond stated that every metal at his disposal in England had been subjected to such experiments. Iron alone gave small quantities of a carbonyl. The infinitesimal quantities of this compound in water-gas cause the deposition of iron on the hoods of the Welsbach burner, thus reducing their effectiveness very considerably.

Messrs. C. F. Doremus and C. F. Chandler referred to experiences with similar iron deposits.

## A CASE OF SO-CALLED "SPONTANEOUS COMBUSTION."

BY M. ALSBERG.

For a number of years the lead compound of eosine (tetrabromfluoresceine), on account of their beautiful colour, have been very extensively used, especially the mixtures with red lead ($Pb_3O_4$). Owing to their comparatively low price, they have supplanted the mercuric sulphide, vermilion, and hence are known as vermilion substitutes. At three different times it happened that such mixtures of red lead and eosine lake took fire while they were being transferred from one cask to another. In vain did I look for an explanation, although once I strongly suspected a burning cigar or match to have caused the fire, but could prove nothing, all the less so as it was impossible to save any of the contents of either barrel, owing to the extreme rapidity of the combustion. When the second "spontaneous combustion" occurred, I thought that the man employed in re-packing had used a piece of gas-pipe to ram the material tight, and might have struck a protruding nail, thus giving rise to a spark; but he stoutly denied using the pipe. When the third fire took place I was fortunate enough to remove and save the barrel from which the lake was being transferred, and not being a believer in "spontaneous combustion," in the ordinary sense of the phrase, I immediately thrust my hand into the remainder of the lake, and found it quite cold, as I had expected; thus the combustion of the eosine by the oxygen of the $Pb_3O_4$ in the original package was excluded. On further scrutiny, the presence of a lighted cigar or match, as well as that of an iron pipe, was found to be absolutely out of the question—it was necessary to look elsewhere for an explanation. This was found in a burning gas-jet, distant about 5 ft. from the barrel into which the lake was being put. The latter has the very disagreeable property of rising in a cloud of dust whenever exposed to even a slight draught, and this dust readily took fire from the lighted jet. The $Pb_3O_4$, of course, acted as a carrier of oxygen, and the combustion, once started, set the whole mass afire with lightning rapidity.

The case presents many analogies with fires in flour-mills or starch-works, only the eosine lake did not have to depend on atmospheric oxygen, but found all that might be required to cause a serious conflagration in a condensed form in the $Pb_3O_4$ present, since there was 5 per cent. of lake and 95 per cent. of $Pb_3O_4$.

The rapidity of combustion in this case is equalled, if not surpassed, by that of the ferroferricyanides of iron, which frequently take fire when being powdered. Here, a spark, generally produced by a piece of iron (a nail), is the cause of ignition, the atmosphere furnishing the oxygen.

That the gas-jet was the cause of ignition is proved by the fact that since the substitution of incandescent electric lights for gas no "spontaneous combustion" has taken place.

### DISCUSSION.

Messrs. H. ENDEMANN and JAS. H. STEBBINS reported cases of spontaneous combustion of copper and iron lakes of log-wood, for which they could not account.

Prof. PETER P. AUSTEN stated that he had heard of such combustions, but never had experienced any himself.

Mr. H. M. RAU emphasised the importance of studying these occurrences, since these lakes were so extensively used in the arts.

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## THE UTILISATION OF WASTE ACID FROM THE PARTING OF GOLD AND SILVER.

BY JOHN ENEQUIST.

### *Method of Parting Gold and Silver.*

For this purpose there are two methods in use, the nitric-acid method, which we will not touch upon here, as being foreign to our subject, and the sulphuric-acid method as practised by most of the refiners in this country and abroad. This process is carried out at the United States Assay Office in New York City as follows:—The base metal, so-called, which is received from mining companies, brokers, and other outside parties, is melted, each lot by itself, and its contents of silver and gold ascertained by careful assay. Each assay is checked by being run in triplicates by three different assayers. These tests should agree, or else the metal is adjudged not uniform in character and is re-melted. After the fineness and the weight of each lot is ascertained no further attempt is made to keep them separate, but each customer receives an amount of fine gold or silver corresponding to the assay after subtracting the charges for melting and refining.

The metal is now made up into batches of suitable size for the further refining treatment. For this purpose the metal, if too fine, is alloyed with sufficient silver to bring the relative correspondence between the silver and the gold to 2 to 1. These proportions being established, the metal is poured on to shallow cast-iron trays provided with a number of projecting points on the bottom, leaving the metal when cold in slabs about $\frac{1}{8}$ of an inch thick, 12 ins. wide, and 12 to 14 ins. long, and with a number of 1-inch holes, perhaps 2 ins. apart from centre to centre. In that shape the metal is easily acted upon by the sulphuric acid, and the former method of granulating has therefore been abandoned as unnecessary. These sheets or slabs are now put into a cast-iron kettle, hemispherical in form, and perhaps 4 ft. in diameter, heated by a coal fire, and provided with a lead-covered hood in which there is a charging door and an outlet pipe for carrying off the acid fumes. These fumes are condensed in an apparatus on the next floor above and are drawn there by means of an aspirator. Along with the metal charged into the pot there is run in the required amount of sulphuric acid, using the spent acid from the second series of pots, where the last of the silver is extracted from the gold. It is therefore not pure sulphuric acid that is used here, as that is reserved for the more energetic action required in dissolving out the last traces of silver contained in the gold. The proportion of acid varies, of course, according to the composition of the base metal. The boiling is continued from four to six hours, when the liquid is allowed to cool and settle. After sufficient settling, the clear solution is syphoned into tanks of water, and the gold left in the pot is ladled out, washed, and allowed to drain, and after that charged into the second series of pots, similar in construction to the first series, and is here boiled with concentrated sulphuric acid, which operation is sometimes repeated several times in order to give the gold the necessary fineness, which is from 997 to 998 parts of pure gold in 1,000 parts of metal.

The clear liquid from these pots is run off and used, as above stated, in the first series of pots. The gold is taken out, washed until free from acid, and then drained, pressed, and dried, and finally melted with bone-ash and nitrate of soda in the melting department.

The liquid drawn from the first series of pots, which is substantially a solution of sulphate of silver accompanied by smaller quantities of the sulphates of the other metals contained in the base metal, is diluted to about 20° B., and the silver precipitated in the same tank by means of copper slabs, which cover the bottom and line the sides and ends of the tank. There are no copper strips or slabs distributed in any other part of the tank. The silver precipitated here necessarily becomes mixed with sulphate of lead, and will also contain any metals present which are precipitated by copper in a sulphuric acid solution. When the precipitation is complete, which is known by testing with common salt, the solution of sulphate of copper is pumped into concentrating vats for further treatment, and the silver is collected from the sides and the bottom of the tank, and washed until free from acid, then pressed in a hydraulic press, the outlet pipe from which is provided with a muslin bag on the end of it to prevent any metal from being carried away by the liquid removed by pressing. When coming from the press the cakes are dried in an oven and are then melted with bone-ash and nitrate of soda until sufficiently fine, which in this case is 999.

The sulphate of copper solution just mentioned is concentrated by means of a steam coil to 40° B., and is then settled and allowed to crystallise after being drawn into suitable coolers. When the crystallisation is complete the mother-liquor is run off into a storage tank, and constitutes the waste acid that forms the main subject of this paper.

In the storage tank there is more or less crystallised sulphate of copper separating all the time, which is collected when found convenient, while the liquor itself is sold to the chemical manufacturer who supplies the sulphuric acid. These first crystals obtained are too acid to be marketable, and are therefore redissolved and the solution recrystallised. The strength of the solution in this case is only 30° B., and the mother-liquor from this is concentrated again to 30°, and again recrystallised, which process is repeated once more, so that the mother-liquor from the recrystallised sulphate of copper is concentrated twice before being sent to the waste acid storage tank as unfit for further treatment. When we say unfit here, we must bear in mind that the Assay Office is situated in the very heart of the down-town district of New York, and what is a suitable and a paying treatment in a chemical works 5 or 10 miles outside of New York City, may be a very expensive and altogether unsuitable treatment in this case.

Only one grade of blue vitriol is made—that is, no attempt is made to separate the crystals obtained on the "hangers," which are much larger and in every way superior to the ones found on the sides and the bottom.

### *Composition and Properties of the Waste Acid.*

The strength of this acid, as ascertained from innumerable tests, varies from 40° to 44° B. at 60° F., being somewhat stronger in the summer time than in the winter. Its average strength is probably 42° B. By analysis of a sample of 40½° B., it was found to contain 43½ per cent. real sulphuric acid in the free state, and 4·31 per cent. anhydrous sulphate of copper, corresponding to 6·73 per cent. blue vitriol, and bringing the total per cent. of sulphuric acid up to 46·14 per cent.

By long standing this acid will continue to deposit some blue vitriol, even in the tanks where stored while awaiting further treatment in the chemical works. In its original condition it is somewhat difficult to dispose of, as, owing to its percentage of copper, very few consumers of acid are able to use it directly. Even the fertiliser manufacturers seem unwilling to use this acid in large quantities, and the only application of any extent has been for the manufacture of acetic acid. In that case it may be used mixed in certain proportions with stronger acids, so as to produce a mixture strong enough to decompose the acetate of lime. This mode of utilising the acid is of course very unsatisfactory, as it wastes all the copper.

We will now describe how this acid may be put to a more satisfactory use, partly without and partly with concentration.

### *Utilisation without Concentration.*

The above method of using it for decomposing acetate of lime comes under this head, but we will not touch upon that matter any further, as the acid is really in no way refined in that case. The methods we shall here touch upon are (1) production of copperas, or sulphate of iron, with or without recovery of the precipitated copper; (2) precipitation of the copper by electrolysis. The first of these methods was practised at the Phœnix Chemical Works, which for many years furnished the acid to the United States Assay Office, and, according to contract, was compelled to remove the waste acid. The method here pursued, was, however, far from rational, as no attempt was made to recover the copper, but only the acid was utilised. The process here was to pump the acid into large, round, lead-lined tanks, provided with a lead coil placed in the centre of the tank and used for heating the contents.

The acid was diluted to 10° or 12° B., and treated with scrap iron until a strength of 40° B. was attained. It is readily understood that no steam was used in the beginning of the operation, but during the latter part some steam had always to be admitted to the coil to keep the reaction going. If the liquid was allowed to cool, the copperas would crystallise upon the scrap iron and the reaction stop. Some free acid, amounting to 6 per cent. or 8 per cent., was generally left in the liquid, as it was found that a sufficiently good grade of copperas could be thus obtained without the yield in any way suffering. To neutralise the free acid entirely was not found to be necessary or even advisable, except in special cases where an exceptionally neutral salt was demanded. The solution, after settling, was run into peculiarly constructed crystallising tanks, which it is not necessary to here describe. As to the precipitated copper, it was allowed to accumulate in the dissolvers or corroders, so-called, and became here mixed with all the insoluble impurities from the scrap iron or tin scrap. The latter was sometimes used after having been first submitted to a process of boiling and heating to redness in order to remove the tin and solder. No attempt was made to utilise the mixture of copper and undissolved scrap metal, &c., but the same was taken out and thrown on the waste dump. To have utilised the copper as well as the acid in this process, the copper should first have been precipitated as cement copper by means of iron straps suspended in the liquid or in some other suitable way, and the acid solution of sulphate of iron drawn off from the precipitated metal should then have been further neutralised with scrap iron in a manner suitable for the production of copperas. As to the cement copper, it would of course be treated in the same way as done with similar metal at the mines.

The second method, or the electrolytic treatment, is a method of which I can give no practical details, as I have not attempted to thus utilise this raw material; but from a laboratory point of view, I can see no reason why this method should not be perfectly satisfactory wherever cheap voltage can be obtained. In its results it is nearly identical with the first method, only we here obtain, instead of an acid solution of sulphate of iron, a nearly pure sulphuric acid, which can hardly contain any other metals than iron, zinc, and aluminium, and may-be a little nickel. As to the copper here obtained, it should be very pure, as the ordinary impurities in electrolytic copper cannot be present here, having been already precipitated by the copper along with the silver.

### *Utilisation with Concentration.*

When first called upon to deal with this waste product—which had always been a source of considerable annoyance, and was looked upon as a nuisance to be got rid of in one way or another by the chemical manufacturers supplying the concentrated sulphuric acid to the Assay Office—I very soon found that a very large percentage of the sulphate of copper contained would separate very readily by simply concentrating and subsequently cooling the acid. When concentrating the acid to 62° B., in the laboratory, which gave the acid a temperature of 290° to 300° F., and then allowing the acid to cool slowly, it was found that the acid remained clear down to 260° to 270° F., at which temperature a small deposit of anhydrous sulphate of copper commenced to form. Upon further cooling, no great separation was noticed until 120° to 130° F., when a very abundant formation of crystals took place. Upon further cooling, smaller quantities of crystals were separated right along, and it was found that this continued for a considerable time after the surrounding temperature had been reached. The following observations were made upon another lot, also concentrated to 62° B.:—At 260° to 270° formation of crystals commenced, and the solution became cloudy as it cooled further; at 170° F. it was perfectly clear, and green in colour, and remained so down to 140° to 150°, depositing very little of a fine powder between those temperatures; upon further cooling the same phenomena were observed as with the first lot, the colour of the liquor becoming lighter all the time; after two days' standing, the colour was that of "brown vitriol" or Glover-tower acid.

The crystals, when collected and drained, and dissolved in water, gave a clear blue liquid, which separated sulphate of copper crystals very soon. It was found when dissolving the anhydrous salt in water that the temperature rose considerably; and once or twice, when shaking the clear solution while yet warm, the salt suddenly separated to a very large extent; and when, after some standing, the liquid was filtered and the filtrate cooled, no further crystallisation took place. I am somewhat at a loss to explain this sudden separation when experimenting on a small scale, and have never noticed anything similar when working upon a larger scale in the factory. In this case it was found that a further addition of sulphuric acid, if large enough, caused a further separation of crystals, while without this addition no crystals separated, as above stated, in the filtered liquid.

The concentration in the factory was carried out on the pans over the sulphur burners, and also on lead pans heated from below, where the acid travelled in the same direction as the flame. Some crystals separated already when the acid had reached 50° B. (in the second pan), probably at a temperature considerably below the boiling point of that acid, as no precipitation was noticed in hot 50° acid in the laboratory. More crystals separated as the acid gained in strength while traversing the pans further removed from the fire, where the temperature fell somewhat at the same time the strength rose. In the two last pans (the series being composed of six pans measuring about 6 ft. by 6 ft. by 6 ins. high) there was a very abundant separation. The acid was run off from the last pan at 60° B. to 61° B. (tested cold) into settling tanks or "coolers." It is useless to attempt to cool this acid in anything except an open gutter, as a coil would be choked up in a very few minutes. There is, however, no necessity for making any provision for cooling, as the temperature of the acid leaving the last pan with the above arrangement would never exceed 200° F. It is of course necessary to clean the pans from time to time, as the anhydrous sulphate of copper would otherwise cover the bottom with a non-conducting salt layer. It was found necessary to clean the two last pans at comparatively frequent intervals, while the two next pans could run two to three times as long without any special attention.

The concentrated acid was left as long as possible in the coolers, and was then pumped into a storage tank or drawn off into carboys and drums, for sale, or for use in the works. As too long standing causes a weakening of the acid on the surface, it is better to run the acid off at 61° than at a lower strength, so that when ready for use it will test 60° B. The coolers are cleaned out from time to time, and the anhydrous salt thus obtained, together with that from the pans, is left on a lead-covered platform, and the acid drained off allowed to run back into the cooler. As above stated, the acid contains less copper the longer it has stood, but need not hold over 1.5 per cent. of copper if standing 60° B. and thoroughly cooled. Its colour is always light brown, like Glover-tower acid, from the presence of iron and organic matter, and it contains about 2 per cent. less real acid than contained in the regular commercial article of the same strength. The difference between total and free sulphuric acid is, however, less than $\frac{1}{2}$ per cent., and its deficiency in acidity is therefore not entirely owing to metallic salts; probably the presence of some salts of alkalis or alkaline earths and organic matter accounts for this. This point I have never investigated thoroughly.

This 60° acid can be sold to fertilisers, and is fit to use for many other purposes. I have myself used it for making nitric acid of ordinary strength, and there is not the slightest objection to its use for that purpose unless it be in the bisulphate produced, which may show a slight greenish tint, and therefore be objected to by some persons. But is can be used without any trouble whatever to produce neutral Glauber salts by either the soda or lime process. If ordinary acid crystals are made they will show a trace of copper, and the mother-liquor, after a while, show a green tint. This acid will answer as well for the manufacture of muriatic acid, where the resulting sulphate is used in the same way as the bisulphate above mentioned.

For the manufacture of acetic acid this acid is quite suitable—much more so, of course, than the original waste acid. I have used it to decompose acetate of lime, and found it to work quite satisfactorily.

It will answer for the decomposition of bauxite in the manufacture of alum as long as the liquors produced are acid, as is always the case when aiming at crystallised alum. In that case the sulphate of copper stays in the mother-liquor, and the traces accompanying the first alum crystals will be removed in the roching or recrystallisation process.

In no case, however, does this acid go quite as far as the commercial article of the same strength, for the reason above stated—that the per cent. of free acid falls about 2 per cent. short of that contained in the regular article of the same density.

The concentration is somewhat disagreeable and expensive on account of the salt deposit having to be removed more or less often, depending upon the amount of acid concentrated, or very small effects will be obtained from the fuel used. As a very low price is paid for the waste acid (not over 1 dol. per 1,000 lb.), and 1,000 lb. of waste acid give 520 lb. of 60° acid, with a consumption of 130 lb. of fuel and 8 cents' worth of labour, it is easily seen that the concentration pays, even where no blue vitriol could be got out of the acid besides. More about this further on.

### *Manufacture of Blue Vitriol from the Anhydrous Sulphate of Copper.*

The trade demands a large, clear, well-developed crystal of a pure deep-blue colour, and objects decidedly to small or greenish, pale blue, or cloudy crystals. It therefore becomes necessary to arrange the manufacture accordingly. The green shade is caused by an admixture of iron or nickel sulphates; the small crystals result when cooling the liquid quickly, and are therefore found more on the bottom and the sides than in the middle of the cooler, on the strips or hangers suspended there to give the crystals a foothold. It is hardly necessary to say that a thorough settling of the solution is necessary to obtain good results.

To avoid the admixture of other metals it is best to have an acid solution, particularly as a better yield is obtained in the presence of an excess of free acid. This, of course, cannot be carried too far, or the resulting salt will require recrystallisation. But with a solution holding no more than 10 per cent. of free acid, a marketable crystal is obtained by simply washing the drained salt. The small crystals are avoided by using large square coolers built of heavy planks (at least 2 in. thick), and guarding as much as possible against loss of heat by radiation. At the top, this is effected by covering the surface with a layer of water 1 inch deep or by using a board cover. The strength is also of considerable consequence, as under otherwise equal conditions a stronger liquor will of course crystallise sooner, and therefore require slower cooling than a weaker liquor. By observing these precautions the amount of small crystals can be much reduced and the yield of marketable goods much increased, but plenty of coolers are required so that sufficient time can be given each batch. This is especially the case where the liquors are run pretty strong with a view of getting a good yield.

After a good deal of experimenting, I found that with coolers measuring 6 ft. by 8 ft. by 3 ft. high, a good crystal and a fair yield could be obtained at the same time if running the liquors at 36° B., hot, and with an acidity corresponding to 5 per cent. to 6 per cent. of sulphuric acid. The coolers used were of course lead-lined, and a very large quantity of hangers, not less than 30 or 40, were used on each cooler. The hangers were nothing but lead strips, 2 in. wide, suspended over iron pipes or wooden strips crossing the cooler; they are allowed to come within six inches of the bottom, and no closer, so as to avoid their being caught in the bottom layer of salt. It is very important to have the liquor as hot as possible, preferably 180° to 190° F., when arriving in the coolers, as otherwise it is not to be expected that nice crystals will be obtained. *A slow crystallisation in an acid solution* is the chief condition for obtaining that result. The crystallisation should not be completed in less than 8—10 days. Under those conditions, all the salt obtained is marketable, with the exception of the bottom layer, which need not measure over 2 in. in depth, and frequently does not hold more than 1 in. of really unmarketable crystals. These have of course to be redissolved and worked up along with the mother-liquor, which is concentrated by means of a steam coil lying on the bottom of the dissolver. For a dissolver measuring

6 ft. by 8 ft. by 4 ft. high there is required a steam coil of ¾-in. lead pipe about 70 ft. long.

If it is not feasible to have the dissolver so constructed that the liquor will settle thoroughly without cooling it below 190° F., it will answer to both settle and crystallise right in the dissolvers. I have done that with altogether satisfactory results, as in that way it was very easy to maintain the temperature and cool as slowly as desirable. As long as this condition is maintained it matters not so much about the strength and acidity, only it must be remembered that the higher the strength and also the acidity are up to a certain point, the better the yield obtained. To go above 44° B., hot, with 10 per cent. of free acid is not advisable, as in that case recrystallisation would have to be resorted to. No liquor should be returned for concentration on the lead pans until that acidity is reached. If inconvenient to return it to the pans, then keep on concentrating with steam, and crystallise until the acidity is at least 25 per cent., otherwise too much copper is lost when the liquor is finally run to waste.

### *Concentration to 66° B.*

In concentrating sulphuric acid it is well known that lead pans cannot be used to attain a higher strength than 62° B. at 60° F., as above that strength the attack upon the lead becomes too severe. I have made no attempts to bring this acid to a higher strength on lead pans, nor have I attempted to concentrate it further in either iron or platinum; but from my experience with it, I have every reason to believe that it can be brought to 66° B. I had hoped to make some experiments with a view of demonstrating this positively, but have found it impossible to do so in time for this meeting. I have ascertained, however, that the copper continues to separate out as the strength increases, and am satisfied that if no other obstacle is met in its concentration to 66° B., a product can be obtained which will be satisfactory for probably 75 per cent., if not more of all the sulphuric acid trade. With the copper removed to within a small trace, it only remains to remove the coloration caused by the presence of the organic matter, and this can readily be accomplished by the aid of a little permanganate of potash judiciously applied. With the acid thus clarified as to colour, and the copper and iron removed by the concentration to 66° and subsequent settling, I cannot see why there should be any objectionable impurity present, looking at it from the view of the average consumer.

One objection to concentrating to 66° B. would be that it would have to be done in two stages, as, after reaching 60° B., it would be absolutely necessary to first thoroughly settle out all the $CuSO_4$ that could be thus removed and then proceed to concentrate to 66° B. This objection, together with the deposit of cupric and ferric sulphates in the still, would make it unprofitable to bring this acid up to 66° B., even if the quality were satisfactory.

### *Cost of Concentrating Waste Acid to 60° B.*

If we assume that 100 lb. of spent acid will yield 52 lb. of 60° acid instead of 57·6 lb., as indicated by the relation between the acid contents (which are 43·6 per cent. and 75·7 per cent. free acid respectively), we get, cost of 1,000 lb. of such 60° acid as follows :—

| | $ |
|---|---|
| 1,920 lb. waste, delivered on lead pans at $2·80 per 2,000 lb. | 2·69 |
| Fuel, 250 lb. (cheap steam coal) at $2·72 per long ton at furnace | 0·30 |
| Labour | 0·15 |
| Divers wear and tear on pans, &c. | 0·10 |
| | 3·29 |

Or $6·48 per 2,000 lb. in factory, which is cheaper than the ordinary acid of the same percentage of real sulphuric acid can be produced for around New York.

Add to this at least 5 per cent., or about 100 lb., blue vitriol, produced from the precipitated anhydrous salt at a cost not exceeding $0·30 per 100 lb. in the bin, or $0·40 in barrels ready for shipment, and we have here an additional profit, figuring blue vitriol at 4 cents, of $3·60 from our 1,920 lb. of waste acid.

It is therefore seen that a profit of $3·50 to $4·00 per 2,000 lb. can be made on this waste product by the above simple mode of utilisation. As to the commercial aspect of utilising it in other ways, I have not sufficient data now at my disposal to enter upon that on this occasion.

## Banquet to the President and Hon. Foreign Secretary.

*November 1st, 1895.*

The President, Mr. Thomas Tyrer, and the Honorary Foreign Secretary, Mr. Ludwig Mond, F.R.S., were entertained at dinner on November 1st, by invitation of the Committees of the New York Section of the Society, and the New York and Lehigh Valley Sections of the American Chemical Society, at Delmonico's in New York. Mr. A. H. Mason, Chairman of the New York Section presided. The President responded to the toast of the Society of Chemical Industry, and Mr. Ludwig Mond to that of the guests.

# Journal and Patent* Literature.

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## I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

### PATENTS.

*Treatment of Liquids by Gases, Improvements in or connected with the.* J. J. Meldrum, T. F. Meldrum, and J. W. Meldrum, all of Manchester. Eng. Pat. 20,480, October 26, 1894.

A series of diaphragms are arranged in tanks provided with separate inlets below for the liquids and gases. These diaphragms are preferably perforated plates, or in some cases of woven tape or wire, so that the gas is constantly broken up in its passage through the perforations or interstices, thereby exposing new surfaces to the liquid under treatment.

The invention has special reference to the carbonating of sewage effluent, to neutralise the excess of lime formed in the precipitating process, and to remove the alkalinity in such effluents.—E. G. C.

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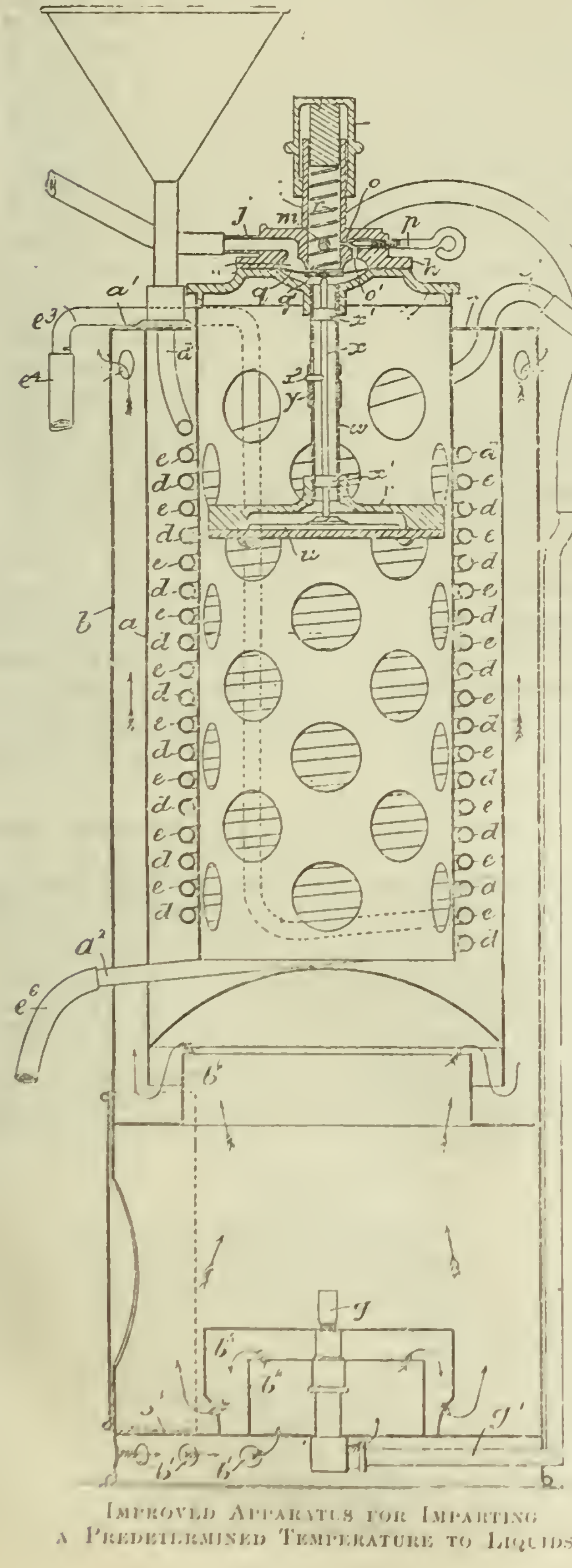
* Any of these specifications may be obtained by post by remitting 8*d*.—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

*Imparting a Predetermined Temperature to Liquids for Use in Developing Photographic Plates and for other Purposes, Improvements in Apparatus for.* C. E. Hearson, Camberwell, Surrey. Eng. Pat. 22,013, November 14, 1894.

The apparatus is intended for use in bringing the developing liquid to a standard temperature immediately before use, and also for maintaining a desired temperature in the developing dish by means of water at the predetermined temperature.

The apparatus consists of a pair of perforated cylinders *a*, round which are coiled the tubes *d* and *e*, through the first of which the developing liquid is run, whilst water circulates in the second. At the base of the enclosing shell *b* there is a gas-burner *g*, the light from which is carefully shielded from the upper part of the apparatus by means of baffle plates $b^6$, so arranged as not to interfere with the upward passage of the hot products of combustion for heating the liquids in the coils *d* and *e*. The degree of heat is regulated by a thermostatic device consisting of a capsule *u* of an expansible liquid in the casing *v*, actuating the diaphragm disc valve *q* by means of a rod *x*, furnished with guides $x^1$ $x^1$, so that when the capsule expands through a rise of temperature, the rod tends to close the valve and shut off the supply of gas entering by the tube *j* and flowing past the valve to the supply pipe *m* of the burner. When the valve closes entirely, the bye-pass $o^1$ allows sufficient gas to pass to keep the burner alight, whilst a regulator-spring *r* serves to vary the closing of the valve *q* somewhat. The apparatus is first got ready for use by pouring in water of the standard temperature, and afterwards the developing liquid and water are run through their respective tubes, and become attempered by the regulated burner *g*, and finally delivered below into their respective receptacles.—E. G. C.



Improved Apparatus for Imparting a Predetermined Temperature to Liquids.

*Carboy Envelopes or Hampers, Improvements in.* J. Brown, Manchester, and A. Berry, Failsworth. Eng. Pat. 10,009, May 21, 1895.

Diagonal standards or bands are interlaced round horizontal hoops to form an envelope or hamper for carboys and the like; this construction gives greater strength and rigidity than the ordinary form, where the standards are vertical. —E. G. C.

*Filter Presses, Improvements in or relating to.* G. C. Downing, London. From The Maschinenbau "Elktiengesellschaft" [Actiengesellschaft], Prague, Bohemia. Eng. Pat. 14,169, July 25, 1895.

The plates for filter presses are formed with vertical corrugations so as to form short vertical channels of semicircular or rectangular form. These bulged projections form supports or distance-pieces for the filtering fabric, which latter may be of any well-known material; the plates are stiffened at the bottom and two ends with a metal band of channel or other cross-section.—E. G. C.

*Filtering Liquids, Improved Means applicable for Use in.* S. Stroh, Eisenstadt, Hungary. Eng. Pat. 15,297, August 14, 1895.

A double-acting pump, provided with suitable inlet and discharge valves, draws the supply of liquid to be filtered and forces it into a surrounding jacket containing perforated tubes filled with filtering material, which latter may be papier maché, extract of tamarind mixed with blood, or the like. The filtered liquid, after being forced through the cylindrical layers of filtering material, collects in a suitable receptacle, from whence it is drawn off by means of a pipe. —E. G. C.

## II.—FUEL, GAS, AND LIGHT.

*Acetylene, Production and Use of.* R. Lüpke. Elektrochemische Zeits. **2**, 1895, 145—153.

The heat of formation of acetylene is – 47,750 cal. This amount of heat is absorbed when 24 grms. of carbon and 2 grms. of hydrogen unite to form 26 grms. or 22·33 litres of acetylene. This negative heat of formation can also be deduced from the fact that in the reaction—

$$C_2H_2 + O_5 = 2CO_2 + H_2O,$$

310,050 cal. are evolved. For the heat of formation of 2(C, $O_2$) is equal to 194,000 cal., and of ($H_2$, O) is equal to 68,300 cal. These together amount to 262,300; and the difference between this and 310,050, viz., 47,750 cal., is absorbed in the synthesis of acetylene. The Neuhausen Aluminium Co. offer calcium carbide wholesale at the rate of 40 pf. per kilo. (about 2·2*d.* per lb.). It is stated that 1 kilo. on an average produces 275 litres of $C_2H_2$. Since 1 kilo. of pure $CaC_2$ should yield 348·9 litres of $C_2H_2$, the Neuhausen product really contains about 79 per cent. of $CaC_2$. In the electric furnace the carbide is a viscous fluid. On cooling, it solidifies to a bronze-brown or grey crystalline mass as hard as granite. In demonstrating the preparation of acetylene, about 50 grms. of the carbide should be placed in an Erlenmeyer's flask provided with a stoppered funnel from which water is allowed to drop slowly. In the decomposition of the carbide the volume increases greatly, and much heat is evolved; the residue consists of calcium hydrate mixed with only a few specks of carbon. The carbide needs to be kept in well-stoppered bottles made tight with paraffin, for it is decomposed by the aqueous vapour always present in the air. The Neuhausen product is too rich to be used in a Kipp's apparatus for producing a constant stream of acetylene, and the author recommends an arrangement like that for supplying hydrogen in a Döbereiner's lamp.

If acetylene be required for a series of experiments it should be collected over a concentrated solution of common salt in a glass gasholder containing about 10 litres. (Water at 18° absorbs about its own volume of acetylene, whereas 100 volumes of the above solution only absorb about 5 volumes of the gas.) Acetylene condenses to a colourless liquid (sp. gr. = 0·42) under much the same conditions as carbon dioxide; its critical temperature is 37° and its critical pressure is 68 atmospheres. A Mannheim firm is already preparing to supply liquid acetylene in steel cylinders. Acetylene is about as poisonous as carbon monoxide, of which 0·4 per cent. is fatal; but it fortunately possesses a most characteristic smell. The presence of acetylene can be detected chemically by the formation of its silver compound, $C_2HAg.AgOH$, which falls as a yellow precipitate when the gas is passed into an ammoniacal solution of silver nitrate.

To demonstrate the high illuminating power of the flame of burning acetylene, we only require very simple apparatus,—a glass test-tube standing on a foot and provided with a stopper through which passes a glass tube. The lower end of the tube should be cut on a slant and provided with a side-opening so that condensed water may easily drop off; its upper end should be provided with a platinum tube squeezed at the top so as to leave a slit-shaped opening. About 3 grms. of calcium carbide are placed in the test-tube and a few drops of water added; the stopper is pushed in and the gas lighted. An efficient illuminating agent should not only produce a bright light, but it should also be cheap, and the products of combustion and the heat evolved should be comparatively small. All these factors are affected by the construction of the lamp or burner. Schülke's Regina lamp is well adapted for burning pure acetylene. The cost for a given number of candle-power-hours is about the same as when petroleum is burnt in the same lamp; but acetylene produces only one-third the amount of heat and one-fifth the amount of carbon-dioxide. Light for light, acetylene is about 55 per cent. cheaper than electric glow-lamps. With the arc light it cannot compete in cheapness, although it has the advantage of being more easily handled, and of sufficing in many cases where the extreme brilliancy of the arc light is not required. The author gives a detailed comparison of the efficiency of various illuminating agents, accompanied by tables showing the consumption, price, number of calories and of cubic metres of $CO_2$ evolved per 100 candle-power-hours. In the foregoing table typical sources of light are arranged in order according to the number of candle-power-hours which can be provided at a cost of 1 mark. In making such a comparison it is necessary to bear in mind that the introduction of improved burners and mantles has greatly improved the efficiency of ordinary gas as an illuminating agent for both in- and out-door work. The Auer incandescent light only requires 112 litres of illuminating gas to produce 57 normal candle-power per hour; even if we allow for deterioration of the mantles this only comes to 4·34 pf. per 100 candle-power-hours. Fed with water-gas the same burner will give the same amount of light at a cost of only 2·39 pf. Whether acetylene in combination with water-gas can compete with this, remains to be seen.—D. E. J.

NUMBER OF NORMAL CANDLE-POWER-HOURS OBTAINABLE AT A COST OF 1 MARK.

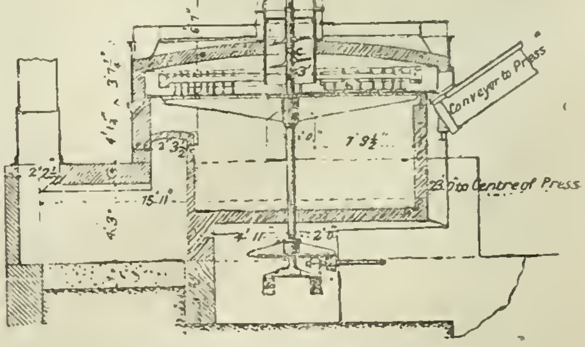
| | |
|---|---|
| Wax | 33 |
| Stearin | 77 |
| Incandescent electric light | 410 |
| Coal-gas (slit burner) | 625 |
| Acetylene and air (slit burner) | 716 |
| Oil-gas | 1,660 |
| Water-gas and benzene | 1,666 |
| Electric arc | 2,232 |
| Schülke's petroleum gas-lamp | 2,250 |
| Auer burner, coal-gas | 2,300 |
| Auer burner, water-gas | 4,350 |

### *Production of Acetylene by Electricity.* D. Korda. Monit. Scient., June 1895, 45, 409.

The fact that acetylene is produced by the action of metallic carbides upon water has been known for a long time. Wöhler first prepared calcium carbide, in 1836, by heating charcoal with a zinc-calcium alloy. The progress which since then has been made in the manufacture of aluminium and magnesium was utilised by Maquenne and Travers for the preparation of barium carbide and calcium carbide from barium carbonate and calcium chloride respectively. The employment of the electric arc for the simultaneous reduction of the metal and formation of the carbide next suggested itself, and was studied by Wilson, and later on by Moissan. In treating, in the electric furnace used for the manufacture of aluminium, 2,000 lb. of powdered carbon with 2,000 lb. of powdered lime, 2,000 lb. of calcium carbide were obtained, which is nearly the theoretical yield. The electric energy required for this operation, according to Wilson, amounted to 180 electric horse-power (134 kilowatts) for 12 hours. Estimating this power at 6 dols. and allowing 6·5 dols. for the above materials and 2 dols. for labour, the cost of the 2,000 lb. of carbide obtained would amount to 15 dols. These 2,000 lb. of carbide should yield theoretically 316 cubic metres of acetylene; the practical yield was slightly less, *viz.*, 297 cubic metres. Although it follows from these figures that acetylene is rather dearer than ordinary gas, its illuminating power more than compensates for this disadvantage. V. B. Lewes has shown that the illuminating power of acetylene is three and a half times that of ethylene, 50 times that of methane, and 15 times that of ordinary gas. Acetylene can therefore be used either in admixture with ordinary gas to increase its illuminating power or by itself as an illuminant, although in this case specially constructed burners are required to prevent the smoking of the flame. In such burners no copper, brass, or bronze should be used, but there is no objection to either iron or nickel. It has been urged that acetylene is too poisonous a gas to be used for domestic lighting. It is, however, no more poisonous than ordinary coal-gas, which may contain as much as 10 per cent. of carbon monoxide, and whereas the latter is odourless, the strong odour of acetylene could not escape notice.—C. O. W.

### *Coal Briquettes, Manufacture of.* W. Colquhoun. Inst. of Civil Eng. 118, iv.

The increasing demand for briquettes for steam-raising has brought up the annual production throughout the world to seven millions of tons. For this manufacture, screened small coal must be washed, if impure, and crushed, unless already quite fine. Washed coal must be dried subsequently, for not more than 4 or 5 per cent. of moisture is permissible; the drying has been effected by the agency of steam pipes traversing the mass of coal, which is a costly method, although still largely in use for treating brown coal (Jacoby's oven) in Prussia and Austria. A suitable appliance for drying is the Bietrix furnace (*vide* figure) which



BIETRIX FURNACE.

consists of an iron-cased, circular, brick chamber, with a central, circular, cast-iron table, from 12 to 18 ft. in diameter, revolving 3 or 4 times in a minute. At one side of the chamber is a fire-grate, and from this a current of gases at a temperature of 100°—200° C., passes first over and then under the table. The wet coal is automatically fed on to the centre of the table, and is gradually conveyed to the periphery by means of fixed scrapers. The furnace, which costs about 750*l.* to erect in Belgium, requires the attention of a fireman, and burns 35 lb. of fuel per ton of coal dried, an expenditure which is compensated for by a saving of 1 or 1·5 per cent. of agglomerating pitch, otherwise needed.

The crushing of the coal is necessary, both to reduce the size of excessively large fragments, and to ensure a thorough incorporation of the agglomerant. Roller crushing-mills break down all particles alike; but it is better that the harder grains should remain unbroken, since they already resist compression well, and the Carr disintegrator, which breaks by impact only, is to be preferred. A 30-in. disintegrator of this type, running at 300 revolutions, will pass about 60 tons of coal *per diem*. In crushing, care must be taken that there is sufficient fine material produced to fill interstices, but an excess of small coal must be avoided, as it calls for an increase in the proportion of agglomerant. Highly bituminous coal may sometimes be caked by heat and pressure without any binding medium, but only with a loss of some volatile constituents, and at the risk of firing the coal. Lignites, however, may be so prepared at 60° to 70° C. Pitch is the most convenient agglomerating material, when it can be obtained; but when anthracene and heavy oils have been recovered from it in course of manufacture, its binding properties will have been destroyed. A suitable pitch should soften at 75°, melt at 100° to 120° C., remain hard at the normal temperature, and be capable of carriage in bulk; its fracture should be dead black, conchoidal, clean and soft, without being greasy to the touch, and the edges should not splinter when bitten with the teeth. There is room for a cheaper and less smoky material than pitch. Clay has been used, but it increases the volume of ash. Lime-wash mixed with the coal, mitigates the sulphur nuisance; but the blocks have afterwards to be dried. Waste grain, starch residues, and albuminous matter from vegetable roots have lately been used in England, but with these also the briquettes must be dried and rendered water-resisting; besides these substances, molasses, sawdust, plaster of Paris, blood, manure, magnesia, chalk, paper pulp, potassium nitrate, silicate of soda, and others have been tried.

The pitch is added either liquid or dry. The melted pitch process is now practically used only in the Centre coalfield (France), where 30 per cent. of tar is added to the pitch, which reduces the proportion of agglomerant required, but adds to the smoke and smell in burning. The pitch is melted in closed vertical wrought-iron cylinders, tar is added at intervals, and the mixture is stirred by a revolving shaft with pugging arms, and then forced by steam into an overhead reservoir, from which it is distributed on to the coal. The extra cost involved in methods intended for the use of tar alone, at temperatures sufficient to distil off the more volatile constituents, is not justified by the difference in the prices of tar and pitch. The process mostly used in Europe consists in breaking up the pitch, mixing it automatically in the correct proportion with the coal, completing the mixture in a disintegrator, heating the mass to from 70° to 90° C., and compressing it into blocks.

To be thoroughly plastic, the mixture should contain not more than from 3 to 5 per cent. of water, whilst the proportion of pitch may range from 6 to 10 per cent., according to the nature and fineness of the coal. The pressing machinery requires attention, as the wear and tear are great, the pressures used are high, and it has often to work in an atmosphere laden with dust. The Stevens press has a horizontal revolving table with moulding dies, provided each with a separate compressing piston, two briquettes being prepared at each stroke. The pistons rest and slide upon an inclined plane, and the table (the movement of which need not be absolutely exact) is rotated intermittently by pawls. In the Mazeline press, pistons are successively forced upwards by hydraulic power into their corresponding moulds fixed in a horizontal table. In the Dupuy press, which is horizontal, the briquettes are formed in one mould and by the action of one piston. Middleton's press compresses the coal simultaneously from opposite sides, and therefore gives a higher cohesive power to the fuel than do the preceding machines; it is made in four sizes, producing 10 cwt., 1, 2½, and 5 tons per hour respectively. The Bietrix press is a double compression machine, of which there are about 250 in use in Europe. The presses are made in three sizes: for briquettes weighing 7, 12, or 24 lb., the table containing 10 to 12 single or double moulds. The medium-sized machine weighs about 15 tons, costs 1,250*l.*, and produces 90 to 100 tons per 12-hour day, with an absorption of 20 h.p. The Roux-Veillon press is similar to the last named, but is more complicated and costly; it has hydraulic plungers, and this obviates the risks to which lever machines are open. In the Bourriez press, compression is effected in an open mould, sufficiently long to ensure high frictional resistance of the paste against its walls. The pressure is prolonged, and the machine is therefore specially fitted for wet coals, but more pitch is required than in the above-named presses. Eggettes (or "ovoid fuel") are produced in a pair of horizontal rolls with corresponding mould hollows in their surfaces, which revolve in contact with each other, but in opposite directions. In the Fouquembert machine the rolls are driven by worm-gearing, running at 25 revolutions for each revolution of the rolls, and working in oil within a dust-proof casing. Six tons per hour of ovoids, weighing 3 to 4 oz each, are produced by a rolling motion, which necessitates the use of a large proportion of water and pitch to prevent crumbling. The waste, through crumbling and failures, amounts to from 4 to 10 per cent., and is collected beneath a small screening grid, over which the perfect ovoids pass from the rolls to a travelling belt. The ovoids correspond in size to "screened nuts." Belts are generally used to convey briquettes from the machine, that they may have time to cool and harden before being subjected to rough handling.

European railways specify for 10-lb. briquettes, whilst in the West Indies and India the large block of 28 lb. has been adopted, since it constitutes a load for a native. In storing, the briquettes occupy a space of 37 cb. ft. per ton, as against 43 cb. ft., which is the average of large screened coal. Since the small coal used is washed, the percentage of ash may be equal to that from large coal, the average on the Continent being 6 per cent. The strength of the briquettes is always 10 to 20 per cent. greater than that of large coal of the same quality, because they have no cleavage lines. They should be sound and hard, with strong edges. The surfaces should be free from cracks, and the fracture close, with no visible free particles of pitch. They should not appreciably deteriorate, even if stored for years, and they should burn freely, binding like a good semi-bituminous coal. If made from anthracite, they should be perforated with holes, or else be ovoid in shape.

The analysis of cost in an English factory making 80 tons per diem is as follows:—

| | Cost per Ton. | |
|---|---|---|
| | *s.* | *d.* |
| Labour, including stacking (when necessary) . | 0 | 8·07 |
| Oil and grease ................................ | 0 | 0·30 |
| Sundry stores ................................ | 0 | 0·50 |
| Fuel for boilers ................................ | 0 | 2·00 |
| Coal slack for briquettes, 72 tons at 4*s.* 10*d.* ... | 6 | 11·07 |
| Pitch „ „ 8 „ 1*l.* 6*s.* 3*d.* . . | | |
| Interest and depreciation at 7 per cent. ....... | 0 | 2·50 |
| Total cost per ton........... | 8 | 0·44 |

It may be noted that similar machines are used for compressing coke breeze, charcoal, sawdust fire-lighters, iron ores, magnesite bricks, &c.—W. G. M.

*Combustion of Mineral Oils in Ordinary Lamps.* P. Konindjy. Bull. de la Soc. d'Encouragement, 1895, August [116], 943—955.

Of the factors influencing the efficiency of lamps, the attention of investigators has been chiefly concentrated on the air supply, other considerations of equal importance, such as the internal friction of the oil, the speed of the air current, the height of the wick-duct, &c., having been comparatively neglected. According to Stepanoff (Ann. de la Soc. impériale tech. de la Russie, Jan. 1895) the ascent of the oil in the wick is independent of its specific gravity, but is in direct proportion to the constant of capillarity and in inverse ratio to the internal friction; but as the capillary powers of oils of various origin approximate very closely, this particular factor sinks into insignificance in comparing the value for burning in lamps. As regards the effect of the texture of the wick he finds that in a loosely-woven wick the oil rises more rapidly at first than in a more compact one, but that after attaining a certain height this apparent advantage disappears, and the latter class of wick absorbs the oil better, irrespective of the density of the oil, whence it would appear that when the burner is situated but little higher than the surface of the oil, an open wick is preferable, and conversely when the oil has to be raised to a greater height a close wick will be of greater advantage.* The internal friction or viscosity therefore remains, apart from the flashing point, as the chief characteristic of a burning oil. As a rule, viscosity increases with the density of an oil, but diminishes as the temperature rises, but that the actual effect of the influence of temperature varies with oils of different origin is shown by the results obtained by Stepanoff, working with Ostwald's apparatus. For example, whilst an American petroleum of sp. gr. 0·7782 (at 19° C.) exhibited at 12·6° C. a degree of internal friction expressed by 0·01762 in C.G.S. units, decreasing to 0·0055074 at 99·96° C., a red pyronaphtha (Nobel), of sp. gr. 0·85428 at 17·9° C., gave 0·06434 C.G.S. at 13·25° C., but only 0·01115 at 99·96° C., from which it appears that the temperature of the oil in the lamp is an important factor, and, in fact, becomes an active agent in the utilisation of the same. Stepanoff asserts that though we may not detect an increase of temperature in well-made lamps, that does not imply that the oil is not heated. In fact, the copper tube surrounding the wick, being a good conductor, conveys heat to that portion of the oil with which it is in contact, the result being to regulate the ascent of the oil, even while the depth of the oil is decreasing, and to prevent the lowering of the flame.

In a series of experiments on the effect of the height of the burner on the amount of oil consumed per unit of light, and of the quantity and speed of the air current, in various burners ("kosmos," "solar oil," and "Koumberg" burners) Stepanoff employed an apparatus wherein constant levels of oil could be maintained. From the tabulated results given, it appears that the amount of oil consumed exceeded that which the wick could furnish at ordinary temperatures, and that the flame only began to diminish when the oil had sunk so low that the effective conductivity of the metallic duct encasing the wick was notably decreased.

From researches carried out by the author with heavy oils he deduced the conclusion that, in order to obtain the maximum effect with such oils, the construction of the lamp should be so ordered that the heating action of the wick duct will increase concurrently with the exhaustion of the oil in the receiver. This involves a definite relationship between the length of the duct and the depth of the reservoir, so that when the latter is full the lower end of the duct will be immersed in the oil and be thereby cooled, becoming hotter as the surface of the oil recedes. At the same time the dimensions of the wick will require to be larger, and the height of the burner less than for ordinary petroleum. The first condition, that of temperature, is, however, the most important, and it is pointed out that by reason of their high flashing point (about 100° C.) the pyronaphthas and similar oils can be heated up to about 40° C. without danger, though, if the heating be carried to excess, charring of the wick and thickening of the oil may result.

The amount of air passing through the ordinary heavy-oil burners is greater than is required for the combustion of the oil and it is necessary that the supply should be restricted without, however, causing any diminution of the speed of the current; an end obtainable by the insertion of a rod, or closed tube, in the central shaft admitting air to the inside of the flame, and by bringing the outside of the flame closer to the sides of the chimney, either by means of a button, or a constriction in the chimney itself, to an extent varying with the internal friction of the oil.

The defects existing in the lamps now in use, viz., instability of flame, excessive consumption of oil per unit of light, and liability of flame to turn red, flicker and smoke when the lamp is moved, are due to irregular ascent of oil (by reason of the lack of proper proportion between the upper and lower parts of the burner), excess of air, and abnormalities in the draught through the burner. The remedy lies in the application of the principles enunciated above, by modifying the access of air, the dimensions of the duct and the size and shape of the reservoir. This latter may be effected by decreasing the diameter where the heat is too great, and enlarging the same when the conduction is too gradual. It must be remarked that the relation between burner and reservoir has a decided influence on the efficiency of the lamp, so that a burner giving good results with one form of reservoir will behave altogether differently with another, and similarly, a lamp may be found all right with one oil but unsatisfactory when used for another of different internal friction.—C. S.

## PATENTS.

*Gas, Improvements in and in Apparatus for the Manufacture or Production of.* V. B. Lewes, Greenwich. Eng. Pat. 2914, February 9, 1894.

The patentee has found by experiment that, for like rates of consumption, the flame yielded by carburetted water-gas or by carburetted hydrogen, though relatively brilliant, is far shorter and smaller than that yielded by coal-gas; so that to obtain flames similar in appearance and in bulk, it is necessary to burn larger quantities of the former. It is methane which he has discovered to be the cause of these phenomena; this gas being present in coal-gas to the extent of 35—40 per cent., whilst only 16—26 per cent. of it occurs in carburetted water-gas or in carburetted hydrogen. The patentee now describes a method and apparatus whereby he produces a gas rich in methane, which he mixes with carburetted water-gas, or with carburetted hydrogen, or with a mixture of these two gases.

The apparatus employed (see figure) consists of a fire-brick-lined producer 1, with fuel inlets 2, 2, and clinker outlets 3, 3. The gas outlet 15, leads into the regenerator 14, the latter containing fire-bricks arranged chequerwise in its upper part, and small iron pigs in its lower part. The manufactured gas passes from the regenerator, by 16, through the seal 17, to 18; and thence to the gas-holder. The main 4 supplies air, which is delivered either under the grate of the producer at *4a*, or at different heights, 5, *5b*, *5a* therein. Hydrocarbon is conducted by 11 and 13, to the two ranges of injectors 10 and 12, and to these latter, steam is supplied by 8. The steam is sometimes previously superheated by traversing a coil, 7, embedded in the wall which separates the producer from the regenerator.

The manufacture of gas is conducted as follows:—

Carbonaceous fuel (*e.g.* coke) is raised to incandescence by urging an air-blast through the producer, the products of combustion (mainly N and CO) being allowed to escape by 23, which at this stage is open. By this means the refractory linings of producer and regenerator, and the steam superheating coil, are raised to a high temperature, and the iron oxides on the pigs are reduced to metallic iron. The air blast is now cut off, 23 closed, and ordinary coal-tar or heavy hydrocarbon oil introduced, by superheated steam, through the lower injectors to the hottest part of the producer. A gas which is largely $CH_4$ and H is thus produced, accompanied by a separation of C. Jets of steam, issuing from 19, 19, direct the flow of the gas through the regenerator, the steam itself being here decomposed; and the new gases, introduced by this decomposition, react with any sooty matter carried over from the producer, so preventing such matter from choking up the regenerator.

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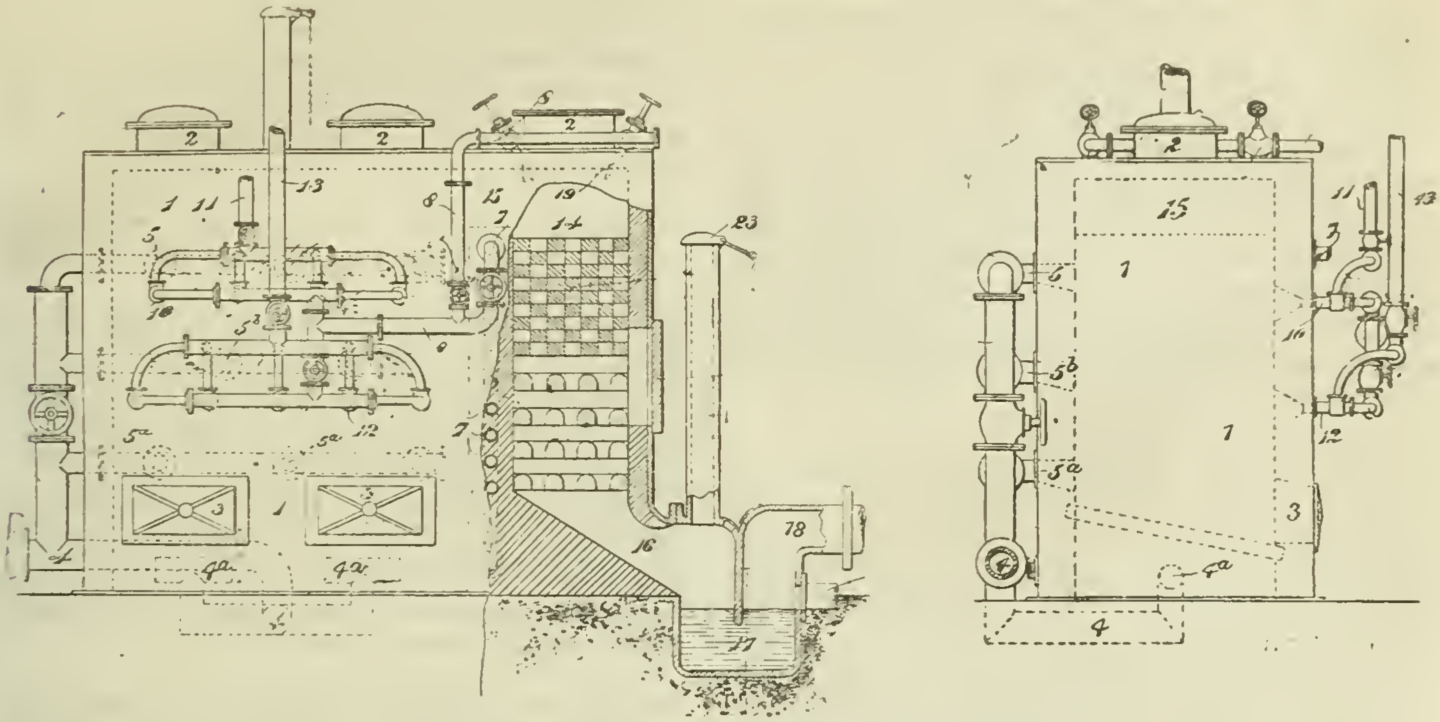
* No experimental data, however, are furnished in support of these statements.

After this operation has gone on long enough to partly reduce the temperature of the fuel, the lower injectors are stopped and lighter hydrocarbon, "such as paraffin," injected by steam through the upper injectors; a gas rich in ethylene and other illuminants is thus generated.

When the fuel has fallen below a certain temperature, all hydrocarbon and steam are shut off and the air blast turned on, the fuel raised to incandescence, and the cycle of operations renewed. Any residual hydrocarbon gas assists the CO and N in reducing the iron oxides. Sometimes both light and heavy hydrocarbons are simultaneously injected into the producer.



Apparatus for Production of Gas.

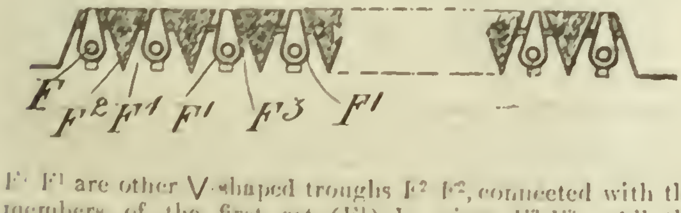
The patentee states that with a producer, the dimensions of which were 12 × 12 × 8 ft., he has obtained satisfactory results by using 3 gallons of tar to 1 gallon of paraffin, the injection of each material occupying about 5 minutes, the steam pressure being 100 lb. to the sq. in. and its temperature about 400° C. The apparatus should be so managed that the gas produced has a brown colour.

The water-gas formed from the injecting steam, serves to prevent that over-cracking of the hydrocarbons, which would result by reason of the large mass of incandescent fuel present, and the heat of the regenerator, serves to fix the gas and to render possible the production of a permanent illuminating gas.

The patentee's previous patents, 21,598 of 1891 (this Journal, 1893, 457) and 16,258 of 1892 (this Journal, 1893, 511), should be consulted in connection with the present one.—E. R. B.

*Hydrocarbon Oils and the like, Improvements in or relating to the Storing and Burning of, and in Apparatus therefor.* S. G. Homan, Brixton. Eng. Pat. 4813, March 7, 1894.

The patentee's burner, which is represented in transverse section in the figure, consists of a series of perforated pipes F, each placed in a trough $F^1$, which tapers towards its upper part, and forms there a narrow slit, above which the flame burns; in lieu of the slit there may be substituted a number of perforations. Alternating with the troughs



$F^1$ $F^1$ are other V-shaped troughs $F^2$ $F^2$, connected with the members of the first set ($F^1$) by pipes $F^3$ $F^3$. All the troughs are loosely filled with asbestos. The air for the combustion of the hydrocarbon passes up in the spaces $F^1$ $F^1$ between the troughs.

The principal advantage of this burner is stated to be as follows:—When it is necessary to generate steam slowly, the oil may be supplied at such a rate that it is consumed at the outlets of the troughs $F^1$ $F^1$ only; when faster steam-raising is demanded, more oil is supplied, the surplus running over through the pipes $F^3$ $F^3$ into the troughs $F^2$ $F^2$, converting a series of separate flames into practically a continuous sheet of flame.

The improved storage tank of the patentee is a closed and jacketed one, its inner vessel containing hydrocarbon, while the outer (the jacket of the foregoing) is filled with water.

When water is forced into the outer vessel, a valve, which only permits of a flow in one direction, opens, and hydrocarbon is forced through a pipe connecting the top of the inner tank with the burner. Near the bottom of the inner tank are a pair of electric terminals, and as the incoming water covers them, an electric connection is formed which operates a signal. Similarly the water connects another pair near the top of the tank, as it drives the last of the oil out. In filling the tank the signals are successively cut off as oil displaces the water. The foregoing arrangement is designed to obviate the danger of fractured gauge-glasses. In the first instance the water is put under pressure by a hand-pump, or by employment of a suitable head, or, on board ship, by connecting the outer tank with the water beneath the ship. As soon as the burner has raised steam enough in the boiler it is heating, a steam-pump may be employed, and to render the operation of this latter automatic under the increasing steam-pressures in the boiler, the following arrangement has been devised:—

The outer vessel is connected with a small closed chamber, in the roof of which is the seating of a conical valve. The plug of the valve is carried by a rod, which in turn is connected by a link to a lever disposed at right angles to the direction of the rod. The lever, at one side of its attachment to the link, is pivoted to a fixed support, whilst at the other it is successively attached to a piston-rod and a spring, which latter may be adjusted by a nut to exert any desired pressure on the valve. Steam, at such pressure as to be able to overcome the spring, entering the cylinder, will raise the piston, and, in consequence, the valve from its seat. Water now flows through the valve from the outer vessel, and, with the diminishing pressures on the liquids of the tank, less and less oil goes to the burner, in consequence of which the steam-pressure in the boiler diminishes.—E. R. B.

### *Gas-Producers, Improvements in.* B. Dawson, Malvern Link. Eng. Pat. 15,150, August 8, 1894.

The objects of these improvements are to render effective for the production of gas the "whole interior area" of the producer, and to provide means whereby refuse may be removed from the bottom of the producer practically around its entire circumference.

The improved producer is of like circular section throughout its entire height, and stands in a circular water-trough. At the bottom and under the level of the water in the trough are a series of arches through which may be removed the refuse clinker and ashes. The single axially-placed tuyère, which is protected by a conical top, evenly distributes the blast over the entire interior area. In the sides and at the top of the producer there are poking holes which allow of the dislodging of any fuel or clinker which may adhere to the wall of the producer.—E. R. B.

### *Artificial Fuel, an Improvement in.* W. B. Hartridge, London. Eng. Pat. 17,759, September 18, 1894.

This invention relates to the composite artificial fuel described in a former specification (Eng. Pat. 12,389, 1893; this Journal, 1894, 873). It consists in combining together pieces of the composite artificial fuel therein described, so as to form faggots. Pieces are placed parallel with one another, with spaces for air between. Above them a number of pieces are cemented transversely, again leaving air spaces; whilst above this layer is another layer of longitudinal pieces. The lower layer is preferably impregnated with tar, resin, paraffin, or the like, so as to serve as a fire-lighter.—R. S.

### *Furnaces or Kilns using Solid or Gaseous Fuel for Burning or Calcining Limestone, Ore, and like Substances, Improvements in and connected with.* W. Deighton. Eng. Pat. 18,241, September 26, 1894.

The furnace or kiln consists of two similarly constructed chambers arranged one above the other, and connected by an intermediate neck-piece of refractory material or by a water-cooled ring. The chambers are slightly conical, and are formed of metal plates lined with refractory material such as firebrick. The upper one serves as a hopper to the lower one, which is the actual calcining kiln. The upper chamber is furnished with a suitable charging door for the material to be treated, with an outlet having a damper for the evolved gases, and with a central opening at the bottom allowing the semi-calcined material to pass through the movable neck-piece and through a central opening in the arch or roof of the kiln below. The latter is provided near the top with a charging opening for solid fuel, or with gas burners and pipes for gaseous fuel, as water-gas, producer-gas, or waste gases from blast or other furnaces. The limestone, ore, &c. falling from the hopper chamber leaves an annular space in the upper part of the kiln in which combustion takes place. The treated material is withdrawn through doors at the bottom.—R. S.

### *Furnace Smoke-consuming Arrangements, Improvements in.* W. Michalk, Deuben, Saxony. Eng. Pat. 20,447, October 25, 1894.

The gases or products of combustion are drawn by suitable suction devices from a part of the flue or chimney where the loss of heat they have sustained is small, and where they consist of finely divided soot and a considerable percentage of unused oxygen, and led back to the furnace to consume the unburned carbon.—R. S.

### *Furnaces, Improvements in.* R. Marshall, Kensington. Eng. Pat. 20,686, October 29, 1894.

In furnaces in which the air supply, under forced or natural draught, is made to pass downwards through the fuel, one or more sides of the fuel chamber is or are formed inclining downwardly and inwardly. When more than one side is thus inclined, that wall in which the discharge opening is situated has the greatest inclination. The flame and gases pass from the fuel chamber first outwardly, then downwardly, and lastly backwardly, in a more or less horizontal direction under the arch forming the bottom of the combustion chamber, to the boiler. The arch or bottom of the fuel chamber, and the sloping side or sides thereof, may be supported by tubes through which water, steam, or air may be circulated to prevent such tubes becoming overheated, and to provide a supply of heated water, steam, or air. The outer wall of the combustion chamber at a point opposite the bend of the flue is provided with one or two doors for convenience in cleaning the flue of deposit.—R. S.

### *Gas Retorts and such like Apparatus, Improvements relating to.* J. Henderson, Osmaston. Eng. Pat. 23,662, December 5, 1894.

Means are described for ensuring tight jointing between gas-retort mouthpieces and such like apparatus and their lids or covers, consisting in arranging said lid or cover so as to be capable, when securely fixed, of a rubbing motion in any required directions upon its bearing surface; any foreign substance intervening between the two can thus be removed by attrition, and hence a tight joint secured.

Motion is imparted to the cover by operating the long arm of a lever, the short arm of which carries jaws capable of holding a boss or projection on the cover. The fulcrum of the lever is a pin, which passes through a perforation in the lever. The pin may be borne conveniently by the cross-bar of the fastening of the retort.—E. R. B.

### *Apparatus for the Manufacture of Water-Gas, Improvements in.* A. G. Glasgow, Westminster. Eng. Pat. 1487, January 22, 1895.

The patentee states that "it has been attempted heretofore to utilise the heat of the waste gases issuing from the generator or superheater, according to the type of the apparatus, to heat the boiler from which the steam supply of the generator is drawn; but, as this source of heat is irregular and uncontrollable — there being no relation between the supply and the demand—this attempt has met with indifferent success in the manufacture of uncarburetted water-gas, and has, I believe, been entirely abandoned in the case of carburetted water-gas." To overcome the foregoing difficulties in the utilisation of the waste heat in question, the inventor provides two boilers, the main one of which is capable *per se* of supplying, if necessary, all the steam demanded by the generator, and is fired by an independent source of heat, whilst the second or accessory boiler is so arranged that its tubes are the conduits for any waste gases allowed from time to time to escape from the generator or the superheater. The steam spaces and the water spaces of these boilers are connected together by suitably arranged pipes, and water is fed to the accessory boiler only, whence it escapes, after becoming heated, by an overflow pipe, to the main boiler.

There is an arrangement provided by means of which air can be mixed with the escaping gases of the superheater or generator, so that their complete combustion may be effected as they traverse the tubes of the accessory boiler.

The inventor states that the gases traversing the tubes of the accessory boiler may be either those from a generator or from a superheater, or may be the "commercial gases" produced by the process, as shown in J. L. Stewart's U.S. Patent, 33,691 of 1886.—E. R. B.

### *Gas, Sewage, or the like, Improvements in the Manufacture or Preparation of Materials for the Purification of.* J. E. Campbell, Bradford, Manchester. Eng. Pat. 4799, March 6, 1895.

Precipitated iron hydroxides, obtained by adding lime, magnesia, &c., to galvanisers' spent pickle, are mixed with enough kieselguhr to make the mixture porous. A similar material is made from the waste iron or borings from the aniline manufacture. Either material separately, but by preference a mixture of the two, admits of repeated use and re-use for gas-purifying purposes, and finally, when ground and levigated, forms a good base for a red pigment.—L. A.

*Scrubbing or Purifying of Gases, Improvements in and relating to, and in Apparatus therefor.* F. L. Slocum, Pittsburgh, Penn., U.S.A. Eng. Pat. 6158, March 25, 1895.

The apparatus proposed consists of a series of perforated discs, keyed on to a horizontal shaft; the discs being kept not farther apart than ½ inch, by means of collars, also keyed on to the shaft; the foregoing arrangement being enclosed in a case, which is half filled with the absorbent liquid (water for ammonia, oil for benzol, &c.).

The discs are very accurately made and fitted, and the top part of the casing is also very accurately turned, so that the discs nearly touch the casing; and, when they revolve, carry up some of the absorbent liquid, which makes a "film joint" between each disc and the contiguous part of the casing.

The gas to be purified enters at one end of the casing and leaves at the other, passing successively through each plate. The perforations of a given plate are not in a line with those of the next, and as the sum of the area of the available perforations in a given plate is considerably less than that of the inlet aperture, the speed of the gas is accelerated as it traverses the perforations, so that the jets of gas play upon the wet opposing disc with considerable force and ensure a very intimate mixture of the gas with the absorbing liquid. According to the patentee, the peculiar efficiency of the foregoing arrangement is not obtained if the distance between the discs exceeds ½ in., whilst it is increased if this distance be diminished.

The patentee remarks that in rotary scrubbers a frequent source of leakage is the imperfection of the stuffing-boxes of the shaft, and to avoid this difficulty he does away with the necessity for gas-tight joints by supporting the shaft in closed water-tight bearings, and by driving the shaft by gearing disposed within the casing of the scrubber, this gearing being driven by a shaft, which, as it leaves the scrubber below the level of the absorbent liquid contained therein, passes through a stuffing-box which need only be water-tight.—E. R. B.

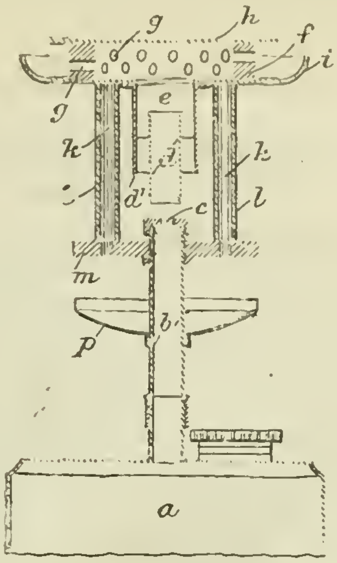
*Manufacture of Gas, Improvements in and connected with the.* H. Simon, Manchester. Eng. Pat. 7517, April 13, 1895.

This invention provides means for separating tarry matters from gas as it exists near the stand-pipes; it also provides means for working each retort independently of all others in the same battery, and is particularly applicable to the coke ovens described in the present patentee's former Eng. Pat. 2616 of 1879 (this Journal, 1884, 507 and 603).

Interposed between the stand-pipe and the dip-pipe which carries the gas into the hydraulic main, is a further set of pipes, arranged in such fashion that the direction of the gas flow, which is vertical in the stand-pipe, becomes successively horizontal, vertical, horizontal, and then vertically downwards in the dip-pipe; the second horizontal direction being at right angles to the first. This double change of direction causes the thick tarry and other heavy matters carried by the gas to this point to more readily deposit and so flow to the bottom of the hydraulic main, whence they may be easily removed by specially arranged lateral apertures. The hydraulic main is constructed in separate sections, each separately connected with the gas main. The cutting off of the gas from a given retort is accomplished by a bell-valve of ordinary construction.—E. R. B.

*Vapour-Burners, Improvements in.* A. J. Boult, London. From G. Barthel, Dresden, Saxony. Eng. Pat. 14,636, August 1, 1895.

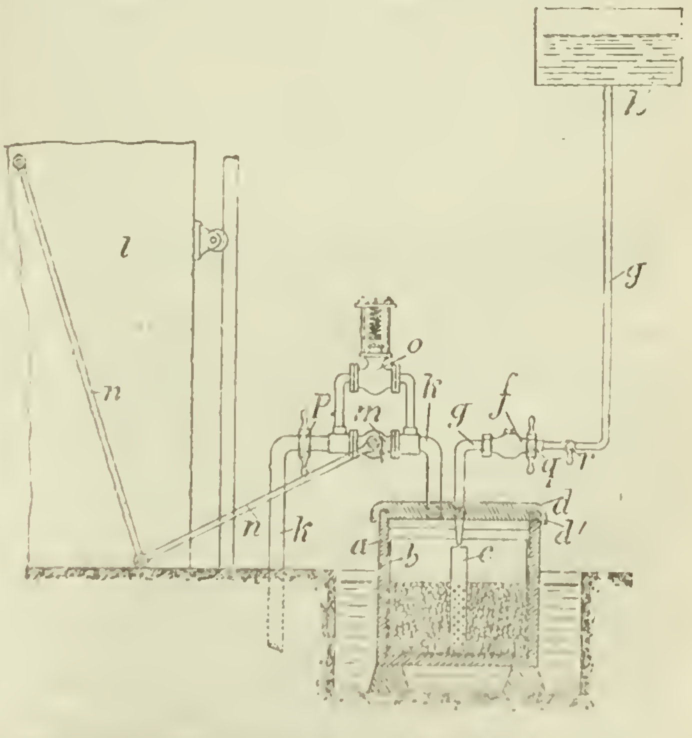
The oil reservoir *a* carries a vapour tube *b*, provided with a wick (not shown), and heated, when starting the burner, by ignited spirit in the dish *p*. The vapour given off passes upwards through the tube *d*, while air is drawn up the surrounding pipe $d^1$, and the two mix in the space *e*, from which the mixture passes upwards and escapes through one or more rows of radial openings *g* in the circular wall *f*, and is ignited. The central portion is covered with an overlapping plate *h*, whilst a dish-shaped ring *i* is placed beneath the flame, the two not only causing the flame to take a cup-like form, but protecting it from direct draughts. Copper columns *k*, protected, if desired, by brass tubes *l*, convey the heat from the burner to a metal disc *m* screwed on the vapour tube. The burners may be used for heating or cooking purposes.—R. S.



Improved Vapour Burners.

*Carbide of Calcium, Improvements in Automatical Apparatus for Decomposing.* H. Gabe, Copenhagen. Eng. Pat. 15,991, August 26, 1895.

The decomposing chamber *a* is provided with an inner removable reservoir *b*, containing the calcium carbide, to which is fixed an upright perforated tube *c*. The chamber is closed, after the manner of a gas retort, by a hinged cover *d*, securely held against the packing $d^1$ by a hand screw. Two tubes are screwed into the cover, one, *g*, leading from the water tank *h*, the other, *k*, leading to the gasometer *l*. The tube *g* is provided with a disconnecting screw *q*, a cock *r*, and a reverse valve *f*, whereby the supply of water is automatically cut off when the pressure within the decomposer exceeds that of the water. The delivery tube *k* is provided with a disconnecting screw *p*, a safety-valve *o*, and a stop-cock *m*, connected by rods *n* with the bell of the gasometer *l*, so that the said stop-cock is closed or



Automatic Apparatus for Decomposing Calcium Carbide.

opened as the bell rises or falls. When fully closed, the safety-valve allows the gas which continues to be developed, to escape after it has reached the required pressure. The decomposing apparatus may be placed in a water chamber, as shown.—R. S.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Sulphur Petroleums of Ohio and Canada, Composition of the.* C. F. Mabery. Technol. Quar. **8**, [1], 4—18.

From Ohio petroleum the author has already separated a homologous series of sulphides with the general formula $(C_nH_{2n+1})_2S$, ranging from methyl- up to hexyl-, along with higher distillates containing sulphur compounds still unidentified. Prolonged distillation *in vacuo* yielded distillates consisting of sulphur compounds, unsaturated hydrocarbons of the $C_nH_{2n}$ series, and apparently saturated hydrocarbons either of the $C_nH_{2n+2}$ or the hexa-hydro-aromatic series ($C_nH_{2n}$); Canadian oil also has been found to contain sulphides of the $(C_nH_{2n+1})_2S$ series, together with others. The separation of these compounds is very tedious, even after prolonged fractional distillation, the only effectual method being by the aid of alcoholic mercuric chloride as a precipitant, together with decomposition by hydrogen sulphide in the presence of alcohol.

Owing to the unstable nature of these crude oils it was found necessary to distil the first time at low temperatures, air being excluded. The only stills found suitable for the process are made of porcelain, neither metal nor glass being serviceable. The succeeding distillations can be carried on under atmospheric pressure. In the general, characteristics of specific gravity, bromine absorption, and proportions of similar fractions, the Canadian and Ohio oils and their distillates stand between those from Pennsylvania and Russian petroleum, Ohio oil being next to the former and Canada oil nearer the Russian product. The following table shows the comparative volatility of all four oils at 110° to 120° C., and the residues left behind at 320°—250° C.

| Boiling Point. | Pennsylvanian. | Ohio. | Canadian. | Russian. |
|---|---|---|---|---|
| ° C. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Below 120 | 19·7 | .. | .. | 0·5 |
| „ 110 | .. | 9·75 | .. | .. |
| „ 115 | .. | .. | 2·75 | .. |
| Residue left— Above 320 | 35·54 | .. | .. | 53·0 |
| „ 350 | .. | 43·0 | 70·75 | .. |

—C. S.

*American Sulphur Petroleums, Composition of the.* C. F. Mabery. Journal Franklin Inst. **834**, 401—424, and **835**, 1—26.

The term "sulphur petroleum" is given to certain petroleums which differ markedly from all others by virtue of their containing a considerable proportion of sulphur compounds; moreover, these petroleums are found only in districts quite distinct from those yielding oils free from sulphur. Sulphur petroleum is of great importance, for the Ohio-Indiana petroleum field, though only discovered in 1884, is the most prolific in America, and second only to the Baku fields in importance in the world.

1. *Occurrence of Sulphur Petroleum.*—In the Ohio-Indiana field this petroleum occurs in connection with the Trenton limestone, a formation which extends from New England to the Rocky Mountains.

At places where the oil becomes commercially available, the limestone is dolomitic, crystalline, and porous.

The gas (which is now approaching exhaustion) and petroleum of the Ohio-Indiana fields are, as has been already pointed out, under pressure.

In California, however, sulphur petroleum occurs under somewhat different circumstances. Here the source rock is a bluish slate or shale with a variable admixture of fine sand, and the oil occurs under pressures which are low, if they exist at all.

The sulphur petroleums are generally considered to be of animal origin.

2. *Chemical Investigation of Sulphur Petroleums.*—The method employed was fractional distillation, under atmospheric pressure, and, owing to the liability of these oils to undergo cracking, under reduced pressures.

The distinctive qualities of Ohio sulphur petroleum are shown in the following tabular statement of the results of distillation of 800 grms. under ordinary atmospheric pressure.

| —— | 110°—150° | 150°—220° | 220°—257° |
|---|---|---|---|
| Grammes | 76 | 133 | 86 |
| Per cent. | 9·75 | 16·63 | 10·75 |
| Specific gravity at 20° | 0·7282 | 0·7669 | 0·7940 |
| Sulphur per cent. | 0·10 | 0·38 | 0·41 |

| —— | 257°—300° | 300°—350° | Residue. |
|---|---|---|---|
| Grammes | 76 | 69 | 348 |
| Per cent | 9·75 | 8·63 | 43·5 |
| Specific gravity at 20° | 0·8138 | 0·8242 | 0·8976 |
| Sulphur per cent. | 0·37 | 0·37 | 0·54 |

The above oil was somewhat thicker than Pennsylvania oil and had a slight odour of hydrogen sulphide. Its specific gravity at 20° was 0·838: its sulphur content 0·72 per cent., and bromine absorption 6·1 per cent. The bromine absorptions of the fractions were 0·73, 1·74, 4·84, 5·04, 12·1, and 19·5 respectively. At the beginning of the distillation some hydrogen sulphide escapes, but the higher fractions are almost free from it. During distillation, much of the sulphur is lost, escaping as $H_2S$, and some sulphur is thrown down. Coke from Ohio petroleum contains 95·06 per cent. C, 4·85 per cent. H, and 0·11 per cent. of ash, the latter composed of oxides of Ca, Mg, Al, and Fe, with traces of Au, Ag, Cu, &c.

Canadian sulphur petroleum, from Petrolia, was thick and nearly black, with a peculiar characteristic penetrating odour. Its specific gravity was 0·8821; S content, 1·00 per cent.; Br absorption, 15·11 per cent. It yielded upon distillation under atmospheric pressure:—

| —— | 115°—150° | 150°—200° | 200°—250° |
|---|---|---|---|
| Grammes | 22·00 | 62·5 | 72 |
| Per cent | 2·75 | 7·8 | 9·5 |
| Specific gravity | 0·767 | 0·8026 | 0·8228 |

| —— | 250°—300° | 300°—350° | Residue. | Loss. |
|---|---|---|---|---|
| Grammes | 43 | 27 | 561 | 12 |
| Per cent. | 5·1 | 3 1 | 70·1 | 1·75 |
| Specific gravity | 0·8345 | 0·9037 | .. | .. |

The fractions showed percentages of S respectively as follows:—0·28, 0·42, 0·50, 0·51, 0·86, 0·70, while their percentage Br absorption was 0·67, 1·12, 3·49, 8·39, 14·4, 17·8.

This oil is still more prone to "crack" than is Ohio oil, and above 200° the "cracking" is considerable; moreover, some of the distillates have a tendency to polymerise if heated after long standing.

When these two petroleums are distilled under reduced pressure they compare as follows:—

| —— | 100° | 100°—150° | 150°—200° | 200°—250° |
|---|---|---|---|---|
| Percentage in Canadian oil. | 6·00 | 11·3 | 11·1 | 13·3 |
| Percentage in Ohio oil. | 18·6 | 19·8 | 15·1 | 18·0 |

| — | 250°—300° | 300°—350° | Residue. |
|---|---|---|---|
| Percentage in Canadian oil. | 12·2 | 10·4 | 31·2 |
| Percentage in Ohio oil. | 6·2 | | 20·9 |

Whilst from the following tables comparisons with other petroleums may be made :—

| — | Baku. | | Pennsylvania. | |
|---|---|---|---|---|
| Temp. | Per Cent. | Sp. Gr. | Per Cent. | Sp. Gr. |
| 120—150 | 0·5 | .. | 19·75 | .. |
| 150—200 | 10·9 | 0·786 | 8·75 | 0·757 |
| 200—250 | 12·8 | 0·824 | 15·23 | 0·788 |
| 250—320 | 24·7 | 0·861 | 20·7 | 0·809 |
| Residue | 52·1 | .. | 35·57 | .. |

| — | Canada. | | — | Ohio. | |
|---|---|---|---|---|---|
| Temp. | Per Cent. | Sp. Gr. | Temp. | Per Cent. | Sp. Gr. |
| 115—150 | 2·75 | 0·767 | 110—150 | 9·75 | 0·7282 |
| 150—200 | 7·8 | 0·8026 | 150—220 | 16·63 | 0·7669 |
| 200—250 | 9·5 | 0·8228 | 220—257 | 10·75 | 0·7940 |
| 250—300 | 5·1 | 0·8345 | 257—300 | 9·75 | 0·8138 |
| 300—350 | 3·1 | 0·9037 | 300—350 | 8·63 | 0·8242 |
| Residue | 70·10 | .. | Residue | 43·00 | .. |

The author gives an account of the present state of knowledge with regard to the constituents of other petroleum, and to this the reader is referred (*vide* J. Franklin Inst. **834**, pages 416—421) ; while, with the aid of the American Academy of Arts and Sciences, and of the C. M. Warren Fund for Chemical Researches, the author and his assistants have undertaken the complete qualitative and quantitative investigation of all the constituents of sulphur petroleum. So far, he has only reached the fractions (see preceding tables) collected up to 150°, under atmospheric pressures.

The present results of this vast programme may be briefly classified as follows :—

*A. Ohio Sulphur Petroleum* (being the crude oil produced by the Peerless Refining Company, of Findlay Ohio).

1. *Substances shown to be present :—*

*a.* Hydrogen sulphide.

*b.* Butane, pentane, isopentane, hexane, isohexane, heptane, octane, nonane.

*c.* Benzene, toluene, paraxylene, metaxylene, orthoxylene (?) (ethylbenzene and hexahydromesitylene ?).

*d.* Hexahydro-isoxylene (octonaphthene of Markownikoff).

*e.* Methyl, ethyl, propyl, butyl, isobutyl, pentyl, ethylpentyl, hexyl sulphides, and other sulphur compounds not yet identified. (These bodies amount "to at least 5 per cent. of the crude oil.")

2. *Substance occurring in certain other Petroleum, but proved to be absent from this Sulphur Petroleum :—*

*d.* Hexahydrobenzene.

*B. Canadian Sulphur Petroleum* (being crude oil and various manufactured oils and residues from Messrs. Samuel Baker and Co., of Petrolia).

1. *Substances shown to be present :—*

*a.* Hydrogen sulphide.

*b.* Hexane, isohexane, heptane, isoheptane, octane, nonane.

*c.* Benzene, toluene, paraxylene, metaxylene, orthoxylene (?).

*d.* Hexahydro-isoxylene.

*e.* "Several members of the $(C_nH_{2n+1})_2S$ series" and "evidence of sulphides of another series."

*C. Kentucky and California Sulphur Petroleums.*—These have not yet, apparently, been examined in detail as to their constituents ; but, concerning the Californian oil, the author states that it is quite different from any other American petroleum. Its specific gravity is very high (0·875—1·053) ; and, without resorting to cracking, there is very little burning oil distillate. The percentage of sulphur is higher than that of the other sulphur petroleum, as is also the percentage of nitrogen (0·56—1·12).

The author states that the ethereal sulphides have a pronounced solvent action upon certain metals, such as lead, solder, zinc, &c., and in some cases even the mercury compounds can only be decomposed by the prolonged action of $H_2S$ on the hot oil (though usually it is as a crystalline precipitate of $R_2S$, $HgCl_2$, readily decomposable by $H_2S$ when suspended in alcohol, that the sulphides are removable from the oil). The above facts throw additional light upon the known solvent action of certain petroleums upon metals, attributed by Macadam (J. Chem. Soc. **34**, 355) to their hydrocarbons, but by Engler (Ber. **12**, 2186) to solution of metallic oxides in acid compounds, produced by oxidation from certain constituents of the oil.—E. R. B.

*Utah Gilsonite, a Variety of Asphalt, Investigation of.* W. C. Day. J. Franklin Inst. **140**, [3], 221—237.

Bitumens formed the subject of analytical experiments by Boussingault and Völckel, but neither of these investigators appears to have detected the presence of nitrogen or sulphur. Kayser, on the other hand, claimed to have obtained 10 pure fractions containing sulphur from Syrian asphalt-oil, and gave them formulæ derived from ultimate analyses. His results, however, need confirmation, on account of the boiling points of the fractions having been given in round numbers instead of in exact ranges. As beyond these researches and those of Peckham there has been little, if anything at all, published which affords indication of the real nature of the asphalts, or accurately describes pure products obtained therefrom, the author has endeavoured to isolate from gilsonite "such single hydrocarbons, or classes of hydrocarbons, as would give some information as to the nature of the material itself."

This mineral is entirely soluble in carbon bisulphide, and almost to the same extent in ether, but only a little over one-half can be brought into solution by repeated treatment with hot alcohol. Glacial acetic acid and chloroform are also partial solvents, and petroleum ether will extract nearly the whole of the substance after about 30 successive treatments. The dissolved portions and the residues differ according to the solvent employed ; for instance, the substance soluble in petroleum ether is when evaporated, black, hard, and brittle, whereas that obtained from the alcoholic solution is a soft, reddish-brown solid, becoming fluid at 100° C.

Subjected to analysis, gilsonite is found to contain 56·46 per cent. of volatile matter, 43·43 per cent. of fixed residue and 0·10 per cent. of ash, its average elementary composition—determined by combustion with lead chromate in a current of oxygen—being 88·30 per cent. of carbon, 9·96 per cent. of hydrogen, 1·32 per cent. of sulphur, 0·10 per cent. of ash, and 0·32 per cent. of oxygen and nitrogen (undetermined). Sauer's method for the determination of sulphur proved unsuitable, owing to the frothing up of the gilsonite during distillation, whereby some of the evolved vapour escaped combustion, but a combination of the Carius and Eschka processes was found satisfactory.

When distilled by steam a very small portion of colourless oil, having a pleasant odour, was condensed, but was too minute to examine further. Distilled dry, the temperature rapidly rose to 300° C., and the distillate, at first pale, became finally reddish-brown with green fluorescence, and had an unpleasant odour. Ammonia was freely evolved towards the end of the operation. The distillate, re-distilled with steam, separated into a readily-volatile oil and a tarry residual oil, the former of which, after some 30 agitations with concentrated (and fuming) sulphuric acid, and subsequent washing with water and drying over calcium chloride, yielded a water-white oil resisting the action of concentrated nitric and sulphuric acids, and which was (from its behaviour on distillation), probably a complicated mixture of paraffin hydrocarbons. If, instead of using strong sulphuric acid with the volatile oil, it is warmed for some time with dilute acid, and the dissolved substances precipitated by sodium hydrate, a brown oil, having an odour resembling quinoline, is obtained. This occurrence confirms the connection between gilsonite and the California petroleums, and indicates their animal origin.

The tarry residual oil from the steam distillation was dried and distilled to five fractions, the lowest of which, on redistillation, all passed over, except a few drops, at 300° C., showing that the others had higher boiling points. The highest fraction, treated with concentrated nitric acid, gave a semi-solid oil, which was converted into a purple solid with a musky odour by the continuous action of dilute warm nitric acid.

When gilsonite is acted on by a considerable excess of concentrated nitric acid for about 24 hours it dissolves, and if the solution be poured into water a flocculent brown precipitate is produced. This precipitate, washed to remove the nitric acid, and dried, is separable into three portions: one, soluble in alcohol, being a dark, brittle substance; another, soluble in ether, forming a hard, shiny, reddish-yellow varnish-like substance, which is apparently a pure organic acid; and the third, a small residue. From the filtrate was obtained, after a series of extractions and purifications, a crystalline acid body soluble in water. Some of the acids obtained seem to resemble the acid naphthene derivative found in Wallachian petroleum by Hell and Medinger, and it is hoped that the study of these compounds will lead to a knowledge of the hydrocarbon constituents of the mineral. So far it would appear that the paraffins, and probably also the naphthenes, are represented, but no aromatic hydrocarbons have been detected. It is considered that, owing to the risk of decomposition by distillation, the products resulting from the reaction of such reagents as nitric and sulphuric acids will afford a sounder basis for deductions than the first-named method.—C. S.

### *Asphalts and Bitumens.* S. P. Sadtler. J. Franklin Inst. **140,** [3], 198—212.

Following the classification adopted by Peckham, the author applies the term asphalt to the solid bitumens, calling such as are of semi-liquid consistency, maltha. The chief sources of the latter bitumens occur in Southern California, and the crude "mineral tar" is often mistaken for petroleum residue, from which, however, it differs by containing from 12 to 15 per cent. of water (instead of merely 1 or 2 per cent.) in such a state that a temperature of or above boiling point is required to effect its removal. The presence of air, carbon dioxide, and hydrogen sulphide in the crude maltha causes frothing at about 100° F., and fills the apparatus with foam before any of the water has passed over.

A liquid bitumen of similar class is the "liquid asphalt" found, oozing into a bed of sea-sand from a subjacent stratum of shale, in Santa Barbara County, Cal. This maltha is freed from the sand by mechanical means, and is then sold as "Alcatraz liquid asphalt."

Of the solid bitumens, the purest are known as "glance pitch" or "gum asphaltum," one of the most important being the "gilsonite," found in Utah, and containing between 90 and 98 per cent. of bitumen soluble in carbon bisulphide, on account of which the mineral is extensively used in making varnishes and insulating compositions.

The most considerable deposits of asphalt occur in intimate association with inorganic substances. Such are the asphalts of Trinidad, Bermuda, California, Cuba, and Syria, and the asphalt rocks of Seyssel, Val de Travers, Ragusa (Sicily), Limmer, Texas—these consisting of limestone and bitumen—California, Utah, and Kentucky (in which sandstone forms the inorganic constituent). In Trinidad asphalt there are approximately 40 per cent. of bitumen, 34 per cent. of earthy matter, 9 per cent. of vegetable matter, and 17 per cent. of water, before refining. After exposure to a temperature of some 300° F. to allow the earthy bodies to settle down, the vegetable matter to be skimmed off, and the water to evaporate, the percentage of bitumen (soluble in $CS_2$) amounts to about 60 and the earthy matter to 36 per cent. Bermuda asphalt is much purer, consisting, in a crude state, of about 90 per cent. of bitumen, increased by refining to 97 per cent., and holding in the latter condition only about $1\frac{1}{3}$ per cent. of mineral matter. The La Patera (Cal.) asphalt contains 59 per cent. of bitumen and 40 per cent. of mineral matter (fine silica, free from clay and organic matter); and the Kern County asphalt is still purer (about 85 per cent. of bitumen and nearly 9 per cent. of mineral matter—highly absorbent infusorial earth). In general the proportion of bitumen in the bituminous limestones ranges from 5 to 14 per cent., that from Uvalde County, Texas ("lithocarbon") containing from 15 to 33 (with an average of 20) per cent. of a very elastic bitumen. The bituminous sandstones of the United States contain between 12 and 18 per cent. of bitumen, and, being readily pulverised when hot, are employed for street paving. That from Utah is frequently so rich as to require dilution with sand before being available for this purpose.

Respecting the chemical composition of bitumen, the products ("petrolene" and "asphaltene") obtained by Boussingault from Pechelbronn maltha can no longer be regarded as definite chemical compounds, but rather as mixtures. The first named is extracted by petroleum ether, acetone, or ethylic ether, and is tough, viscid, and of great cementing quality, whereas "asphaltene"—obtained by the solvent action of hot turpentine, chloroform, or carbon bisulphide—is brittle and dry. However, it has lately been shown by Miss L. A. Linton (Chem. News, **71,** 9) that the proportions of these extracts will vary considerably according to the solvents employed, and it therefore becomes necessary to know, in addition, the nature of the bitumens if we are to compare the results of analyses where only general statements of percentages are given. The following pair of analyses afford a good example:—

| —— | Total Bitumen. | Per Cent. of Total Bitumen soluble in Acetone. | Per Cent. of Total Bitumen left, soluble in Chloroform. |
|---|---|---|---|
| Crude black asphalt | 84·79 | 67·50 | 32·50 |
| Crude brown asphalt | 82·08 | 21·30 | 78·70 |

In point of elementary composition the bitumens vary considerably, some, like the Trinidad, Bermudez, and Syrian asphalts, containing notable quantities of sulphur, whereas the Californian asphalts and maltha have very little sulphur, but always contain nitrogen as pyridine and quinoline bases, a circumstance pointing to their animal origin. Peckham (Amer. Journ. of Science, September 1894, 254) has described the changes produced in crude petroleum by the action of oxygen on the esters contained therein, and traced the evolution of asphaltum through the intermediate stage of maltha.

The employment of asphalt in the arts is extensive, and varies with the degree of purity of the bitumen and also with the nature of the associated bodies in the mixture. The asphalts rich in bitumen are used in making varnish, insulating composition, and waterproofing, whilst the limestone and sandstone asphalts are mainly employed as roofing or paving material, for which purposes they are heated and spread out to be tamped or rolled until a smooth, compact surface is produced. In some cases refined asphalt, and in others sand or fine gravel, is incorporated along with the native asphalt before use. One essential for the production of a satisfactory paving composition is a high ratio of "petrolene" to "asphaltene" in the mixture, another important point being the nature of the bituminous or oily addition (when such is made). For this latter purpose malthas or natural "liquid asphalts" will be found to unite better and form a more durable paving than if, as is sometimes the case, petroleum residue be used.—C. S.

### *Bone Black, Decarbonisation of.* W. D. Horne. J. Amer. Chem. Soc. 1895, **17,** 503.

*See under* XVI., *page* 977.

## PATENT.

### *Ammonia and By-Products, Improvements in and relating to the Manufacture of.* H. H. Lake, London. From C. Pieper, Berlin, and C. Fellner, Frankfort. Eng. Pat. 22,207, November 16, 1894.

Turf or peat is broken up and placed in a retort, where it is dried. Heating at a low temperature is continued to obtain as much as possible of volatile substances, such as tar, &c. After this operation still more heat is applied to the coke which remains, and which contains nearly all the nitrogen, and at the same time superheated steam is admitted. The steam decomposes the coke, with formation of carbonic oxide and hydrogen, which latter, in its turn, combines with the nitrogen to form ammonia, care having been taken to maintain a temperature incapable of decomposing the ammonia formed. The remaining coke is used for the manufacture of fuel in blocks.—J. R.

## IV.—COLOURING MATTERS AND DYES.

*Catechu (Cutch) and "Kath" from the Wood of Acacia Catechu, Isolation of.* Imp. Inst. J. (Research Department), 1895, 399.

The first number of the *Forest Series of the Agricultural Ledger* (1895) contains a valuable contribution on this subject. The acacia catechu is a small tree, belonging to the leguminosæ; its heart-wood is dark red, and is used for a variety of purposes where durability and hardness are essential. The natives who prepare the extract known as *dark Catechu* or *Cutch* first remove the bark and sapwood, and then cut the red heart-wood into chips, which are boiled in water in earthen pots for 12 hours. The water is evaporated one-half, the chips removed, the extract boiled down with continual stirring in iron pans, and finally allowed to cool in a wooden frame or mould.

Pale catechu or "kath" is the result of a slightly different process. A bunch of twigs is placed in the hot extract, and the pots are left to cool. The kath is deposited upon the twigs in a crystalline form and the crystals are compressed into cakes. It is eaten by the natives, and not exported. The active principle is catechin, $C_{19}H_{20}O_5$. The active principle of cutch is the variety of tannin known as catechu-tannin.

Dr. Leather has recently undertaken a series of experiments to ascertain (1) what quantities of crude catechin and catechu-tannin are contained in certain samples of wood, and (2) by what process those substances could be most easily obtained. The total amount of crude catechin in two samples of wood was found to be 7·18 and 6·43 per cent., and of crude catechu-tannin 7·61 and 9·02; total extract 14·79 and 15·45 per cent. The following conclusions were drawn from these experiments :—

1. The wood should be reduced to thin shavings.
2. As little water should be used as possible, say 10 parts.
3. The boiling should be continued for half an hour only.

Further experiments on six different samples of wood showed that the amount of catechin and catechu-tannin varied greatly in different samples, and that the highest yield of catechin was not associated with the greatest yield of catechu-tannin, but the contrary. The remarkable range in yield from 0·47 to 3·61 for the former, and from 2·72 to 8·11 for the latter, makes it extremely desirable that the peculiarities of each sample should be carefully ascertained, and also that the conditions favourable to their formation, either within the tissue of the plant or during the process of manufacture, should be accurately determined.
—C. F. C.

*Azo Compounds, Laws Governing the Formation of* W. Vaubel. J. prakt. Chem. **52**, 281—288.

A certain similarity exists between the entrance of an azo group into an aromatic nucleus and the bromination of the same compound, and the influence is discussed of various substituting groups on the entering azo group, various instances also being given of combinations of azo compounds. According to Griess, the entrance of an azo group into an aromatic nucleus depends upon the presence of an amido or a hydroxyl group. The combination takes place in the para position, or in the ortho if the former is already substituted. In certain instances, however, the substituting group is replaced by the azo group, as, for example, in the case of *p*-hydroxybenzoic acid, or of resorcylic acid, $[1.2.4]C_6H_3(CO_2H)(OH)_2$, when the azo group replaces the carboxyl group. Substituents in the position meta to the amido or hydroxyl group do not affect the entrance of the azo group, and this is also the case with the groups $NO_2$, halogen, alkyl, $SO_3H$, $CO_2H$, in the ortho and para positions. The same is also true of quinonoid oxygen, since chlorodihydroxyquinone, $[1.1.2.3]C_6H_2.O_2.Cl.OH$, will combine with diazo compounds. Pyrocatechol will combine with diazo compounds in concentrated solution, whilst quinol does not, although its benzoyl derivative will combine. Alkylated amido compounds, such as dimethylaniline, are still capable of combination, whilst alkylated hydroxyl derivatives, anisol, phenetol, &c., are not. Naphthylglycin, $C_{10}H_7.NH.CH_2.CO_2H$, is said to give colouring matters with diazo compounds. Aniline and *p*-toluidine only combine slowly with diazo compounds, whilst *p*-xylidine, $[1.4.2]C_6H_3(CH_3)_2NH_2$, combines very easily, in a manner similar to α-naphthylamine. It is also noteworthy that pyrrol and ethylpyrrol give azo and disazo compounds; and with regard to the disazo compounds of pyrrol, since pyrroldisazobenzene-β-naphthalene and pyrrol-disazo-β-naphthalenebenzene are identical, it follows that the azo groups enter the pyrrol molecule symmetrically to the nitrogen, and are either α-α- or β β-derivatives. In support of the former view, it is the carboxyl group in pyrrol-α-carboxylic acid which is replaced by the azo group, although the azo group can enter the β-position when the α positions are occupied, as in the case of α-α-dimethylpyrrol. This behaviour bears out the author's work on the bromination of pyrrol and his conclusions as to the constitution of this substance. Thienylmercaptan, $C_4H_3SSH$, will combine with diazo compounds, although phenylmercaptan will not. In the case of naphthalene derivatives, those substituted in the α-position behave like benzene derivatives substituted in the ortho position, whilst the β-derivatives are only substituted in the α-o-position. It is, however stated that 1.2-amidonaphthol will combine with diazo compounds, and the resultant colouring matter possesses the valuable property of giving metallic lakes. The examples quoted show that the bromination of a hydroxyl or an amido compound can be compared with its capability for combining with azo compounds, the differences being explained by the greater affinity of the azo group to the amido as compared with the hydroxyl group, and its lesser acidity as compared with bromine. It must also be remembered that bromination takes place in an acid solution, whilst the formation of the azo colouring matters is generally carried out in an alkaline or neutral solution, and rarely in an acid one.—T .A. L.

*Tetramethyldiamidobenzhydrolcyanide, Process for the Preparation of.* H. Weil, Munich. Ger. Pat. 75,334, September 17, 1893.

When an alcoholic solution of tetramethyldiamidodiphenylcarbinol is treated with aqueous hydrocyanic acid, crystals separate out after some time. They consist of a tetramethyldiamidodiphenylmethane-exocyanide. Nascent hydrocyanic acid acts in a similar manner. The new substance is insoluble in water, with difficulty in alcohol, and melts, when pure, at 124° C. If the methane-exocyanide be dissolved in glacial acetic acid, and then treated with 1 mol. of lead peroxide, an intensely green liquid is obtained, from which, after dilution with water, bluish-violet crystals are precipitated on addition of common salt. These crystals have a yellowish-green reflex, and they represent the hydrochloride of the tetramethyldiamidodiphenylcarbinol exocyanide. The diphenylcarbinol exocyanide exhibits the peculiar capacity of condensation under the influence of zinc chloride, with a series of aromatic substances, as well as with the salts of ammonium and the aliphatic bases. The tetramethyldiamidodiphenylcarbinol exocyanide is proposed as a material from which dyestuffs may be prepared.
—W. S.

*Extracts of Fustic, Interpretation of some Results in the Analysis of.* C. B. Boyer. J. Amer. Chem. Soc. 1895, **17**, 519.

*See under* XXIII., *page* 993.

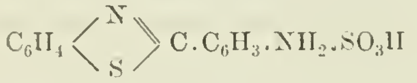
## PATENTS.

*Manufacture of Stable [Non-Explosive] Diazo Compounds in Concentrated Liquid or Solid Form.* O. Imray, London. From "The Farbwerke vormals Meister, Lucius, and Brüning," Höchst-on-the-Maine, Germany. Eng. Pat. 21,227, November 5, 1894.

The process depends upon the fact that diazo compounds are stable in presence of an excess of a mineral acid, and that solutions of these compounds may be evaporated to a syrupy consistence at temperatures not exceeding 45° C. without decomposition. In order to obtain the compounds in a dry state, the syrups obtained are mixed with anhydrous sodium sulphate or calcined alum. The preparation of dry diazotised *p*-nitraniline is carried out as follows:—14 kilos. of *p*-nitraniline are diazotised with 7 kilos. of sodium nitrite and 17 kilos. of sulphuric acid (66° B.) in an aqueous solution as concentrated as possible. After filtering, the diazo solution is evaporated in a lead or copper vacuum pan at a temperature not exceeding 45° C. When the mass has become syrupy or pasty, it is mixed with an equal weight of dry sodium sulphate or calcined alum, and thus obtained as a dry powder; or 50 kilos. of sodium sulphate or 15 kilos. of alum may be added to the diazo solution, which is then evaporated to dryness. Hydrochloric acid, sodium bisulphate, or sulphate of alumina may be substituted for the sulphuric acid employed in the example given. Diazodianisidine may be obtained in the same way. For the preparation of the diazo solution from these compounds, they are dissolved in water and neutralised with an alkali or with sodium acetate. The *p*-nitraniline product is known commercially as Azophor PN.—T. A. L.

*Production of Dehydrothio-aniline Sulphonic Acid and of [Red] Colouring Matters therefrom.* A. G. Green and R. Jansen, Manchester. Eng. Pat. 21,786, November 12, 1894.

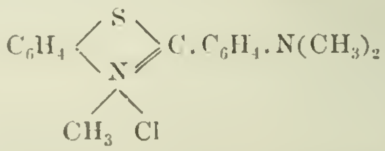
According to Fr. Pat. 216,086, a lower homologue of dehydrothio-*p*-toluidine is obtained by heating together *p*-toluidine, aniline, and sulphur. When the base so obtained is treated with fuming sulphuric acid, it yields a sulphonic acid which probably has the constitution—



The substance is a whitish powder, sparingly soluble in water with a bluish fluorescence, and forms easily soluble alkaline salts. The ammonium salt, as distinguished from that of dehydrothio-*p*-toluidine sulphonic acid, is easily soluble in water, and crystallises in small colourless needles. The so-called dehydrothio-aniline sulphonic acid may be converted into colouring matters by two methods, either by combination with certain diazo compounds or by diazotisation and combination with amines, phenols, and their derivatives. For the preparation of the thiobenzenyl base, 107 kilos. of *p*-toluidine, 140 kilos. of aniline, and 128 kilos. of sulphur are heated for 24 hours until the loss of sulphuretted hydrogen amounts to 103 kilos. and the temperature has risen to 240° C. In order to purify the base, it is distilled, freed from aniline, and crystallised from amyl alcohol, when it forms yellow crystals melting at 151° C. The base is converted into the sulphonic acid by dissolving 100 kilos. in 400 kilos. of 95 per cent. sulphuric acid and slowly adding 400 kilos. of fuming sulphuric acid (70 per cent. of $SO_3$) until a sample dissolves to a clear solution in sodium carbonate. The melt is then poured into water, and the precipitated sulphonic acid, after having been washed free from sulphuric acid, is converted into the sodium salt. A greenish-yellow colouring matter for cotton can be obtained from it by dissolving 32·75 kilos. of the sodium salt in an excess of sodium carbonate and running in the diazo solution from 13·75 kilos. of *p*-nitraniline, keeping the mixture alkaline. After standing several hours, the whole is warmed to 70° C. and the colouring matter is salted out. The following method describes the preparation of a colouring matter by the diazotisation and conjugation of the sulphonic acid:—32·75 kilos. of sodium dehydrothio-aniline sulphonate and 7·25 kilos. of sodium nitrite are dissolved in 1,000 litres of water and acidified with about 10·2 litres of 30 per cent. hydrochloric acid. The diazo compound so obtained is added to a solution containing 14·5 kilos. of β-naphthol, 4 kilos. of caustic soda, and 10 kilos. of strong ammonia in 500 litres of water. The colouring matter which separates is filter-pressed and dried, and dyes wool red from an acid bath.
—T. A. L.

*New Basic Yellow Colouring Matter, Production of a.* A. G. Green and R. Jansen, Manchester. Eng. Pat. 21,787, November 12, 1894.

According to Eng. Pats. 6319 and 14,884 of 1888 (this Journal, 1888, 620, and 1889, 771), the trialkylammonium salts of dehydrothio-*p*-toluidine are valuable basic colouring matters for silk and tannin-mordanted cotton. The lower homologue of these products, which can be obtained by alkylating the thiobenzenyl base referred to in the preceding specification, possesses similar properties, but dyes a yellow somewhat greener in shade than the *p*-toluidine derivative. The following proportions are given:—25 kilos. of the thiobenzenyl base melting at 151° C., 22·7 litres of methyl alcohol, and 13·6 litres of 40 per cent. hydrochloric acid are mixed and heated in an autoclave for 12 hours to 160°—170° C. The melt is then dissolved in water, filtered, and the colouring matter salted out. It probably has the constitution—



and is a yellow powder which dyes a somewhat greener shade than Thioflavine T. In place of alcohol and a mineral acid, methyl bromide or benzyl chloride can be employed.
—T. A. L.

*Red Direct Cotton Colouring Matters, Improvements in the Manufacture of.* A. G. Green and R. Jansen, Manchester. Eng. Pat. 21,788, November 12, 1894.

The thiobenzenyl base referred to in the above specification, 21,786, is after diazotisation combined with an α-naphthol sulphonic acid, or with a derivative thereof, in which at least one hydroxy- and sulphonic acid group have the relative positions 1:3. Such compounds, for example, are, 1.3-naphthol sulphonic acid, 1.3.1′-naphthol disulphonic acid, 1.1′.3.3′-amido naphthol disulphonic acid, 1.1′.3.3′-dihydroxynaphthalene disulphonic acid, &c. About 22·5 kilos. of the thiobenzenyl base suspended in 200 litres of water and about 13·6 litres of 30 per cent. hydrochloric acid, and cooled with ice, are diazotised with 7·25 kilos. of sodium nitrite. The clear solution obtained, is run into 300 litres of water containing 30·5 kilos. of α-naphthol-ε-disulphonic acid [$OH:(SO_3H)_2 = 1:3:1'$], and 20 kilos. of dry sodium carbonate. The colour which separates is filter-pressed and dried, and dyes cotton bright red from an alkaline or salt bath. The colouring matter is a lower homologue of Erika B (Eng. Pat. 17,333 of 1888; this Journal, 1889, 980) and gives a yellower shade of red than this dyestuff.—T. A. L.

*The Production of Mixed [Blue] Disazo Dyestuffs from Delta-amido-naphthol.* S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 22,273, November 17, 1894.

By combining tetrazo compounds with δ-amido-naphthol, dyestuffs are obtained which are quite insoluble in water. If, however, the intermediate compound, from one molecular proportion of a tetrazo compound and one molecular proportion of a disulphonic acid of an amido-naphthol or a hydroxynaphthalene, be further combined with δ-amido naphthol, the resulting colouring matter is soluble and dyes blue to blue black shades fast to light and washing. For example, the tetrazo compound from 24·4 kilos. of dianisidine is added quickly to a solution of 32 kilos. of 1.1′.3.3′-dihydroxynaphthalene disulphonic acid kept alkaline by means of sodium carbonate. A solution containing 16 kilos. of δ-amido-naphthol and 4 kilos. of caustic soda is then added, and the dyestuff, which forms immediately, is salted out. It dyes unmordanted cotton a dark greenish-blue, very fast to light and washing. The dianisidine may be replaced by another *p*-diamine, such as tolidine, whilst other disulphonic acids which may be employed are the 1.1′.2.4 and 1.1′.3.3′.-amidonaphthol-disulphonic acids and the 1.1′.2.4-dihydroxynaphthalene disulphonic acid.—T. A. L.

*The Manufacture or Production of [Indigo Blue] Dye-Stuffs and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 22,454, November 20, 1894.

According to Eng. Pat. 9610 of 1894 (this Journal, 1895, 478) *m*-tolylene diamine is phenylated in the amido group para to the methyl group when heated with aniline or its homologues in presence of an acid. When these compounds are heated with naphthols in presence of a condensing agent, the ortho-amido group is substituted by the naphthyl radicle, yielding, for example, phenyl-β-naphthyl tolylene diamine—

$$1.2.4\text{-}C_6H_3.CH_3.NHC_{10}H_7.NHC_6H_5.$$

This substance can be obtained by heating together 1 kilo. of phenyl-*p*-amido-*o*-toluidine and 2 kilos. of β-naphthol for 20 hours to 280°—320° C., whilst a current of carbon dioxide is passed through the mass. After cooling, and extracting with soda-lye, the residue is crystallised from benzene and petroleum spirit, and after recrystallisation from alcohol, separates in white scales, melting at 120° C. Higher homologues can be obtained in a similar manner, and symmetrically substituted *m*-phenylene diamines may be obtained by heating for example *m*-amidodiphenylamine and β-naphthol as above. The specification further describes the production of azine dyestuffs from these products by condensing them with the nitroso derivatives of secondary or tertiary amines, or with *p*-quinone diimides or chloroimides, or with certain amido-azo compounds; or else by oxidising them together with *p*-diamines, alkylated *p*-diamines or their sulphonic acids. For instance, 10 kilos. of phenyl-*p*-amido-β-naphthyl-*o*-toluidine are dissolved in 100 litres of alcohol and 8·6 kilos. of nitroso-dimethylaniline hydrochloride are gradually added, and the mixture stirred until the nitroso compound has disappeared. A further quantity of 8·6 kilos. of the nitroso-compound and 3·1 kilos. of zinc chloride is then added, and the whole is boiled until the formation of the colouring matter is complete. The melt is then diluted with water, and the dyestuff salted out. It gives bright indigo-blue shades on tannin-mordanted cotton fast to washing and light. The following example describes the preparation of a colouring matter from an azo compound:—A mixture of 5·2 kilos. of phenyl-*p*-amido-β-naphthyl-*o* toluidine, 4·3 kilos. of benzene-azo-α-naphthylamine hydrochloride, and 20 kilos. of phenol, is heated on the water-bath until the presence of an azo-compound can no longer be detected. The melt is then diluted with water, supersaturated with soda-lye, and the precipitate is filtered off and pressed. After adding acetic acid, the press cake is extracted repeatedly with boiling water, and the dyestuff is salted out from the combined filtrates, after adding hydrochloric acid. The colouring matter dyes reddish-violet shades on tannin-mordanted cotton. For the preparation of a colouring matter by the oxidation method, 3·2 kilos. of phenyl-*p*-amido-β-naphthyl-*o*-toluidine and 2 kilos. of *p*-amido-diethylaniline hydrochloride are dissolved in 50 litres of alcohol, the whole being oxidised by gradually adding 3 kilos. of sodium bichromate dissolved in the smallest possible quantity of water. After constant stirring and gently warming the melt, the dye stuff is salted out and purified by re-dissolving and again precipitating. It gives indigo-blue shades on tannined cotton.—T. A. L.

*Improvements in Dyes [Basic Cotton Blue and Violet Dyes].* L. G. Williams and A. Turner, Hounslow. Eng. Pat. 22,743, November 23, 1894.

The colouring matters referred to are obtained by the action of the hydrochlorides of the nitro-ocompounds of secondary or tertiary aromatic amines on the induline melt in presence of a solvent such as dimethylaniline, ethylaniline, or aniline. Basic cotton dyestuffs are produced, which give induline shades on a tannin mordant. For the production of one of these dyestuffs, 40 kilos. of violaniline (obtained by heating together aniline and amido-azobenzene hydrochloride) and 31 kilos. of nitrosodimethylaniline hydrochloride are gradually stirred into 40 kilos. of dimethylaniline at 70° C. After the reaction has ceased, the melt is raised to 140° C. until all the nitroso compound has disappeared, and after cooling to 40° C., it is neutralised with caustic soda, and the dimethylaniline distilled off. After grinding, dissolving in dilute hydrochloric acid, and filtering, the dyestuff is salted out, pressed, and dried, when it forms a brownish-black powder. A further claim is made for the production of colouring matters by reacting on primary aromatic amines and amido-azo compounds with the nitroso compounds of secondary aromatic amines in presence of hydrochloric acid at a temperature of 70°—175° C. (see also Eng. Pat. 17,204 of 1889; this Journal 1890, 1032).
—T. A. L.

*Fast Yellow Dyestuffs from the Sulpho Acids of Dehydrothiotoluidine or Analogous Bases, the Production of.* S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine. Eng. Pat. 22,914, November 26, 1894.

These dyestuffs are produced by the action of hypochlorites in a faintly alkaline solution on the diazo derivatives of dehydrothiotoluidine sulphonic acid or analogous compounds. 24·2 kilos. of dehydrothiotoluidine melting at 191° C. dissolved in 96 kilos. of sulphuric acid at 30°—40° C., are sulphonated with 36 kilos. of fuming sulphuric acid containing 60 per cent. of $SO_2$, at a temperature of 50° C. When completely sulphonated, the melt is poured on to ice, the sulphonic acid filtered off and dissolved in water by adding sodium carbonate. The solution, after acidulation with 46 kilos. of hydrochloric acid, is diazotised by adding 7 kilos. of sodium nitrite at about 20° C. After standing about half-an-hour, the diazo compound obtained is added to a solution containing 22 kilos. of sodium carbonate and a quantity of sodium hypochlorite corresponding to 17·7 kilos. of chlorine. The whole is allowed to stand 12 hours and is then warmed to 80° C., the colouring matter being subsequently salted out. It dyes unmordanted cotton a yellow fast to light, alkalis, and chlorine. (See also Eng. Pat. 5761 of 1892.)—T. A. L.

*The Manufacture or Production of [Black] Colouring Matters, and Materials therefor.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 23,584, December 4, 1894.

By the action of *p*-phenylenediamine on a salt of *o*-chloro-*m*-nitrobenzene sulphonic acid ($Cl:SO_3H:NO_2 = 1:2:4$) in presence of sodium acetate in an aqueous solution and subsequent decomposition with hydrochloric acid there results after reduction, the compound *p*-diamido-diphenylamine-*o*-sulphonic acid—

$$(1.4)H_2N.C_6H_4.NH.C_6H_3.SO_3H.NH_2(1.2.4)$$

which is to be employed as the base for the production of disazo colouring matters. By converting the base into its tetrazo compound, and combining this with two molecular proportions of an amido-naphthol sulphonic acid, colouring matters of no particular value are obtained, whereas symmetrical disazo dyestuffs produced by combining the compound with a *m*-diamine yield valuable colouring matters for cotton, which can be further diazotised and combined on the fibre. Mixed disazo compounds, of which the following is an example, are also valuable cotton colouring matters. The tetrazo compound from 2·8 kilos. of *p*-diamido-diphenylamine-*o*-sulphonic acid (by stirring into 300 litres of water with 3 kilos. of hydrochloric acid 20° B. and diazotisation with 1·4 kilos. of sodium nitrite in concentrated solution) is run into an alkaline solution containing 2·4 kilos. of 2.1′.3′-amido-naphthol sulphonic acid. The intermediate compound which forms quickly is diazotised by acidifying the mixture and adding 0·7 kilos. of sodium nitrite in concentrated solution. A solution of 3·8 kilos. of *m*-phenylene diamine hydrochloride is then added, the formation of the dyestuff being assisted by the addition of sodium acetate. The colouring matter, after salting out, dyes very deep black shades on unmordanted cotton fast to acids and alkalis, and has the following formula—

$$HN \begin{cases} C_6H_4.N_2.C_{10}H_4(OH)(SO_3Na).N_2.C_6H_3(NH_2)_2 \\ C_6H_3(SO_3Na).N_2.C_6H_3(NH_2)_2. \end{cases}$$

In place of the above-mentioned amido-naphthol sulphonic acid, other amido compounds may be used, preferably those which can be further diazotised, and the usual methods for obtaining different combinations may be applied.—T. A. L.

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## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*Indian Jute, some Experiments on. First Report.* Imp. Inst. J. (Research Department), 1895, 398.

These experiments are intended to throw light on the chemical history of the fibre both in the plant and during transit from India, and to indicate certain directions of probable improvements.

Under the auspices of the Indian Government a growing crop (1894) was selected and stems were cut down at critical periods of growth; the fibre was separated from the stems in the usual way, 400 lb. being operated upon in each experiment. The yields showed only small variations, viz. from 24—26 lb.

(1.) The fibre samples were sent over and analysed in the laboratory of the Institute by the methods of Cross and Bevan. The results are appended, with the remarks of the experts who examined the fibre:—

| Stage of Growth. | Moisture. | Ash. | Loss by Alkaline Hydrolysis. | | Loss by Acid Purification. | Cellulose. | Loss on Mercerising. | Nitration. Yield of Nitrate. |
|---|---|---|---|---|---|---|---|---|
| | | | (*a.*) | (*b.*) | | | | |
| 1. Before flowering ....... | 11·55 | 1·1 | 6·2 | 10·5 | 0·8 | 74·0 | 10·2 | 137·2 |
| 2. After budding.......... | 8·74 | 1·1 | 8·5 | 11·9 | 0·5 | 76·2 | 10·7 | 132·1 |
| 3. In flower............... | 10·70 | 1·4 | 9·7 | 11·6 | 0·7 | 74·1 | 12·0 | 132·2 |
| 4. In pod.................. | 10·00 | 1·1 | 8·9 | 12.0 | 2·4 | 74·8 | 8·1 | 133·2 |
| 5. Fully matured ......... | 9·72 | 0·9 | 7·3 | 11·2 | 1·4 | 76·4 | 11·0 | 136·6 |

Remarks made by Collector of Samples.

1. A fine, soft, silky fibre.
2. Quality inferior to above.
3. Quality still coarser.
4. Quality as above. (The usual time for cutting in this district.)
5. Inferior quality. Plants cut at this stage for seed only.

Remarks made by Mr. Collyer.

1. Bright yellowish, clear; mostly good strength; best of its class.
2. Bright, silky, soft; mostly strong; fairly clear.
3. Dull grey, specky; mostly tender; mixed.
4. Dull grey; of mixed strength; rather specky.
5. Bright, clear; of medium strength; rather specky.

The results of the chemical analysis taken as index of quality conform with the judgments of the experts as to commercial value.

The results show that there are no sudden changes in the composition of the fibre at the critical periods of growth, and that the *incrustation* of these lignified fibres expresses their morphological history only; the common assumption that incrustation signifies an overlaying of cellulose by non-cellulose (lignone) constituents is an error. (Compare A. Pears, Chem. Soc. J. 63, 864; 65, 471.)

(2.) The fibre, after separation, has also been treated with dilute alkaline solutions to remove the easily hydrolysable constituents.

These samples are still under examination and the results will be communicated in a later report.—C. F. C.

### PATENTS.

*Fibres extracted from the Plants, Stems, or Straws of Flax, Hemp, Ramie, or the like, Improved Means or Apparatus for De-gumming or otherwise Treating the.* T. Burrows and D. E. Radclyffe, London. Eng. Pat. 14,903, August 3, 1894.

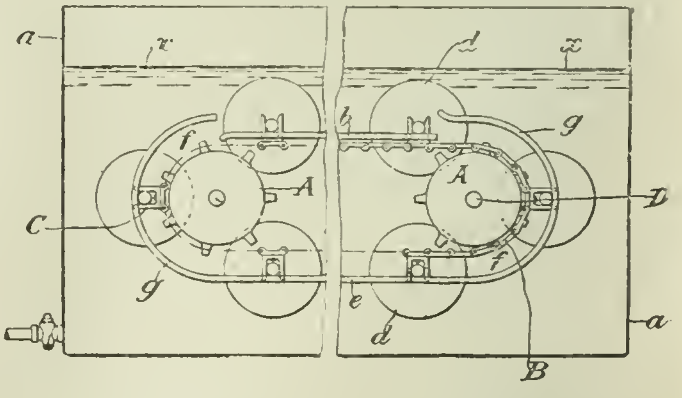
One form of the apparatus, devised for the purpose of ungumming, washing, bleaching, "or otherwise treating" the fibres specified in the title, consists essentially of a tank *a* (Fig. 1) in which are placed, along with suitable driving mechanism, two pairs of chain-pulleys A and endless chains B, carrying perforated or reticulated drums or cages *d* filled with the ribbon-like masses of the fibres to be treated.

Horizontal strips or bars of metal *b* and *c*, attached to the sides of the tank, serve to support the projecting axes *e* of the cages. The ends *g* of the lower pair of bars are curved upwards, forming guide-channels *f*.

In a second form of the apparatus (Fig. 2, see next page), discs I, affixed to shafts D, carry radial arms J with forked ends C for the reception of the projecting trunnions of the cages.

By means of these arrangements the fibrous masses are readily introduced into, or withdrawn from the tanks in which the requisite operations upon them are performed.

Fig. 1.



A tank is preferably reserved for each process, a series of tanks being employed, and the transference of the cages from one tank to another effected by an overhead crane.
—E. B.

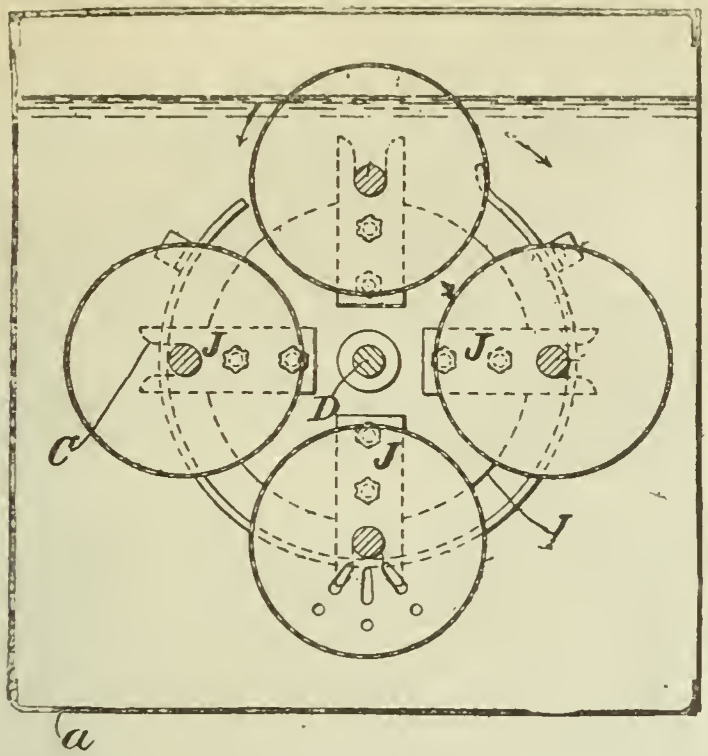
*Fibrous Peat, Cleaning and Treating, Improvements in the Process of, and Machinery or Apparatus for.* G. A. Cannot and J. Burke, London. Eng. Pat. 18,904, October 5, 1894.

Claims are made for the use of, or improvements in, the following apparatus for cleaning and preparing fibrous peat:—

1. A beating-engine, consisting of a series of breaking- and beating-cylinders and arms, with endless travelling bands for the conveyance of the peat, and screens for the separation of stones and other impurities.

2. A machine for finishing and fractionally separating the fibres, comprising a revolving drum with radial saw-

Fig. 2.



shaped teeth, feeding-rollers, an oscillating screen, and a fan and beaters for blowing the fibres into a series of chambers, in which they are deposited according to their degrees of fineness, the finest "down-like" fibres being furthest carried by the air-current, and an exhausting-fan to assist the action of the fan and beaters.

3. A finishing carding-engine :—card-cylinders, doffing cylinder and comb, toothed blades, rollers, endless moving bands having a lateral, oscillating motion, and winding rollers.

A modification of a process of preparing peat previously patented by Cannot (Eng. Pat. 8742 of 1888) is also claimed. This consists in submitting the peat successively to washing with water, treatment with caustic soda, potash, or carbonate of soda, washing, treatment with sulphuric or hydrochloric acid, and, finally, a thorough washing with water. The peat may afterwards be bleached by means of chlorine or hypochlorous acid.—E. B.

*Waterproof Fabrics, Improvements in the Manufacture of.* L. Frankenstein, Manchester. Eng. Pat. 5120, March 11, 1895.

The "proofed" surfaces of waterproof fabrics, whilst in an unfinished or sticky state, are prepared for printing upon by covering them with a fine layer of bone-dust "or material of similar chemical composition." The fabrics are then printed in the ordinary manner of calico-printing.

The bone-dust may be used in a white or bleached condition, or may be dyed prior to being applied, giving in the latter case, coloured grounds.

The proofing is vulcanised preferably after printing, although, should it be found more convenient, this may be done before printing.

A second layer of the proofing may be applied to the surface after printing, to render the colours faster.—E. B.

*The Carbonisation of Wool and other Material, Improvements relating to.* H. Schirp, Barmen, Germany. Eng. Pat. 12,012, June 20, 1895.

The principal claims are for a process of carbonising and for the use, as a whole, of apparatus adapted for carrying it out. Claims are made, in addition, for the construction and arrangement of various parts of the apparatus.

The process consists in introducing into a revolving drum, preferably of polygonal shape, which contains the materials to be carbonised, a mixture of hot, smokeless gases derived from the combustion of coke or gases, hydrochloric acid vapours, produced by letting the aqueous acid drip into a pot placed on the fire-grate where the coke or gases are burnt, hydrochloric acid vapours, generated from a mixture of hydrochloric and sulphuric acids, and air, heated by a passage along with the other gases through the combustion chamber and flue, the whole being intimately mixed in a system of zigzag flues before entering the drum. The gases are drawn into the drum by an exhauster which sends them afterwards through flues filled with wet coke or other absorbent material. A bye-pass is, further, arranged to lead the gases from the exhauster back to the furnace, in case they should not have been sufficiently burnt.—E. B.

*Raw Silk, an Improvement in.* C. Ris-Kummer, Basle, Switzerland. Eng. Pat. 15,152, August 12, 1895.

The sericin-coating of the silk fibre is rendered insoluble by treatment with a fatty aldehyde, by preference formaldehyde.

This is effected by placing the raw silk in the form of threads, or in a woven, knitted, plaited, or other condition, in a $\frac{1}{4}$—$\frac{1}{2}$ per cent. solution of formaldehyde, and allowing it to remain therein for about three hours at the ordinary temperature. The silk is then rinsed in water and dried. The traces of formaldehyde left in it may, if desired, be removed by means of ammonia.

The sericin modified in this manner is quite insoluble in acid, hot soap, and dilute alkaline solutions. The silk so treated is, moreover, stronger than ordinary raw silk and its dyeing properties are modified.—E. B.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Turkey-Red Oil for the Bleaching of Cotton Goods.* G. G. Hertel. Höchst-on-the-Maine. Ger. Pat. 75,435, March 30, 1893.

The cotton goods are either soaked with Turkey-red oil, dried and then boiled under pressure with caustic soda-lye, washed, soured, and soaped, or else at once boiled under pressure with caustic soda-lye and Turkey-red oil together, without previous preparation, and afterwards subjected to further treatment as described. The process is said to be particularly suited to the case of Mako cotton, which hitherto could only be bleached by means of strong chloride of lime solutions. The bleached cotton is said to be pure white, free from oxycellulose and lime salts, and suited especially for alizarin dyeing.—W. S.

*Comparative Dye Tests, Accuracy of the Method of.* C. S. Boyer. Amer. Chem. J. **17**, 1895, 468—472.

The relative values of a number of samples of sumac extract and logwood were determined by comparative dye-tests, and were found to accord very closely with those obtained by analysis (by absorption of the sumac-tannic acid and hæmatoxylin and hæmateïn with hide-powder).

The method of estimating the colouring-values of dye-stuffs by comparative dye-trials has the distinctive advantages of readily showing admixtures of other colouring matters in the sample under examination, and in some instances of affording an indication of the process of manufacture followed. Thus, logwood-extract which has been treated with hydrogen dioxide gives evidence of this by dyeing ordinary chrome-mordanted wool more rapidly than unoxidised logwood-extract.—E. B.

*Dyeing Leather with Basic Colours.* Paul Bertram. Färber Zeit. **6**, 1895 [19], 293.

The author considers the use of tartar-emetic only necessary as a fixing agent in the dyeing of leather with basic colours, when the uncombined "tannin" is not removed from the leather. It may, however, be used with advantage in the case of dark colours such as Philadelphia-yellow, Philadelphia-brown, Ethyl-green, and Auramine, giving, however, a darker and fuller shade. With Fast-blue B, on the other-hand the shade becomes lighter by its use. With light colours, blue or rose, tartar emetic should not be used, or a brownish tinge will be produced. The strength recommended is 1 grm. per litre. The author maintains that a weak bath of sulphuric acid for 10 minutes previous to dyeing, washing thoroughly, produces a better result, the leather being more pliable and of a more even tint.

In order to remove the uncombined tannin from skins to be dyed, such as "skivers," "calf-skins," and "Moroccos," skivers should be soaked in water at 30°—35° C. for about half an hour, moving them frequently to avoid sticking together. They should then be placed one by one in a revolving drum about 10 ft. diameter, and revolved for about 10 minutes in 10—12 litres of water at 30°—35° C. per dozen skins. The water is then allowed to run off, and the process is repeated with 10—12 litres per dozen of fresh water at the same temperature for a few minutes, after which the skins are taken out, rinsed well in cold water, and if to be dyed in pairs, they are pressed together, with a brass "sleeker."

The treatment for calf-skins and Moroccos is similar. The former, however, are "drummed" for 4—5 hours, and Moroccos 3—4 hours. Skins prepared thus are freed from all uncombined "tannin," and will take the dye in a regular shade. Only so much tannin is left in the skins as is necessary to fix the colour.—J. G. P.

## PATENTS.

*Fast Azo Colours upon the Fibre, a Process for the Production of.* O. Imray, London. From Farbwerke, vorm. Meister, Lucius, and Brüning, Germany. Eng. Pat. 14,601, July 30, 1894.

By the simultaneous addition of copper salts, a very favourable effect is produced, not only with dianisidine or diphenetidine (as previously known), but also with other diazo-compounds which can be combined with β-naphthol on the fibre. Thus, a beautiful dark and particularly fast black can be obtained by causing the diazo or tetrazo compound of aniline or of a toluidine or xylidine or their nitro-derivatives, or a phenylene- or toluylene-diamine, or the diazo or tetrazo compound of amido-diphenylamine, benzidine, tolidine, amido-azo-benzene or toluene, or of a naphthylamine as a mixture with the tetrazo compound of dianisidine or diphenetidine, in the presence of copper salts and Turkey-red oil, to act on β-naphthol-sodium upon the fibre. The black can be resisted by means of tin crystals.—W. E. K.

*Dyeing Yarns and Slubbings or Rovings, or otherwise Treating the same with Liquids, Improvements in Apparatus for.* J. Pritchard and F. A. Blair, Galashiels, Selkirk. Eng. Pat. 17,172, September 10, 1894.

This invention relates to apparatus for dyeing yarn, &c., of that kind in which a semi-cylindrical vat has in its axis a rotating shaft carrying two or more main frames or sets of radial arms, which at their outer parts carry smaller frames for holding the yarn. It consists in detail improvements in these smaller frames, and in the mechanism for turning them, and in means for equalising the temperature of the liquid in the vat.—W. E. K.

*Colour Printing and Apparatus therefor, Improvements relating to.* J. Bachelerie, Paris. Eng. Pat. 18,442, September 28, 1894.

This process is applicable for the multiple printing of engravings and the like, or for producing superposed tints upon the already coloured sheet. From a sheet of felt, or the like, shapes are cut, the outlines of which represent a single colour, and after the various pieces of felt have been saturated each with its proper colour, they are reunited to form the inking plate. The colours are then transferred by means of a suitable press on to a sheet or plate of india-rubber, glass, or celluloid, either plain, strippled, or engraved with the drawings or characters to be printed, and from this the impression is taken on to the sheet or surface to which the print is to be applied.—W. E. K.

*Dyeing Skins, Improvements in Machinery or Apparatus for.* R. Ergang, Magdeburg, Germany. Eng. Pat. 19,127, October 12, 1894.

This invention relates to machines for dyeing skins, in which the skin is placed upon a rotating table to the centre of which the dyeing liquid is supplied, and is then caused by centrifugal force to spread over the whole skin. Hitherto the liquor thrown off has been raised by a pump and re-poured on to the centre of the table. By the present invention the pump is dispensed with and the circulation of the liquor rendered automatic. This is effected by forming a channel at the edge of the table by means of an inwardly and upwardly-bent flange, and by providing a flexible pipe arranged above the table in such a manner that the dyeing liquid collecting in the channel and participating in the rotatory motion of the table, will be caused to pass through the flexible pipe and be discharged over the centre of the table for re-use.—W. E. K.

*Improved Dyewood Extractor.* H. S. Wilkinson, Halifax Yorks. Eng. Pat. 22,174, November 16, 1894.

The use or employment within a dye-vat of a dyewood extractor consisting of a suitable iron or other frame covered, or partly so, with a metallic gauge, and having doors, the purpose being to prevent dyewood which is undergoing extraction from escaping from the dye-vats into the streams or drains, as also to keep it from contact with the goods which are being dyed. Much after-labour in washing is thus said to be saved.—W. S.

*Machinery for Dyeing and Bleaching Yarns and Fabrics, Improvements in.* J. Clapham, Bradford, W. W. L. Lishman, Todmorden, and M. Jefferson, Bradford. Eng. Pat. 22,221, November 17, 1894.

An invention having for its objects the provision of mechanism for raising or withdrawing, for inspection or necessary manipulation, yarns or fabrics from dye-tanks, without drawing off the liquor contained in the latter, and for preventing the escape into the atmosphere of gases or "obnoxious fumes" evolved from the liquors employed.

The apparatus designed for the attainment of the first of these objects, consists of a series of tanks, placed side by side, with guide- and immersion-rollers mounted in frames which can be lifted out of the tanks.

That devised for the second object consists essentially of "one, two, or more chambers" arranged, "in a manner somewhat similar to a gasometer," above the tanks in which the gases are generated.

The mechanism is described with the aid of drawings in the original specification, to which reference must be made for details.—E. B.

*Engraving and Preparing Rollers and Surfaces, with the Aid of Photography, for Printing upon Calico, Paper, and other Fabrics and Materials, Improvements in the Methods of and in Apparatus for.* C. A. Burghardt and H. Meller, Manchester. Eng. Pat. 22,513, November 21, 1894.

The engraving of printing-rollers and surfaces is accomplished by the aid of photography in the following manner:—The design to be reproduced is first prepared and a photographic negative is taken from it. From this a print is obtained on a sheet of zinc, paper, glass, or other suitable material covered with a film of "bichromated" gelatin, albumin, or gelatin and albumin. This is developed and inked with ordinary acid-resisting ink so as to produce a lithographic transfer, and from it an impression in ink is transferred in a dark room to a transferring-roller coated with "bichromated" gelatin. The roller is next exposed to light in order to render insoluble those parts of the film which do not bear the impression of the design, and it is then "developed" in water. It is now ready for use in transferring the design to the printing-surface, a copper cylinder, for instance.

A convenient form of apparatus for obtaining the design from the photo-lithographic print on the transferring-roller is described and patented.—E. B.

*Aniline Black, an Improved Process of Printing on.* H. H. Lake, London. From H. Schweitzer and E. N. Dickerson, New York, U.S.A. Eng. Pat. 11,087, June 5, 1895.

For production of a red resist or discharge coloured pattern on an aniline black ground, a mixture of nitrosamine, sodium salt of $\beta$-naphthol, and oxide of zinc, is printed on the aniline-black prepared cloth and the black developed in the usual manner. The nitrosamine and $\beta$-naphthol may be replaced by their known analogues.—W. E. K.

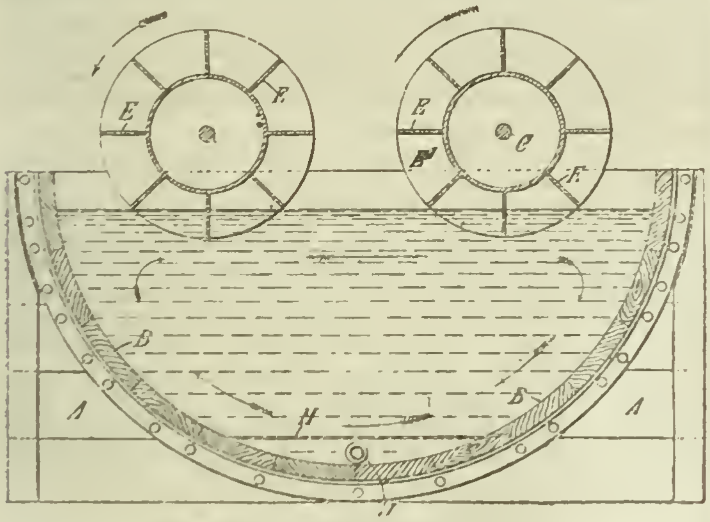
*Applying Colouring or Staining Material to Paper and the like, Method of and Apparatus for.* N. Browne, London. From A. Koebig, Dresden, Saxony. Eng. Pat. 12,746, July 2, 1895.

For the purpose of colouring paper and the like on both sides at one operation, the paper is passed vertically between two brush spreaders which apply the colour, working simultaneously on both sides with equal speed and pressure, but in opposite directions. By reason of the equal pressure which the two sets of brushes exert upon the paper, they reciprocally act as supports for one another, rendering further support for the paper unnecessary, and by their equal speed and opposite motion, the paper is kept flat and creasing is avoided.—W. E. K.

*Dyeing Machines, Improvements in.* E. Weldon, New Basford. Eng. Pat. 16,002, August 26, 1895.

An invention relating, more particularly, to mechanism for dyeing knitted or woven garments.

A dye-vat, with two vertical flat sides A (see figure), and a curved, preferably semi-circular, bottom B, has one or more paddle-wheels E, fixed at such a height above it that their vanes dip into the liquor contained in it.



Hosiery-Dyeing Apparatus.

The wheels are driven either by bevel-gearing or by sprocket-wheels attached to or forming part of them, and chains. If more than one wheel be used for a vat, they are driven in the same direction.

In dyeing, the rotation of the paddle-wheels causes the dye-liquor and the materials which are being dyed to move in a continuous stream towards one side of the vat, and thence downwards across the bottom and upwards to the opposite side.

The steam-pipe J, which serves to heat the dye-liquor, is placed below a false-bottom H.

By means of this arrangement, the materials are evenly dyed, and they do not become entangled, and manual labour is, to a large extent, dispensed with.—E. B.

## VII.—ACIDS, ALKALIS, AND SALTS.

*Nitric Acid, The Condensation of.* E. Hart. J. Amer. Chem. Soc. 1895, **17**, 576–579. (See this Journal, 1894, 1197.)

The good points of this apparatus are briefly summed up by the author as follows:—(1.) It gives great efficiency with small first cost. (2.) It requires but little water. (3.) It requires but little floor-space. (4.) It reduces the pressure, and so reduces leakage. (5.) It is easily and cheaply repaired.—A. K. M.

*Nitric Acid, some Points in the Distillation of.* E. Hart. J. Amer. Chem. Soc. 1895, **17**, 580—584.

In this paper the author describes the results he has obtained with his tube condenser. He obtains a distillate containing a very low percentage of nitrogen peroxide, and when proper care is taken the amount of fuel required is also very small. The following are the specific gravities of the distillates :—

| Lb. | Distillate. | Sp. Gr. | Lb. | Distillate. | Sp. Gr. |
|---|---|---|---|---|---|
| 84 | 1st | 1·527 | 74 | 8th | 1·485 |
| 83 | 2nd | 1·526 | 47 | 9th | 1·474 |
| 83 | 3rd | 1·523 | 47 | 10th | 1·448 |
| 82 | 4th | 1·512 | 57 | 11th | 1·300 |
| 77 | 5th | 1·504 | | | |
| 77 | 6th | 1·493 | 785 | | |
| 74 | 7th | 1·487 | | | |

150 lb. of pea anthracite coal are used for the distillation of 1,000 lb. of nitrate, and this could no doubt be reduced to 125 lb. by running two shifts—day and night. In one stage of the ordinary distillation the acid comes over very rapidly without any increase in the firing, and this portion of the distillate is unusually free from colour. The author attributes this last fact to the rapidity with which the gas passes from the retort, and the consequent decrease in the decomposition caused by the radiated heat. This being so, the importance of an efficient condenser is evident, as it renders possible a greater rapidity in the distillation. The effect of the degree of concentration of the vitriol on the colour of the product is very marked, this being due to the readiness with which concentrated nitric acid is decomposed. It is, however, pointed out that when weak vitriol is used, the water present is largely retained by the nitre-cake until the last stage of the operation, whilst it greatly assists the reaction, giving a fair acid and a cake which is practically infusible. With strong vitriol, on the other hand, the product is highly coloured.—A. K. M.

### PATENTS.

*Cyanides, Improvements in the Manufacture of.* J. E. Chaster, Fulham. Eng. Pat. 15,941, August 21, 1894.

From 65 to 72 per cent. of anhydrous ferrocyanide of an alkali or alkaline earth are mixed with about 20 per cent. of the carbonate of an alkali or alkaline earth. During the grinding about 5 per cent. of charcoal are added, and finally a sufficient quantity of gas-tar, pitch, or the like, to make the mixture of a pasty consistency. The whole mass is thoroughly incorporated and pressed, and then treated in a furnace in the ordinary way. By the above treatment, a better yield of cyanide is said to be obtained.—J. R.

*Cyanides, Improvements in the Manufacture of.* J. E. Chaster, Fulham. Eng. Pat. 15,942, August 21, 1894.

Ammonia, having been previously dried over quicklime, is passed into a vessel, which is heated to a suitable temperature, and contains an intimate mixture of charcoal and an alkaline carbonate or a carbonate of an alkaline earth. In the case of soluble carbonates, an intimate mixture is obtained by treating the charcoal with a saturated solution of the alkaline carbonate, and then drying. The mass containing the cyanide is allowed to cool, and is then extracted with either water or alcohol.—J. R.

*Cyanides and Ammonia, Improvements in and relating to the Production of.* W. McDonnell Mackey, Leeds. Eng. Pat. 18,792, October 4, 1894.

A close vertical furnace is proposed, constructed with two vertical chambers, connected together at the bottom. The one contains coke or other carbonaceous material, the other barium carbonate or other suitable baryta compound and coke. An air-blast is admitted into the coke chamber and passes thence into the chamber containing the carbonate. The barium cyanide is collected in a space below the latter chamber. If desired, steam may be introduced into the space containing the cyanide and the ammonia thus formed may be collected. Potassium or sodium carbonate may be used with barium carbonate, and may with advantage be added to the coke in the first chamber.—J. R.

*Alkali Cyanides, Improvements in the Manufacture of.* H. Y. Castner, London. Eng. Pat. 21,732, November 10, 1894.

An improvement on Eng. Pats. 12,218 and 12,219 of 1894 (this Journal, 1895, 572), in which ammonia or nitrogen with carbon reacted on the alkali metal. The process is, according to the new patent, carried on in two stages. *Firstly*, anhydrous ammonia is passed over metallic sodium heated to between 300° and 400° C., thereby producing an amide and hydrogen, $NH_3 + Na = NaNH_2 + H$. *Secondly*, the amide is fused in contact with carbon, $NaNH_2 + C = NaCN + H_2$. The necessary apparatus is also described. —J. R.

*Zinc Blende for Obtaining Metallic Zinc and Sulphur, and in Effecting the Decomposition of Common Salt for the Production of Soda and Chlorine, Improvements in the Utilisation of.* J. Brock, A. E. Wareing, and F. Hurter, Ph.D., of Liverpool. Eng. Pat. 22,828, November 24, 1894.

Zinc blende is roasted to obtain zinc oxide and sulphurous acid, and from the latter, sulphuric acid is obtained by the usual means. The sulphuric acid is utilised in producing sodium sulphate and hydrochloric acid. The sodium sulphate is decomposed by the Leblanc process to obtain soda, and the calcium sulphide occurring as a by-product is treated with carbonic acid gas in closed vessels, the resulting hydrogen sulphide being burned with a limited proportion of air in "Claus kilns," to obtain sulphur. The hydrochloric acid, obtained as described, is either condensed in water, and used in dissolving the zinc oxide derived from the blende; or the acid gas, mixed with steam, is passed over the moistened zinc oxide in a suitable apparatus, to obtain zinc chloride.

The zinc chloride is electrolysed, to obtain zinc and chlorine, in cells having two compartments separated by a porous partition, one containing a carbon anode and the other an iron or zinc cathode. Provision is made to take off the chlorine evolved in the anode compartments. The connected cells are charged with strong solution of zinc chloride, which is caused to flow, in reverse directions, through the cathode and anode compartments. The flow through the cathode compartments is so adjusted that the solution issuing from the last compartment of the series shall retain from 10 to 30 per cent. of its original proportion of zinc, and this weak solution is mixed with hydrochloric acid and used in dissolving fresh zinc oxide. Or, zinc hydroxide may be precipitated from the solution by lime, for conversion into chloride. The solution flowing through the anode compartments is renewed when necessary. The zinc deposited by the action of the electric current on the cathodes is collected and melted. See also Eng. Pats. 22,826 and 22,827, under XI., page 974.—E. S.

*Obtaining a Continuous Supply of Hydrochloric Acid or Nitric Acid Gas, and in Utilising Acid Sulphates, Improvements in.* J. W. Walker, Fernlea, Irvine, Ayr, N.B. Eng. Pat. 22,853, November 26, 1894.

Sodium chloride is treated, in a decomposer of the usual kind, with sufficient sulphuric acid to form acid sulphate, the apparatus being fitted so as to work continuously, the acid sulphate being discharged at one end whilst fresh material is received at the other end. The acid sulphate (whether thus or otherwise obtained) is roughly ground, and mixed with such a proportion of sodium chloride as is required to form sodium sulphate, and also with as much sodium sulphate as may suffice to prevent fusion of the mixture. The proportions recommended are "about three parts by weight of acid sulphate and two to three parts of salt cake to every part of salt." This mixture is fed continuously into a second decomposing vessel, fitted with stirring apparatus and suitably heated, provision in both operations being made for carrying off the hydrochloric acid. The product, "salt cake or monosulphate, is continuously discharged."

The first and second decomposer may be combined in a single elongated vessel having two compartments, so that the acid sulphate formed in one compartment may overflow at a weir into the second compartment, the necessary addition of sodium chloride and of monosulphate being made.

To obtain nitric acid the same process is used, with substitution of sodium or potassium nitrate for sodium chloride.—E. S.

*Conjoint Manufacture of Metallic Peroxides and Caustic Alkalis or Alkali Earths, Process and Apparatus for the.* (Under Internat. Convent.) L. P. Hulin, Modane, France. Eng. Pat. 23,274, November 30, 1894.

The heavy metal to be peroxidised is alloyed with an alkali metal or alkali earth metal, and the alloy, preferably that described in Eng. Pat. 23,117 of November 28, 1894, is subjected to a red-heat in contact with the air, when the surface of the alloy becomes coated with mixed oxides, consisting of a peroxide of the heavy metal and a monoxide of the alkali or alkali earth metal. Unless the mixed oxides are quickly removed as they form, the peroxide is reduced, with further production of alkali. By heating the alloy to a high temperature in an iron vessel through which a current of air is passed, "the fumes composed of the combined oxides" pass through an exit-pipe, and may be collected. The process is applicable to an alloy containing an alkali metal with any metal capable of forming a peroxide that may combine with a base, and especially such as cannot be peroxidised by mere heating in the air. As an example, the manufacture of lead peroxide and soda from an alloy of lead and sodium is instanced. The compound of lead peroxide and soda, or sodium plumbate, may be digested with water to obtain sodium hydroxide solution and lead peroxide. Any lead in the alkaline solution may be separated by electrolysis. Lime may also be used in effecting the separation. Anhydrous sodium oxide may be obtained by submitting the mixed oxides as they form to the retrograde reaction already described, or by heating the oxides in a closed vessel in a neutral atmosphere with an excess of lead-sodium alloy.

An apparatus is described and shown for effecting the continuous oxidation of the described alloys, with withdrawal of the oxides as they form, consisting essentially of a vessel in which fused sodium chloride is electrolysed to obtain sodium in presence of lead, this vessel being laterally connected near the bottom to another open vessel, wide at the top, in which the alloy is oxidised. The latter vessel is fitted with a vertical revolving shaft, carrying a wheel to rotate the alloy, and blades to gather the oxides as they form towards a discharging spout. There is an upper as well as a lower opening to the electrolysing vessel, the alloy flowing in by the upper channel and back through the lower channel as it becomes impoverished in sodium, the process being a continuous one.—E. S.

*Manufacture of Caustic Alkalis from Alloys of the Alkali Metals, Process and Apparatus for the.* (Under Internat. Convent.) L. P. Hulin, Modane, France. Eng. Pat. 23,370, December 1, 1894.

The process consists in causing aqueous vapour diffused in hydrogen to act upon an alloy of a heavy metal with an alkali metal, so as to obtain an oxide or hydroxide of the latter without oxidising the heavy metal. A hydroxide of the alkali metal is thus first formed on the surface of the alloy, and then an oxide is formed next the alloy, which in its turn is hydrated, and so continuously as long as alkali metal remains.

The alloy is introduced through a lateral (capped) feed-pipe into an iron or steel receiver made in two parts, to form a hermetically closed chamber, of which the lower part is set in a furnace, and has a discharge-pipe at the bottom. A tray, with double bottom for circulation of steam or water to regulate the temperature, is fitted within the upper part of the vessel, and in this tray a quantity of water is placed sufficient to oxidise the alkali metal in the alloy under treatment. A valved pipe leads from the space above the water to a condenser, from which hydrogen escapes, whilst the water of condensation returns to the tray by a vessel having inlet and outlet cocks with a prolongation pipe into the tray. A thermometer is provided, dipping into the water in the tray, and there is a pressure-gauge and safety-valve. When the vessel is charged with the alloy to be treated, and the necessary water has been run into the tray, it is filled with hydrogen, and is gradually heated. When the process is finished, the residue of heavy metal is run off, after which the alkali is collected. In connection with the alloy mentioned, reference is made to Eng. Pat. 23,117, 1894.—E. S.

*Salts or Compounds of Alumina, Improvements in the Manufacture, Treatment, or Purification and Production of.* J. L. Kessler, Paris. Eng. Pat. 1419, January 21, 1895.

The discoloration of aluminium compounds by colloidal ferric oxide or salts, is obviated by treating solutions of aluminium salts with a deoxidising agent, such as hydrogen sulphide, zinc, or the like; or by adding sulphurous acid or a sulphite; or by precipitating by magnesium oxide or carbonate, calcium carbonate or bisulphite, or the alkaline or magnesium bicarbonates, taking care to leave the solution slightly acid. This process applies when a phosphoric compound has been added in such proportion that the phosphoric acid in the compound is equivalent to the iron salt in the solution. The phosphoric compound used may be introduced directly into the salts or compounds of alumina; or indirectly, as, for instance, into paper- or cardboard-making materials in which compounds of alumina are used.—E. S.

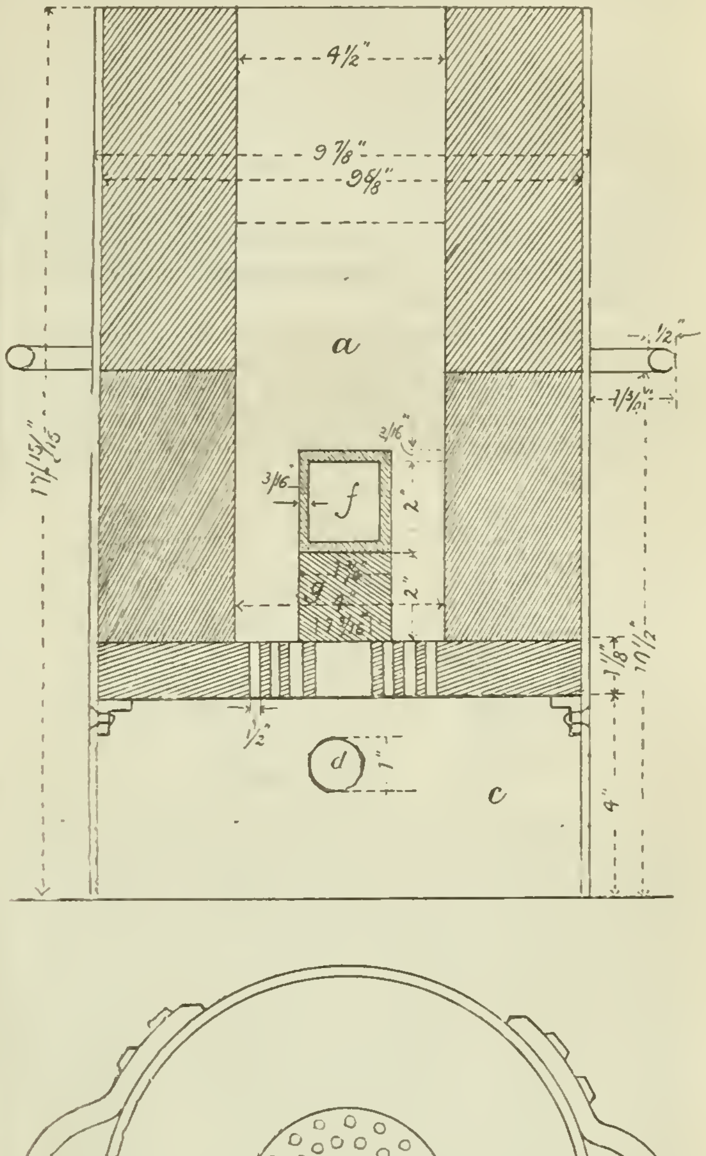
*Cyanide of Potassium and in Furnaces for Producing Cyanide of Ammonium, Improvements in the Production of.* W. Schulte, Siegen, and F. A. Sapp, Hillnhütten. Eng. Pat. 15,040, August 9, 1895.

A mixture of ammonia and "carbonised hydrogen gas" is passed through highly heated spaces enclosed by refractory materials, in this case over the white-hot bars, in the apparatus of Cowper, Withnell, or others, when cyanide of ammonium is formed. The cyanide of ammonium is then passed into melted potash, when cyanide of potassium is formed and the liberated ammonia serves for a fresh production of cyanide of ammonium.—J. R.

## VIII.—GLASS, POTTERY, ENAMELS.

*Fusibility of Fireclays, Determination of the.* H. O. Hofman. Tech. Quarterly, 8, 1895, 63—76.

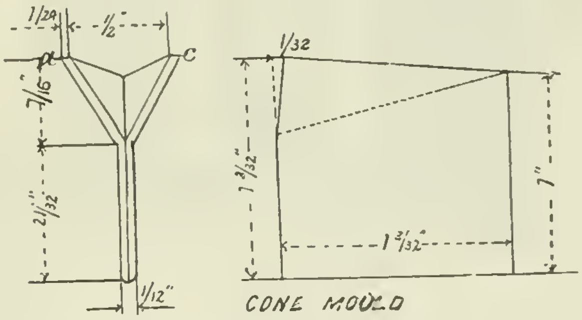
The author, in conjunction with Mr. C. D. Demond, has described (this Journal, 1894, 638) experiments designed to arrive at a criterion of the refractoriness of fireclays by ascertaining the proportion of silica and lime (as a typical acid and basic oxide respectively) necessary to cause the clays to fuse at a temperature of 1,500° C., which was the standard adopted. The result of this investigation being unfavourable, the author has reverted to the direct method, systematised by Seger, consisting in comparing the behaviour of any given fireclay with that of standard cones of known softening point. This method as used by the author is carried out as follows. A Deville furnace, shown in the figure, is used for heating the clay to be tested in company with the cones of known softening point. The furnace is lined, as to the lower $5\frac{3}{8}$ ins., with sintered magnesite, and in the upper portion with a mixture of 90 per cent. magnesite (? burnt magnesite) and 10 per cent. Zettlitz kaolin. The furnace body rests on a cast-iron plate having a large central opening surrounded by three rows of small holes. An air chamber, below the furnace, fed by means of a blast-pipe in the usual manner, completes the arrangement. After a good many fusions (*e.g.* 60) have been carried out in this furnace, relining may become necessary. This is effected thus:—The old lining is crushed so that it may pass a "4-mesh sieve," the product is moistened with 8—10 per cent. of water, and kept for two or three days in order that it may become hydrated. The mass is crushed, and moistened with enough water to make it coherent but not sticky, and is then rammed into the annular space between the furnace body and an appropriate core. The core is a wooden truncated cone $17\frac{3}{4}$ in. high and $3\frac{1}{2}$ and 4 in. in diameter, having at the smaller end a spindle $1\frac{1}{8}$ in. in diameter. This spindle fits into the central opening in the cast-iron plate upon which the furnace body stands. The core is wrapped with five layers of newspaper, the last layer being pasted down. In ramming the lining material into the space between the core and the furnace body, new magnesite is used for the interior portion (against the core), and old magnesite from the former lining is inserted between the fused material and the shell. When the core is withdrawn most of the paper adheres to the lining, but this is of no importance, for it is



Deville Furnace

burned out at the first firing. The core should be taken out immediately the lining operation is finished, lest it swell and become difficult to remove. The furnace is then air-dried for five or six days and heated by a wood fire for a further period of two working days. The author suggests the addition of a door with asbestos packing in the air-chamber below the furnace proper, in order to avoid breaking the sand lute (between the furnace and the plate supporting it) when it is necessary to withdraw unused fuel at the close of an experiment. The top of the furnace is uncovered, save by a piece of sheet iron (with a spy-hole) suspended in an inclined position so as to draw off the products of combustion into a flue. The crucible support *g* (see figure) is made of matter sufficiently refractory to withstand a temperature represented by cone No. 35, *i.e.*, the least fusible but one of Seger's series. The crucible itself is made of equal parts of alumina and Zettlitz kaolin (both calcined), mixed with enough raw kaolin to give the mass plasticity. This material is found preferable to that which was formerly used, which consisted of calcined magnesite, chromite, and alumina.

The standard "cones" are three-sided pyramids $\frac{11}{12}$ in. high and $\frac{1}{3}$ in. in side at the base. Nos. 26 to 36 cover the range usually required for fireclays. Their various changes of state when exposed to the action of the furnace, side by side with the clays under test, may be conveniently described by the following terms: "beaded" (the apex only showing signs of fusion); "shortened" (the pyramid bending or sinking, and bulging towards the base); "globular" (the pyramid becoming round or oval in section); "lenticular" (the pyramid being almost completely fused to a button). The author's experience with nearly 200 cones, is to the effect that they are reliable, their actual and nominal order of fusion being identical. The sample to be tested is moulded into a pyramid by the apparatus shown in the figure. The mould (see figures) consists of a small oblong piece of sheet brass folded crosswise, with two of the corners turned outward just far enough to form an inclined trough, and soldered in the middle; the scraper (see figures) is a piece of sheet zinc pointed at one end to fit accurately into the triangle *a b c*. The dimensions given in the figure are those necessary to form a cone $\frac{1}{2}$ in. at the base and 1 in. high—a little larger than Seger's size; there appears to be no difference in the behaviour of the larger cones, but they have the disadvantage of occupying more room in the crucible. In testing a given sample of refractory material, it is gently calcined to remove organic matter, and made into a stiff paste with water containing 5 per cent. of dextrin. The paste is pressed into the mould, which is placed over the scraper, the latter being pushed slowly upwards, releasing the sample pyramid. It is well to oil slightly the upper part of the mould to prevent the clay from adhering and the top of the pyramid from bending over. The sample is air-dried overnight and heated slowly on an iron plate. Two dried samples, together with three standard cones, are placed in the crucible, refractory clay being rammed into the bottom to afford a level floor for the cones. Gas-carbon is used as the fuel for the furnace. It is crushed to pass a "2-mesh" sieve. In starting the furnace, about 1 oz. of newspaper is used, charcoal being added, and finally gas-carbon, the blast being gradually increased during the process of charging, which lasts about six minutes. Different temperatures are obtained by regulating the pressure of the blast and the quantity of gas carbon used. Bellows or a small fan may be used for producing the blast. As an illustration of the character of the charge and of the blast the following figures may be quoted. They relate to an experiment in which cone No. 35 was fused to a lenticular shape. Paper, 30 grms.; charcoal, 200 grms.; gas-carbon, 1,000 grms.; time of feeding, 6 mins. Blast, 1 min. after starting = 0·5 in. of water; 3 mins. after starting = 1 in.; 6 mins. = 1·5 ins.; 17 mins. = 2 ins. A CO flame became visible 8 minutes after starting, and the crucible could be seen (from the consumption of the surrounding fuel) 25 minutes after starting.



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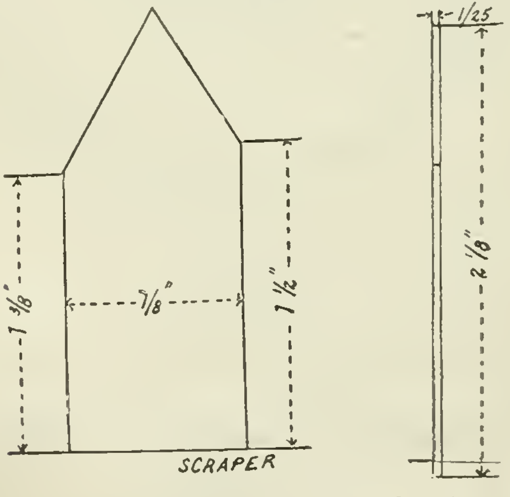

SCRAPER

The paper concludes with a table of analyses and tests of American fireclays.—B. B.

*Expansion of Glass; and Articles made of Different Kinds of Glass welded together.* A report by Dr. Schott, extracted by M. Chatenet for the Bull. Soc. d'Encouragement, **10**, [117], 1027—1032.

The author finds that in the case of ordinary (siliceous) glasses the coefficient of expansion increases with the percentage of alkali. A table is given of the coefficients of expansion of 38 varieties of glass.

When one kind of glass is to be welded upon another it is *not* necessary that the coefficients of expansion should be approximately equal, indeed, it may be advantageous to superpose a second glass of very different expansibility. As the articles made are never called upon to withstand a temperature so great as that at which they were originally formed, it will be best to speak of contractility rather than expansibility, since it is the phenomena of cooling after fabrication which chiefly need attention.

If two plates of glass be welded together, then, on cooling, the double plate is curved, *the more contractile glass being on the inside.* If two such plates are moulded on a curved surface, the more contractile being on the inside, then, after cooling, the inside layer is kept stretched, the outside layer being, on the contrary, compressed. A vessel so constructed would be similar to a thick-walled vessel which had been quickly cooled. Such a vessel breaks if the inner (stretched) layer is even slightly scratched.

On the other hand, vessels are greatly strengthened if both the inside and the outside layers of glass are in a state of compression. This is the case with vessels composed of a single kind of glass which have been rapidly cooled by plunging them in oil, or with vessels made in three layers of which the middle layer is the most contractile, so that both the outer and the inner layer are kept in a state of compression. Vessels so constructed have an important advantage over those formed by cooling in oil, viz., the properties of the glass are not altered by subsequent heating.—V. C.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Cements, Improved Manufacture of, by Treatment with Steam.* G. Prüssing, Jena. Ger. Pat. 75,476, May 2, 1893.

The burnt cement broken up into pieces (each piece of about the size of a nut) is treated with steam or boiling water before grinding. By this means it is stated that the cement more rapidly acquires the property of retaining a constant volume, a property which hitherto in the case of

Portland cement was only acquired after storage for weeks or months of the burnt , though not as yet pulverised material. The binding power of the cement is said not to be in the least injuriously affected by the action of the steam or boiling water.—W. S.

### PATENT.

*Artificial Sandstone, Improved Process for the Manufacture of.* J. Pfeiffer, Kaiserlautern, Germany. Eng. Pat. 12,811, July 2, 1894.

The process consists in exposing mixtures of siliceous matter—*e.g.*, sand and siliceous stones—and slaked lime to the high temperature and pressure produced by slaking quicklime in closed vessels, in which the mass to be acted on is also contained. Carbonation is subsequently effected by the admission of carbon dioxide to the pressure vessel. The lime, by the slaking of which a high temperature and pressure have been rendered available, is said to be suited for admixture with the next batch of material.—B. B.

## X.—METALLURGY.

*Iron and Steel at Welding Temperatures.* T. Wrightson. Proc. Roy. Soc. 1895, **57**, 351—352.

The author has already shown that cast iron expands to the extent of about 6 per cent. in volume during a small range of temperature while it is passing from the liquid to the plastic state. Since this property of cast iron resembles that exhibited by water under similar conditions, it was argued that the welding of wrought iron might be explained by attributing to the iron this same property, which, in the case of ice, is admitted to be the cause of regelation.

The changes of temperature occurring at the point of welding were observed by placing a thermo-junction, consisting of a platinum wire twisted into a second wire of platinum alloyed with 10 per cent. of rhodium, at this point. The electric current produced at this thermo-junction deflected a reflecting galvanometer, the movements of which were photographically recorded. It was found that a molecular lowering of temperature (varying from 57°—19° C., according to circumstances of temperature and pressure) occurred immediately the pressure was applied to the bar when in the welding condition.

These experiments appear to prove that wrought iron at a welding temperature possesses the same property of cooling under pressure which was proved by Lord Kelvin to exist in freezing water, and on which the property of regelation is admitted to depend.—A. G. B.

*Fractional Precipitation of Gold on the Large Scale by Hydrogen Sulphide Gas in a Solution containing Gold and Copper.* J. E. Rothwell. Eng. and Mining J. 1895, **60**, 323.

Ore containing 0·35 per cent. of copper, partly as pyrites and partly as carbonate, was dry-crushed to pass a 24-mesh, roasted, chlorinated, and leached in the usual way. The solution was subsequently treated in tanks having a capacity of 7,500 gallons, first with sulphurous acid to remove free chlorine, and then with hydrogen sulphide gas, the latter being introduced through two parallel $1\frac{1}{2}$-in. lead pipes 5 ft. apart, placed about $2\frac{1}{2}$ ins. above the bottom of the tank, and provided with two rows of perforations, $\frac{1}{8}$ in. in diameter and 6 ins. apart, along lines slightly below the horizontal diameter of the pipes. The solution in each vat represented 24 tons of ore, and contained about 126 lb. of copper and 72 oz. of gold. The sulphur dioxide first introduced precipitated a portion of the gold present, in the form of a fine metallic deposit, which was afterwards carried down by the flocculent sulphide. When hydrogen sulphide had been passing for a few minutes, the current of gas was interrupted, and a sample of the liquid filtered. To one portion of the filtrate ferrous sulphate was added, which would indicate even a trace of gold; another portion was evaporated and the residue scorified and cupelled with lead. When all the gold was deposited, which could be ascertained by the above tests to within 1 dwt. per tank, the solution was allowed to settle for 1—$1\frac{1}{2}$ hours, and the supernatant liquid from about 4 ins. above the bottom was run through the filter press. The clean-up of the precipitate was effected once a week, the precipitate collected in trays, roasted in a muffle, and fused with soda, borax, and nitre. About 70 per cent. of the roasted sulphide was reduced to bullion, which, when melted, gave gold from 830 to 960 fine, showing that very little copper was co-precipitated. If water were scarce, the filtrate could be used over again. In the laboratory it is almost impossible to effect a fractional separation of gold and copper, but when treating several thousand gallons of liquid the separation may be made comparatively sharp.—W. G. M.

*Constitution of Alloys.* H. Le Chatelier. Bull. de la Soc. d'Encouragement, 1895 384—387.

A *précis* of papers by Calvert, Matthiessen, Lodge, Roberts-Austen, and Kamensky, which have appeared in the *Phil. Mag.* and *Trans. Roy. Soc.* These experimenters have measured the electric conductivities of alloys of varying compositions, and from the variation in the conductivity we can draw conclusions as to the chemical constitution of the alloys. For there are three simple hypotheses which can be made as to the latter:—(1) The alloy is formed by the juxtaposition of crystals of the different constituent metals. (2) The alloy consists of the above, with, in addition, crystals of certain definite combinations of the constituent metals. (3) The alloy consists of a homogeneous mixture of the constituent metals.

In the first case the conductivity should be equal to the sum of the conductivities of the constituent metals, each taken separately in such quantity as is present in the alloy. In other words, if we express the composition of an alloy of two metals by the volume of one of them contained in 100 volumes of it, the curve showing the conductivity of the alloy should be the straight line joining the conductivities of the two pure metals. In the second case the curve of conductivity should be a broken line composed of two segments uniting the conductivity of each of the pure metals to that of their definite combination. In the third case the curve of conductivity should be a continuous curve passing through the conductivities of the two metals.

Matthiessen's experiments show that the first hypothesis is realised in certain cases, *e.g.*, in alloys of the following metals taken in pairs: lead, tin, cadmium, and zinc. But in the case of most alloys the curves of conductivity present an appearance which could not be foreseen *à priori*, and which has not hitherto been explained. The curve, starting from one (or both) of the pure metals, drops with great rapidity; a very slight admixture (even if the second metal is a good conductor) suffices to reduce the conductivity greatly. Thus, if silver be alloyed with 0·93 per cent. (by volume) of tin, its conductivity is reduced from 100 to 35·7, whereas the conductivity as calculated by a simple proportion from those of the constituent metals, would be 99·1. Lastly, there are cases in which the curves of conductivity indicate the existence of definite combinations. But here a common error must be pointed out. It is usually assumed that if the composition of an alloy be continuously varied, and if at a certain point the properties of the alloy exhibit a discontinuity, this point must correspond to a definite combination. This proposition is not correct; it is only its reciprocal that is true. Passage through a point of definite combination is certainly *one* cause of such discontinuity, but it is not the only one; similar effects are produced by passage through a minimum point of fusion. This error has introduced great confusion into the study of alloys.

The researches of Matthiessen, Lodge, and Kamensky clearly indicate, by a maximum of conductivity, the existence of the following definite combinations:—$SnCu_3$, $Sn_2Au$, $Ag_2Cu_3$, $SbCu_2$.—D. E. J.

*Micro-Metallography of Iron. Part I.* T. Andrews. Proc. Roy. Soc. **58**, 59—64.

The author has examined the micro-crystalline structure of large masses of wrought iron, with high powers ranging from 300 to 2,000 diameters. He finds that on slow cooling from a white heat, a secondary crystallisation takes place. The normal primary crystals of the iron, which hitherto have been regarded as constituting the ultimate structure of the metal, contained in themselves a sub-crystalline formation consisting of smaller and minute crystals of pure iron. The crystals belong to the regular order of crystallisation, sometimes assuming the hexagonal form, and occasionally the simple cube. The predominant angle of both sets of crystals is 120°. The dimensions of a number of the crystals are given, and from them it is calculated that a cubic inch of iron contains 1,000,000,000 secondary crystals. The forgings were practically pure hammered wrought iron, and about 10 ft. in length and 12 ins. square, and the examinations were made on polished surfaces etched with dilute nitric acid (1 part to 49 parts of water). Slow cooling favours the production of the secondary crystals, and furthermore it is found, by using high-power objectives, that the secondary crystals sometimes contain within themselves a still more minute form of cubical iron crystals, which may be said to constitute a tertiary system of crystallisation. The secondary crystals are rarely noticed in small masses of iron because the cooling is generally too rapid.—A. W.

### *Hardening of Steel by Quenching, Experiments in the.* G. Charpy. Bull. Soc. d'Encouragement, 1895, 660—726.

In this paper the author describes the apparatus employed in, and gives the full results of, his investigations, to which references have been made in this Journal (1894, 40, 737, 1066; and 1895, 366). The electric furnace used for heating the specimens under examination consisted of a small refractory tube 60 cm. long by 2·5 cm. in diameter, within which the specimen was enclosed. The tube was surrounded first by two spirals of platinum wire 7 m. long and 0·5 mm. in diameter, which were covered with a layer of asbestos and then surrounded in turn by two other similiar platinum coils; the whole was wrapped in asbestos cord and enclosed in a brass tube. With a current of about 6 ampères and 70 volts flowing through the wires, a constant temperature of 1,200°—1,300° C. could be maintained within the inner tube. The temperature was controlled by altering the current density with the aid of a rheostat. To secure uniformity of temperature, the apparatus was constantly rotated about its long axis by means of a small electric motor. The author's views may be thus summed up: The quenching of steel affects its mechanical properties by hindering certain physico-chemical transformations, and by thus destroying its state of equilibrium. There are probably three such transformations: (1) the carbon transformation indicated by Eggertz' colour test, which has a preponderating influence on the mechanical properties (a view that is opposed to the $\beta$-iron theory); (2) an allotropic or crystallographic change in the iron, characterised by the appearance or absence of the well-known irregularity in the stress-strain curve, which change has no sensible effect *per se* upon the mechanical properties of the metal, but may influence them indirectly by setting up internal strains in the metal, owing to the alteration in volume consequent upon the change; and (3) a second allotropic change manifested only by the evolution of heat in cooling, and by an alteration in the magnetic properties, but without effect upon the mechanical test of the material. From a practical point of view, the hardening of steel containing less than 1 per cent. of foreign metals, cannot generally be effected if it be heated to a temperature below 700° C., whilst heating to a temperature exceeding 750°—800° C. cannot improve the material, but may in some cases be detrimental. The hardening is effected within the same range of temperature, independently of the manner of cooling. But these rules do not necessarily apply to special steels containing large proportions of other metals. The differences between the temperatures best adapted to the hardening of the various grades of steel are too slight to be considered in workshop practice, whilst the nature of the liquid employed for quenching affects only the magnitude of the change that takes place. Starting with thoroughly annealed steel, all the mechanical properties are changed in the same way, whatever may be the conditions of hardening. The negative hardening (*trempes negatives*) effect, by which quenching produces a softer material, is due to the metal being initially somewhat hard from previous cold-work or quenching, which has escaped neutralisation owing to insufficient annealing. All the observations have been made on small bars, and the laws deduced, relate to the elementary phenomena observable in quenching pieces of variable size, with larger pieces, the results must be modified by the variations in the rate at which the quenching effect is communicated to the interior. The object to be attained is the hardening of the bar to the centre, so that internal strains are minimised; and it is for this reason that the temperature employed and the manner of quenching must both be adjusted to suit the form and dimensions of the piece to be treated.—W. G. M.

### *The Brown and De Camp Lead Fume Collector.* Eng and Mining J. 60, 1895, 373.

This condensing chamber, devised by H. F. Brown and L. De Camp, has been in successful operation for nearly a year at the Omaha and Grant Smelting Works, Omaha. It consists of a large, rectangular brick building, containing a series of screens, arranged in the form of steep gables, running from end to end. The screens are of heavy, strongly-woven cotton cloth, sufficiently open to allow gases to pass, whilst intercepting all solid matter; they are supported on frames, which rest upon transverse beams, 12 ft. above the floor line, and are so arranged that the gases, forced underneath them by a fan placed in the main flue, must filter through them on their way to the chimney. On a longitudinal shaft running near the apex of each gable is a series of beaters, actuated by hand from a gallery outside one end of the building; these beaters serve to dislodge the dust which has accumulated on the filters, and are used when the increase in back-pressure indicates clogging, the operation requiring the services of a lad for about 20 minutes for two chambers. The flue from the smelting plant must be at least 800 ft. long, for the gases must be cooled to 150° F. before entering the condenser. In the plant described, 10 stacks, each 42 × 120 ins., are worked by a 12-ft. Murphy ventilating fan running at 200 revolutions per minute. The main flue has an area of 61 sq. ft., and each compartment of the collector one of 29 × 99 ft., whilst the capacity of each is 60,000 cb. ft. and its superficial straining area 40,000 sq. ft. For maximum duty there must be 16,000 sq. ft. of strainer, and 7 h.p. will be required for each 42 × 120 in. stack. For 10 stacks four chambers are required, of which any one may be cut out, for cleaning up, without interfering with the action of the others. The loss of lead by volatilisation in the furnaces, under the most favourable conditions, is estimated to be 6 per cent.; and this amount is recovered in the filters, two compartments, working in connection with seven stacks (each 42 × 120 ins.), having yielded monthly 100 tons of lead, carrying 10 oz. of silver per ton. When managed properly, there is no visible fume from the condenser chimney; and there is no danger to the health of the operators, for the dust is detached mechanically. The arrangement may be used for zinc-white works, and for dry-crushing gold and silver mills, as well as for lead-smelters; but not for roasting heavy sulphide ores, on account of the large volume of sulphur dioxide then present in the fume. The dust that collects contains much smoke-carbon, which may be burnt off by ignition, leaving the lead-containing portion as a coke-like substance that may be re-smelted or sent direct to the refinery. The soot may be burned off in the collector itself by adapting a separate chimney and making suitable arrangements.—W. G. M.

### *Slags from Lead Furnaces and the Production of Liquation or Crust Effects. With Bibliography of Slags.* J. Struthers. Sch. of Mines Quarterly 1895, 16, 356—373.

Out of at least thirty attempts to produce crusting of slags by melting them in a suitable gas-fired furnace, only two were successful, and of these one was lost in studying the effect of a higher temperature; once re-melted, no further crust formed, even after repeated meltings and coolings, except that inevitably produced by cooling. In the second case the body of the slag was amorphous and strongly vitreous, whilst the crust gave evidence of crystalline structure, but without distinct crystals. In both cases a button of metallic iron was found at the bottom of the crucible. Graphite crucibles gave the best results, although they led to some reduction of iron; the use of platinum was counter-indicated by the presence of lead and silver; of clay, by the high percentage of iron oxide, which caused them to be cut at the slag-line; and of iron, by the elevated temperature employed. The formation of the crusts is attributed to the superficial acidification of the slag, owing to the simultaneous loss of lead and zinc through volatilisation, and removal of iron by reduction, the more acid slag being less fusible. On re-melting at a higher temperature the further volatilisation and reduction exceed the exact quantity necessary for the formation of the more infusible crust, and the whole mass remains liquid. A full bibliographic table is given on all matters relating to slags from the year 1884 up to 1894, inclusive.—W. G. M.

## PATENTS.

*Chemical Disaggregation of Pyrites of Complex Composition, An Improved Process for the, with a View to Rapid Extraction of the Metals contained therein, such as Gold, Silver, Arsenic, Antimony, and Tellurium.* M. Body, Liège, Belgium. Eng. Pat. 10,827, June 4, 1894.

In the case of complex sulphides, the crystalline form is destroyed by fusing them with more sulphur, if necessary, and with a fixed base as oxide, sulphate, &c., together with a little carbon. The quantities used are 10 per cent. of basic potassium, sodium, or calcium salt, and 5 per cent. of sulphur and carbon. After fusion in a muffle furnace having condensation chambers, to recover any volatilised arsenic, the mass is thrown into water and agitated. When afterwards left at rest, the mixture separates into two portions, viz., a sediment in great part magnetic, and a greenish-black muddy solution of monosulphide of iron and of alkaline sulphide, holding in solution sulphides of gold, silver, arsenic, antimony, and tellurium. This fluid is decanted and air, charged with sulphur dioxide, blown through it. On standing, a black mud containing all the gold and silver is obtained, whilst the solution containing the arsenic, &c. becomes clear. The black mud is then dried, calcined, fused with lead, and cupelled to recover the gold.

The arsenic, &c. in solution may be recovered by precipitation and any further treatment that may be necessary. Should the magnetic sediment from the first operation contain any gold, the latter can be recovered from it by direct cyanide treatment or by amalgamation.—A. W.

*Preparing Metal Sheets for the Purpose of Galvanising them, or otherwise Coating them with Metal or Metallic Alloy, a Novel or Improved Method of, and Apparatus for use therein.* Davies Brothers and Co., Limited, E. A. Davies, and S. T. Thomas, all of Wolverhampton. Eng. Pat. 14,306, July 25, 1894.

In the preparation of metal sheets for the purpose of galvanising, a considerable amount of acid is used and wasted in removing scale. This is now avoided by a system of grinding or cleaning by means of brushes with wire or metallic bristles. The apparatus consists of feeding-in rolls and withdrawing rolls, with the brushes on a revolving cylinder above a bed or backing-piece between them. The sheet, after passing through the feeding-in rolls, is brushed by the so-called grinder revolving away from the rolls so as to prevent buckling. As it approaches and is taken in by the withdrawing rolls, the grinder is reversed and the sheet brushed the other way with the same object in view. Two grinders may be used, each revolving in opposite directions to avoid the necessity of reversing the single grinder. In either case the sheet is cleaned on one side only, and consequently has to be twice put through the rolls.—A. W.

*Furnaces for Metallurgical and other Purposes, Improvements in.* S. Trivick, P. A. J. Head, and J. Elsner, all of London. Eng. Pat. 17,666, September 17, 1894.

The plant consists of two furnaces, of the reverberatory or other type, arranged side by side in such a way that the products of combustion of the first are passed through the incandescent fuel in the fire-grate of the second. By this means the unburnt fuel is caught and the carbon dioxide is converted into carbon monoxide, which is then burnt over the hearth of the second furnace. The final products of the combustion then pass through heat accumulators, or their heat is utilised in any convenient manner.—A. W.

*Extracting Precious Metals from their Ores, an Improved Process for.* A. E. Morgans, London. Eng. Pat. 18,279, September, 26, 1894.

Chloride of cyanogen or chloro-cyanogen in a gaseous or liquid state is claimed in this patent as a solvent for the precious metals, the strength not to exceed one-half to one per cent. The ores are roasted, if necessary, placed in a vat, and covered with a solution of potassium cyanide. Chlorine is then passed into the vat in any suitable manner until the chloro-cyanogen is formed, the solution containing the gold is drawn off, and the metal recovered by any convenient process. Solutions containing from one-twentieth to one-tenth per cent. give perfect results in some cases, but in others it may be advisable to vary the strength. The solvent may be prepared in other ways than the foregoing, such, for instance, as by pouring potassium cyanide solution on to chloride of lime.—A. W.

*Applying Variegated Colours to the Surface of Tinned and other Plates, Improvements in the Method of and in Machinery for.* R. Read and A. Read, Liverpool. Eng. Pat. 19,838, October 18, 1894.

The tinned or other plate is passed in rapid succession through a series of rubber-faced printing rollers, each of which is charged with an appropriate colour. The plate is then varnished, so that the various colours are in part superposed and blended together.—W. S.

*Alloys of Manganese with other Metals, Improvements in.* J. F. Allen and J. Brock, both of Liverpool. Eng. Pat. 24,815, December 20, 1894.

To improve the alloys of manganese with copper or other metals, aluminium is added, whereby the castings are rendered more sound and the tensile strength and hardness increased. Suitable alloys are those which are made to contain from one-half to ten per cent. of manganese, from one-eighth to five per cent. of aluminium, and various proportions of copper and tin, copper and zinc, or copper, tin, and zinc. An alloy of copper and manganese is first prepared, and this is added to more copper and the other metals to produce the required alloy, to which is then added the aluminium.—A. W.

*Titanium and Alloys thereof, Manufacture or Production of.* H. Moissan, Paris. Eng. Pat. 3073, February 12, 1895.

Titanium has not hitherto been prepared in quantity owing to its strong affinity for nitrogen, and moreover the metal has never been fused. The author now produces it by reducing the oxide with carbon, using very high temperatures in a similar manner to his reduction experiments with the oxides of uranium, vanadium, zirconium, and silicon. If titanic acid and carbon be melted together in an electric furnace by means of an arc of about 400 ampères and 80 volts, a very hard mass of nitride of titanium, containing from 79 to 80 per cent. of titanium, is obtained. To decompose this nitride an arc of 1,000 to 2,000 ampères and of 60 to 70 volts is required. To obtain the element therefore, 330 parts by weight of rutile, and 96 parts by weight of carbon are heated by such an arc in a carbon crucible for 10 minutes, when a mass, covered with a yellow layer of oxide, is obtained, showing a white fracture, bright and shiny, with a metallic appearance. It reduces to powder under the hammer, and is acted upon by dilute hydrochloric acid, which distinguishes it from the carbide and nitride which are unacted on thereby. The titanium thus produced contains carbon, however, in quantities varying from 2 to 6 per cent. That containing 2 per cent. is pure enough for industrial purposes although it may be still further purified by remelting with titanic acid in the arc of higher intensity.

A definite carbide having the formula $TiC$ may be prepared as above by using more carbon. The titanium is used for alloying with other metals, which alloys are then added to masses of iron, steel, &c. These alloys may also be directly produced by adding the mixture of titanic acid and carbon to the necessary quantity of the molten alloying metal in the electric furnace.—A. W.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### (A.)—ELECTRO-CHEMISTRY.

*The Hargreaves-Bird Electrolytic Cell.* J. Hargreaves. Electrochemische Zeit. 2, 1895, 153—154.

In this cell the cathode does not dip into a liquid, but is brought into contact with a diaphragm which forms one of the walls of the division containing the anode. This anode-division contains the salt solution or other electrolyte. The only liquid in contact with the cathode is that which adheres to it through capillary attraction, hence the liquid is bounded by a layer of gas on one side, and this greatly facilitates the use of air or other gases in carrying out reactions. When oxygen is present the hydrogen given off from the cathode becomes oxidised; and when carbonic acid is present carbonates are formed. In the preparation of carbonates no carbonic acid is found to penetrate from the cathode-division into the anode-division. When used for preparing carbonates the anodes are scarcely attacked at all; they are more rapidly attacked when caustic soda is prepared. The E.M.F. used is from 3 to 3·5 volts. As the salt in the anode-division becomes used up it is replaced either by a continuous circulation of the solution or by means of a saturating vessel filled with salt. Scarcely any chlorates or hypochlorites accumulate in the anode solution, so that the same liquid can be kept in circulation for several weeks.—D. E. J.

### PATENTS.

*Electric Batteries, Improvements in or connected with.* C. P. Shrewsbury, F. L. Marshall, J. Cooper, London, and J. L. Dobell, Devon, England. Eng. Pat. 12,483, June 27, 1894.

This improvement relates to that class of battery in which the electrolyte is a fused nitrate, and carbon the element oxidised. The cell consists of a long, rectangular iron trough containing numerous iron partitions which extend from the bottom upwards to a little below the level of the fused nitrate. Carbon plates, which are in contact with the lid of the vessel, are suspended from it by means of suitable holders, and reach nearly to the bottom; and the lid is insulated from the trough by means of a rim of insulating material. The carbon plates which are suspended in the central portion of the trough, are so arranged that they may be lifted out either singly or collectively. At each end of the cell or vessel a space is left devoid of plates, and each such space is separated from the portion of the cell containing the carbon plates by three division plates of iron, two of which extend from the bottom of the cell to nearly the level of the fused nitrate, whilst the centre plate, which is insulated from the lid, descends nearly to the bottom of the cell. The two end spaces of the cell are connected by a circulation pipe which descends vertically from the bottom of one compartment, and then rises to the bottom of the other. At one end of the vessel is a vaporising chamber maintained at the required temperature by being partially or wholly immersed in the fused nitrate. Above the vaporiser is placed a tank consisting of two chambers, the lower one of which contains nitric acid or dilute nitric acid, and is connected with the vaporiser by means of a glass pipe, and a suitable gauge is provided on the outside of the chamber to indicate the height of the acid. The upper chamber, which is arranged a little distance above the other, also contains a tank, and the two chambers are connected by two pipes provided with cocks for equalising the pressure in both chambers, and for permitting the flow of acid from the upper chamber to the lower one. The upper chamber is provided with a valve for supplying acid to the tank, and with an air outlet, whilst the lower chamber is furnished with a safety valve. When the battery is at work, acid passes into the vaporiser, where it is evaporated, and the fumes escape through a pipe immersed in the fused nitrate, and thence to an injector placed in the circulating pipe, and so causing a flow of the electrolyte through the apparatus. The nitrate may be maintained in a state of fusion by any suitable means.—G. H. R.

*Solutions of Zinc Chloride for the Purification thereof for Electrolytic Purposes, Improvements in the Treatment of.* J. Brock, A. E. Wareing, and F. Hurter, Liverpool. Eng. Pat. 22,826, November 24, 1894.

When solutions of zinc chloride containing sulphate are electrolysed, the chlorine evolved at the anode is mixed with oxygen, and rapid corrosion of the carbon ensues. To remove sulphuric acid from such zinc solutions, a suitable proportion is added of calcium, strontium, or barium chloride, and the corresponding sulphate formed is removed by filtration or decantation of the solution.—E. S.

*Solutions of Chloride of Zinc for the Purification thereof for Electrolytic Purposes, Improvements in and relating to the Treatment of.* J. Brock, A. E. Wareing, and F. Hurter, Liverpool. Eng. Pat. 22,827, November 24, 1894.

Zinc chloride solution obtained by dissolving roasted blende or zinc carbonate in hydrochloric acid is liable to contain iron, lead, and other impurities. But if the acid be used in exact proportion to the zinc present in the ore, a sufficiently pure product is obtained. It is preferred, however, to dissolve the impure oxide in an excess of the acid, and to precipitate the impurities by digesting the heated solution with zinc oxide or hydroxide. If iron in the ferrous condition be present in the zinc chloride solution, it must be oxidised by air, chlorine gas, or preferably by addition of a little of the zinc solution derived from the anode compartment of the electrolytic cell, which is saturated with chlorine, to render it precipitable.

As it is not advisable to remove the whole of the zinc from a zinc chloride solution which is being electrolysed, the residual solution is treated with lime, and the zinc hydroxide precipitated, is utilised in purifying the solutions of crude zinc chloride.—E. S.

*The Utilisation of Zinc Blende for Obtaining Metallic Zinc and Sulphur, and in Effecting the Decomposition of Common Salt for the Production of Soda and Chlorine, Improvements in.* J. Brock, A. E. Wareing, and F. Hurter, of Liverpool. Eng. Pat. 22,828, November 24, 1894.

*See under* VII., *page* 968.

*Active Material for Secondary Batteries, Improvements in the Manufacture of.* S. Hammacher, Berlin, Germany. Eng. Pat. 9937, May 20, 1895.

According to this improvement, the plates are formed of basic phenylates, cresylates or similar compounds of lead, which are either mixed mechanically with the metallic oxides, or produced by a chemical reaction of the aqueous solutions of phenol and the like upon the metallic oxides. The method preferably employed is as follows:—One part phenol, nine parts water, and 90 parts oxide of lead are mixed into a paste, and kneaded into electrode frames which are then dried and charged in the usual manner. The basic phenylate of lead thus formed is stated to be an excellent conductor, containing as it does four parts of lead, and on drying it is converted into a vitreous, hard body.

—G. H. R.

*Electrical Insulating Purposes, an Improved Compound for.* M. Meirowsky, Cologne, Germany. Eng. Pat. 12,498, June 28, 1895.

Sixty per cent. of powdered mica, 30 of "wood or other fibrous pulp," and "about equal proportions of glue and paraffine," are incorporated and moulded into the required shape. The substance is used as an electrical insulator.

—B. B.

*Secondary or Accumulator Cells, Improvements in.* A. Müller, Hagen, Germany. Eng. Pat. 12,622, June 29, 1895.

In the improved cell, the case is composed of lead, and forms the negative plate to which the terminal is attached. The positive plates are either suspended from the negative electrodes by glass rods, or they are supported by insulating feet. The cell is perfectly closed by a lead cover, which is burnt on, and suitable openings are provided in it for the passage of the positive terminals, and the whole is hermetically sealed by surrounding the latter with a suitable insulating material.—G. H. R.

*Improvements in the Electrolytic Production of Oxides and Salts which are Insoluble or practically Insoluble in the Electrolyte [e.g., White Lead and Chromate of Lead].* C. Lückow, Cologne-Deutz, Germany. Eng. Pat. 14,801, August 6, 1895.

According to this process the electrodes are formed of the metal the oxide or salt of which is required; and the electrolyte, which is a dilute solution of some salt of the metal, may be neutral or faintly acid, or alkaline. The quantity of salts contained in the electrolyte varies, according to their nature, from 0·3 to 3 per cent., but the most generally useful proportion is between 1 and 2 per cent. In general the proportion of free acid or alkali present must not exceed 1·5 per cent. of the volume of the solution if the oxidation is not to be interfered with. The voltage required depends on the conductivity of the electrolytes and the distance between the pairs of electrodes. With electrolytes containing about 1·5 per cent. of anhydrous salts, and with a distance between the electrodes of from 10 to 20 mm., the pressure required is, for weakly acid solutions, from 1·5 to 1·6 volts; for a neutral solution, from about 1·7 volts; and for a weakly alkaline solution, about 2 volts. For example, in the electrolytic production of white lead, the electrodes are formed of soft lead, and are placed from 12—15 mm. apart, and the electrolyte is composed of 3 parts of sodium chloride and 1 part of bicarbonate of soda. The most suitable strength of current is 1 ampère to each square decimeter of one side of the anodes at a pressure of 2 volts. The production of chromate of lead is similar to that of the carbonate of lead, and the colour of the deposit may be varied according to the nature of the solution, being yellow in an acid solution, and inclining to red in an alkaline one.
—G. H. R.

## (*B.*)—ELECTRO METALLURGY.

*Metals, their Electrolytic Separation.* E. F. Smith and D. L. Wallace. J. Amer. Chem. Soc. 1895, **17**, 612.

*See under* XXIII., *page* 989.

### PATENTS.

*Extraction of Gold by Electrolysis, Improvements in and Apparatus for the.* J. J. Maclean and H. C. Bull, Twickenham, England. Eng. Pat. 18,172, September 25, 1894.

According to this invention the fluid to be treated is submitted to electrolysis during its passage through a long tube. The apparatus described is specially designed for the extraction of gold from sea water, and consists of a long narrow tube or chamber open at both ends, and made of metal or other suitable material. It is lined with wood or some non-conductor, and the floor is of iron which forms the cathode. The anode, which is also of iron, is placed over this and as near to it as possible.—G. H. R.

*A Vessel for the Electrolytic Separation and Alloying of Metals in the Molten State.* J. C. Mewburn, London. From F. Hornig and W. Borchers, Germany. Eng. Pat. 21,822, November 12, 1894.

The vessel, which may be composed of conducting or non-conducting material, has its inner wall formed with horizontal grooves and projections so that the flow of the molten metal constituting the cathode may be retarded, and give time for the formation of an alloy with the metal separated from the electrolyte, which may be in a liquid or fused state. A pipe leading from the lower part of the vessel serves for the withdrawal of the alloy. The vessel may be provided on its outer side with a flange to permit of the upper portion being surrounded by a hollow annular ring, in which water may be allowed to circulate for cooling purposes. As an example of the use of the apparatus for obtaining an alloy of lead and sodium, fused sodium chloride contained in the vessel forms the electrolyte, and molten lead is allowed to flow slowly from the top groove into the lower ones and their projections, when the electrolytic action causes the sodium to be released on the lead, with which it alloys, whilst the chlorine escapes through an opening in the lid of the vessel.—G. H. R.

*A Process of and Apparatus for Making Compressed Electrolytic Copper, applicable also to other Metals capable of being deposited by Electrolysis.* A. M. Clark, London. From La Société des Cuivres de France, Paris, France. Eng. Pat. 23,680, December 5, 1894.

The improved process consists in the electro-deposition of metal upon revolving cathodes, which are kept separated until a surface coating of metal has been deposited upon each of them, and they are thereafter pressed together with their coated surfaces in contact, the flow of current through the cathode being maintained throughout the operation. The cathodes are contained within the electrolytic tank, and consist of a pair or more of revolving rolls mounted on insulating supports in such a way that they press one on another, and are free to recede as the thickness of the deposit increases. Contact is made with the lower roll by means of a brush, and the anode conforms approximately to the form of the cathode. At the commencement of the operation, the rolls should not touch each other, as they would mutually remove the layer of plumbago or suitable material with which they are coated, before any metal is deposited. This frictional contact is prevented by a copper ring placed on each end of the upper roll, of slightly larger dimensions than the roll and a few millimetres thickness, whereby to allow the passage of the current from one roll to the other without permitting contact at any other part. These rings are removed after the action has been in progress some minutes, and the rolls have become coated with copper.—G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Combustion of Mineral Oils in Ordinary Lamps.* P. Kouindjy. Bull. de la Soc. d'Encouragement, 1895. August [116], 943.

*See under* II., *page* 953.

### PATENTS.

*Detergent Compounds, Improvements in.* R. Armstrong, Cadley, Preston. Eng. Pat. 18,891, October 5, 1894.

Ammonia soap, as free as possible from water, is made by treating ammoniacal salts with caustic or carbonate of soda or potash, and incorporating with the mixture oil, fatty acid, or resin, and as little water as possible, in the following approximate proportions:—

Fatty acid, 28 parts; ammonium sulphate, 70 parts; sodium carbonate, 7 parts; water, 4 parts. Methods of making a detergent powder and fluid are also described.
—J. J. K.

*Soft-Soap, Improvements in Materials for and in the Manufacture of.* M. Perls, London. Eng. Pat. 20,158, October 22, 1894.

These consist in the use of a caustic-potash lye containing 15 to 40 per cent. of potassium chloride, which is said to effect an economy in the cost of production, and to make a soft-soap of good quality.—J. J. K.

## XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

### (*A.*)—PIGMENTS, PAINTS.

*Insecticide Paint for Ships' Bottoms.* Ludwig Pflug, Kiel. Ger. Pat. 75,504, July 10, 1892.

This paint is said to prevent the adherence of barnacles and other living things to the bottoms of ships. Its characteristic and active constituent is hydrazine, which is said to operate with deadly effect upon any organisms in the protoplasmic state coming in contact with it.—W. S.

### PATENTS.

*A Composition for Preserving Wood, also Applicable to other Uses.* J. Matthews, Brunswick, Georgia, U.S.A. Eng. Pat. 17,486, September 14, 1894. (Under Internat. Convent.)

This composition contains the following ingredients, in certain proportions:—Coal-tar, resin, pine-tar, camphor, sulphur, tallow, carbolic acid, arsenic, phosphorus, borax, oil of rhodium, mercury bichloride, cobalt (native ore), "poke-root" bark (*Phytolacca radix*), ether, and carbonate or oxide of iron. If a liquid composition be desired, more tallow and kerosene are added during the manufacture. —J. J. K.

*The Preservation of Iron, Steel, Wood, and Stone from Rust, Corrosion, and Scaling, and for Preventing the Fouling of Ships' Bottoms, a New or Improved Composition for.* A. Tolhurst, London. Eng. Pat. 22,020, November 14, 1894.

This composition consists of a mixture of ferric oxide, zinc sulphide, barytes, gold-size, boiled oil, and turpentine, in equal proportions.—J. J. K.

*The Manufacture of Waterproof Paper or Fabrics, specially Applicable for Use in the Manufacture of Cartridge Cases, Trunks, Drapers' Boxes, Postal Tubes, and Fireworks, Improvements in.* C. T. Fox, Chingford, Essex. Eng. Pat. 11,261, June 8, 1895.

White-lead is mixed with boiled linseed oil and stainers of any required colour. This paint is then mixed with linseed oil, which has been made thick and almost glutinous by continued boiling. (Paper covered with this preparation is said to be waterproof and durable, and to bear washing with soap without injury.) Fabrics other than paper are passed through a solution of size before painting. The stiffness and waterproof quality of the paper and fabric are improved by brushing the back with a thick layer of a paste, which is prepared by boiling 2 lb. gum arabic in $\frac{3}{4}$ pint of water, to which is afterwards added $\frac{1}{2}$ pint paraffin, $\frac{1}{4}$ lb. gelatin (previously dissolved in a small quantity of water), $\frac{1}{4}$ pint of methylated spirit, and a stainer, and the whole boiled for a quarter of an hour. On cooling, a thick, viscid paste is produced.—J. J. K.

### (*C.*)—INDIA-RUBBER, &c.

### PATENT.

*Manufacture of Waterproof Fabrics, Improvements in the.* L. Frankenstein, Manchester. Eng. Pat. 5120, March 11, 1895.

*See under* V., *page* 965.

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## XIV.—TANNING, LEATHER, GLUE, SIZE.

*Sulphite Cellulose Liquors for Tanning Purposes, Preparation of.* C. Opl, Hruschau. Ger. Pat. 75,351, May 19, 1893.

The crude sulphite cellulose liquors are treated with caustic lime for the removal of calcium bisulphite, normal calcium sulphite being precipitated; or the $SO_2$ is liberated by the addition of sulphuric or hydrochloric acid and then expelled from the liquors by steam. In the liquors thus purified, metallic tannates, soluble in water, are formed by the addition of metallic sulphates such as aluminium sulphate, alum, or ferrous sulphate, whilst calcium sulphate is precipitated. The solutions of metallic tannates thus obtained possess, it is stated, tanning powers which it is proposed to apply in the tannery.—W. S.

*Dyeing Leather with Basic Colours.* P. Bertram. Färber Zeit. **6**, 1895, 293.

*See under* VI., *page* 965.

*Isolation of Catechu (Cutch) and Kath from the Wood of Acacia Catechu.* Imp. Inst. J. (Research Dept.), 1895, 399.

*See under* IV., *page* 961.

### PATENTS.

*Dyeing Skins, Improvements in Machinery or Apparatus for.* R. Ergang, Magdeburg, Germany. Eng. Pat. 19,427, October 12, 1894.

*See under* VI., *page* 966.

*Tanning, Improvements in.* J. Y. Johnson, London. From F. Kornacher, Frankfort-on-the-Main, and Diesel and Weise, Poessneck, Germany. Eng. Pat. 21,550, November 8, 1894.

After the usual preparation, followed, if necessary, by colouring with a weak and acidulated tan solution, the hides are treated by the mineral process (or by soap-, glycerin-, or fat-tanning); they are then washed, pared or split, and dried, and in some cases, to preserve the grain when immersed subsequently in a strong tan liquor, they may be greased on the grain side. They are finally tanned by means of an acid vegetable tanning liquid, which should be constantly stirred and renewed from time to time to remove all matter resulting from the preliminary mineral tanning. The liquor should have a concentration equal to 3° or 4° B., and should be heated to from 30° to 50° C. The object is to produce a completely tanned material in a space of time varying from a few hours for light skins, to a few days for heavy hides. The mineral tanning renders the material porous, but all traces of this treatment are to be removed in the last tan liquors.—W. G. M.

*Treatment of Hides for the Manufacture of Leather, Improvements in or relating to the.* W. R. Earp, Warrington. Eng. Pat. 22,968, November 27, 1894.

In order to prevent the putrefaction of dry hides during a long soaking, the water employed is mixed with sufficient waste-liquor from the borax manufacture to bring the specific gravity of the solution to 1·030—1·050 (7°—10° Tw.) This liquor usually contains 5—10 per cent. of borax, 5—10 per cent. of sodium carbonate, 15—20 per cent. of sodium chloride, and 5—10 per cent. of sulphate, of which the first-named is the most useful ingredient; it is the mother liquor which has grown too impure to yield any further crop of borax crystals. The liquor is either contained in a tumbler, or else the hides are handled in it in an ordinary vat.—W. G. M.

*An Improved Glue or Size, and Process of Manufacturing Same.* E. Schmahl and F. Feller, Berlin. Eng. Pat. 14,936, August 7, 1895.

To prevent the cracking, after drying, of glue containing sal ammoniac or similar substance, glycerin is added to the boiling glue or size water, in the proportion of 100 of the latter to from 2 to 5 of the former, and 15 of sal ammoniac or its substitute.—W. G. M.

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## XV.—MANURES, Etc.

*Nitrogen in Fertilisers containing Nitrates, Determination of.* H. C. Sherman. J. Amer. Chem. Soc. 1895, **17**, 567.

*See under* XXIII., *page* 989.

*Production of Wine, and Utilisation of Fertilisers employed.* A. Muntz. Bull. de la Soc. d'Encouragement, 1895, 410.

*See under* XVII., *page* 980.

### PATENTS.

*Humic Acid and its Compounds, Process of Manufacture and Employment of.* L. Gautreau, E. Charbonnier, and E. Serrant, Paris, France. Eng. Pat. 22,028, November 14, 1894.

Peat or similar vegetable refuse is treated with dilute sulphuric acid with the view of converting it into "humic acid." The mass, after removal of the bulk of the liquid accompanying it, is then treated with excess of lime and sulphate of potash is added. The product is used as a manure.—B. B.

*Dry Manure and Ammonia from Fæces or Fæcal Matter, and Apparatus therefor, an Improved Process for Obtaining.* W. P. Thompson, Liverpool. From Wirth and Co., Frankfort-on-the-Main, Germany. Eng. Pat. 24,063, December 11, 1894.

The object of the process described in the patent is the evaporation of the water constituting the bulk of fæcal matter and the simultaneous recovery of ammonia therefrom. The apparatus protected, is essentially a multiple evaporator provided with steam domes fitted with revolving beaters. The object of the latter is to break up the froth which forms during the evaporation of the fæcal matter and prevent contamination of the escaping steam with liquid or solid particles. During its passage from any given evaporator to the next in succession the steam is robbed of its ammonia by means of sulphuric acid. When sufficiently concentrated and freed from ammonia, the residual fæcal matter is dried by any usual device.—B. B.

*Ground Slags intended for use as Fertilisers, Improvements in the Treatment of.* C. H. Langdale, Morpeth, and A. W. Langdale, Newcastle-on-Tyne. Eng. Pat. 11,905, June 19, 1895.

The patentees claim the addition of brine containing salts of sodium and potassium to ground basic slag, in order to facilitate handling of the material, by moistening in a permanent manner the dusty particles which it would otherwise contain.—B. B.

*Phosphate of Lime Fertilisers, Process for Making.* D. T. Day, Washington, U.S.A. Eng. Pat. 12,769, July 2, 1895.

The object of the process described by the patent is to produce from phosphate rock a maximum amount of phosphate soluble in citric acid solution, and thus ranking as a readily-assimilable fertiliser. This end is said to be attained by heating the crude phosphate with calcium carbonate and siliceous matter, both constituents being often naturally present in the native phosphate. A temperature above 1,350° F., but below a white heat, is generally requisite for this operation. Less care in regulating the temperature is said to be needed when ferruginous and aluminous materials to the extent of 10 per cent. or more are added.—B. B.

## XVI.—SUGAR, STARCH, GUM, Etc.

*Bone-Black, the Decarbonisation of.* W. D. Horne. J. Amer. Chem. Soc. 1895, **17**, 503—510.

In this paper the author describes trials both in the laboratory and on a practical scale, which were made to test Weinrich's processes (this Journal, 1894, 240) for improving the quality of spent bone-black. One process consisted in the complete removal of carbon from the bone-black and the artificial introduction of fresh carbon in smaller quantity, and the other process in a uniform partial removal of carbon when that element was in excess. The first is applicable to exhausted char, such as sugar and oil refineries discard, and the second for removing small percentages of carbon from bone-black which has begun to deteriorate through the choking of its pores with carbon. In the first case, all the carbon is burned out by passing the bone-black in a continuous stream through a nearly horizontal cylinder of sheet iron, which is heated to a dull red and constantly revolved. The char enters the drum through a central orifice in the head, closing one end which is slightly higher than the other, and leaves the drum through peripheral openings in the head of the lower end. Within the drum there are longitudinal projecting ribs, which serve to expose the bone-black more completely to the hot air in the drum. The carbon in the bone-black may be either wholly or partially oxidised, according to the heat of the drum, the volume of air passing through it, the amount of bone-black fed into the drum, the speed of turning, &c., &c. When the whole of the carbon is removed, the mineral frame-work remains intact with its pores opened up. The product can then be treated with a solution of glue or molasses to thoroughly impregnate it, dried, and submitted to destructive distillation. The organic matter becomes charred within the pores of the bone-ash, and the carbon thus deposited appears to act in a similar manner to that originally present. The grains must then be washed with hot water, to remove soluble substances, and the char is then ready for use.

In the second case, in which partial decarbonisation is adopted, only the one operation of passing through the drum is necessary, the heating process being regulated, by means not stated, so as to remove any percentage required.

The results of experiments described are stated to have been eminently satisfactory.—A. K. M.

*A Disease of the Sugar Cane.* Prillieux and Delacroix. Sucr. indigène, 1895, **46**, 187.

The authors state that a disease which has recently appeared in the sugar canes of Mauritius, causing the death of the plant by a separation of a gummy or slimy mass, is produced by the mould-fungus *Coniothyrium Melasporum*.—J. L. B.

*Non-nitrogenous Organic Matter other than Sugar.* Maxwell. D. Zuckerind. 1895, **19**, 1188.

The non-nitrogenous organic matter other than sugar, for the most part consists of resinous and gummy bodies, which are insoluble in alcohol, and which when in a fresh condition can be precipitated by lime. On hydrolysis, a cellulose-like body is formed, and a mixture of reducing sugars consisting chiefly of dextrose and levulose, and about 3·5 per cent. of a pentose.—J. L. B.

*The Grey Coloration of Raw Sugar.* Herzfeld and Goldbach. Zeits. Rübenz. 1895, **45**, 689.

Previous investigators have assigned the cause of this coloration to the presence of iron compounds, without, however, explaining the reason of their occurrence in the juice in abnormal quantities.

The authors conclude from their experiments that the coloration arises from insufficient saturation. In the presence of alkalis, ferrous salts are not completely precipitated either in the warm by calcium hydrate or calcium hydrate and soda; or in the cold by calcium hydrate alone, or in conjunction with potash; but in all cases, and in the presence of sugar, they are at once carried down with lime and carbon dioxide. Ferric salts are not precipitated in sugar solutions by free alkalis, or by alkaline carbonates and lime, and separate less easily with lime and carbonic acid than ferrous salts. Ferric salts can therefore partially escape saturation, and though insoluble in pure alkaline sugar solutions, are soluble in warm calcium saccharate with the production of a soluble calcium iron saccharate. If in consequence of bad saturation the defecation-mud contains calcium saccharate, the ferric hydrate present will, during the operation of filter-pressing, enter into solution and cause coloration of the finished product.—J. L. B.

*Treatment of Beet-root Juice with Lime.* Beaudet. Bull. Ass. Chim. 1895, **13**, 180.

The author recommends the use of pulverised and sifted lime. This is added at a temperature of 30°—50°; 2 per cent. are dissolved in the space of 15 to 20 minutes; saturation is carried out at a lower temperature.—J. L. B.

*Purification of Cane-juice in Louisiana.* W. P. Kirchhoff and F. C. Thiele. Chem. Zeit. 1895, **19**, 1830—1831.

The juice containing 85 per cent. of water and 15 per cent. of dry substance falls into a wooden chamber fitted with slanting boards, dropping in transit from one board to another. At the same time, by the injection of sulphurous acid the juice is thoroughly saturated. It is then run into a large collecting vessel, where the principal quantity of lime is to be added. While this is going on, the juice is slightly warmed, and the mixture drawn off to the clarifier, an arrangement of square steam-heated troughs, and the remainder of the lime is then added. When the warmed juice is of a honey-yellow colour, and the precipitate that is formed falls quickly, the sugar-boiler considers that sufficient lime has been added. If the desired colour do not rapidly appear he decides as to whether too much or too little lime has been used, and in accordance with his observations, adds to, or takes from the remaining quantity of lime.

The following method was suggested by the principal of the New Orleans Sugar School:—The sulphurated juice is mixed in the clarifier with lime until the mixture is alkaline to litmus. It is then heated to boiling, left for a short time to deposit, drawn off to a second battery of clarifiers, and mixed with dilute phosphoric acid (clariphos) until a slight acidity is noticeable. After a second deposition the juice is ready for evaporation. Glucose is thus converted into gluconic acid, which in the subsequent treatment is decomposed into volatile acids, and so completely removed.

In the last campagne the following process was tried on two plantations:—The limed juice was pumped by an apparatus that is similar to the "Yaryan" under a pressure of 50 lb. to the square inch, and kept at a temperature of 172° C. The passage of the juice takes from 1 to 2 minutes. The impurities are deposited considerably quicker than in other processes, so that an apparatus for continuous deposit can be employed. This consists of a large conical vessel, the bottom has a filter-press attached, and the upper part an overflow tube. The juice is continually drawn into this apparatus, and flows off as a clear liquid, whilst the deposits which collect at the bottom are from time to time pumped through the filter-press.

The planters are opposed to treating cane-sugar juice in the same way as that of the beet, their contention being that it becomes unfitted for evaporation and does not yield a good sugar.—J. L. B.

*Alimentary Syrups which do not Crystallise, Preparation of.* Herzfeld and Möller. Zeits. Rübenzuckerind. 1895, **45**, 693.

The authors' experiments show that the crystallisation of alimentary syrups does not occur, even when they are kept for a long time, if approximately equal quantities of cane and invert sugar are present. A state of equilibrium is thus brought about by the mutual increase of solubility. Glucose, unlike levulose, is only slightly soluble in concentrated cane-sugar solutions. Cane sugar is readily soluble in solutions of invert sugar, and this solubility increases with greater concentration.—J. L. B.

*Direct Method of Refining.* Prangey. Sucr. indigène, 1895, **16**, 228.

The essential part of this process consists in grinding to a convenient grain white crystals, or a correspondingly purified and crystallised sugar. An artificial massecuite is then prepared from sifted goods by means of a hot and saturated pure sugar solution; the subsequent treatment is the same as commonly employed.—J. L. B.

*Estimation of Sugar by Copper-Potassium Carbonate.* H. Ost. Chem. Zeit. 1895, **19**, (79), 1784—1785 (81), 1829—1830.

*See under* XXIII., *page* 993.

### PATENTS.

*Treatment of Locust Beans in order to obtain Useful Products therefrom, Improvement in the.* C. D. Ekman and C. Christian, London. Eng. Pat. 21,913, November 13, 1894.

The beans are broken up without injuring the seeds and extracted with water. The saccharine solution which is thus obtained is made alkaline with milk of lime, heated to 185° F. and filtered. The bright solution is decolourised if necessary with sulphurous acid or some sulphite, and concentrated *in vacuo* to a syrup.—A. L. S.

*Manufacture of Sugar, an Improved Process for the.* G. Kassner, Münster, Westphalia, Germany. Eng. Pat. 14,925, August 7, 1895.

This process involves the use of lead oxide in place of baryta or strontia as a separating agent in sugar refineries. It is claimed that by the use of lead oxide, invert sugar and cane sugar can both be obtained in a pure state from saccharine solutions such as have to be dealt with in a refinery.

Lead oxide, hydrated lead oxide, plumbites, combinations of lead salts with alkalis or other lead compounds of a similar nature, are triturated with water so as to form a thin semi-liquid mass. The saccharine solution is first treated with lime water so long as a precipitate is thrown down, filtered, and added to the lead oxide. The mixture must be well stirred until lead saccharate separates, when the whole becomes nearly solid. The saccharate is removed from the solution by a filter press or other suitable device, well washed with water and decomposed by carbon dioxide. An insoluble basic lead carbonate is formed and the filtered solution contains the sugar without a trace of lead. The basic carbonate can be easily decomposed into carbon dioxide and lead oxide by a moderate heat; these products being thus available for future use. The proper proportion of lead oxide must always be used, this is two molecules of lead oxide to one molecule of cane sugar, and 1½—2 molecules of lead oxide to one molecule of invert sugar or glucose. When it is desired to separate invert sugar or glucose from cane sugar, only sufficient lead oxide should be added at first to combine with the glucose or invert sugar. The filtrate will contain the cane sugar which may then be separated.—A. L. S.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Organisms of Fermentation.* P. Petit. Monit. Scient. June 1895, **45**, 401—408.

Our knowledge of this subject, notwithstanding the rapid progress made in recent years, is still of a summary description. The variation of species which Hansen first observed in yeasts appears to occur also in bacteria themselves; indeed, the complete determination of a given species requires the study of the form of its colonies in different media. The investigation of the products of the life of the ferments in a given medium would be of the utmost importance, but so far our analytical means have proved almost completely inadequate for this purpose. Jörgensen has obtained most interesting results in examining the air and water of breweries with regard to the distribution of fermentative germs in them. Especially the malting rooms appear to be very rich in bacteria, amongst which Lindner observed *Fusarium hardei* and a *Cladosporum*. Some barleys are perfectly covered with bacteria, sometimes to such an extent as to prevent germination. Indeed, many mishaps in manufacture are due to this cause. In one fermenting room Hansen observed a whole world of ferments, whilst others were found to be almost sterile. Hansen's method for the bacteriological analysis of water is the one most generally employed at present. It consists in placing one drop of the water to be examined, which may first have been diluted, into each of a number of flasks containing sterilised wort. If the dilution of the water under examination has been sufficient, each drop of it will contain one germ only, and in each of the flasks prepared in the above-mentioned manner, a pure culture of one of the germs contained in the water will be obtained. If these cultures are grown in sterilised (pasteurised) beer instead of in wort, owing to the carbonic acid contained in the former, only those germs capable of development in absence of the air, will grow. That process of analysis, according to which the cultures are formed upon peptonised gelatin is without practical value, as upon this medium all ferments will develop which are capable of living in a neutral or alkaline medium, and none of which would appear in the acid wort. The bacterium, which is the cause of acetic fermentation, was first described by Pasteur under the name of *Mycoderma aceti.* Hansen, however, found that this organism really consists of three species, which he distinguished as *Bact. aceti*, *Bact. Pasteurianum*, and *Bact. Kützingianum.* They develop best in sterilised beer containing about 1 per cent. of alcohol, at a temperature of 34° C. These bacteria will only develop in contact with air and at a rather high temperature. For this reason they will appear in beer only which is stored in badly corked bottles or casks. The lactic ferments were studied especially by Kayser, who found their resistance to higher temperatures to vary very considerably. The degree of acidity the development of these ferments produces, varies very much for the different species and for the same species, with the medium they grow in and its reaction. Thus, it was found that by adding calcium carbonate to the fermenting liquids the total yield of acid was enormously increased. By the influence of the air upon lactic fermentation it was found that these ferments include aerobic, anærobic and indifferent species. It is, however, interesting to note that the ærobic lactic ferments (surface cultures) produce a greater proportion of volatile acids (chiefly acetic) than the others. The lactic ferments are able to live entirely upon nitrogenous matter, especially peptone. The cultivation of pure yeasts, which is the most important result of these investigations, was first carried out by Pasteur by means of tartaric acid. After a certain number of generations, industrial yeasts are free from bacteria, *i.e.*, all the cells present appear to be of the nature of those which induce alcoholic fermentation only. Pasteur considered this method satisfactory, as at that time no other fermentative diseases than those caused by bacteria were known. Indeed, bacteria are the most general cause of accidents in manufacture. Considerable difficulties were, however, encountered in the separation of the different races of yeasts. Hansen first observed the formation of turbidity in beers, accompanied by disagreeable taste. In the absence of any bacterium or mycoderma, there was only an abundant development of yeast cells noticeable. By making pure cultures from the sediments in such beers he arrived at the fact that yeasts existed capable of producing as objectionable a disease in beer as any of the bacteria. It now became indispensable to examine whether the purification of the yeasts by means of tartaric acid was capable of eliminating from them those species which might cause diseases, and it became further of importance to isolate and characterise the obnoxious ferment which by microscopic examination could not be distinguished from pure yeast. This necessity caused him to devise his process for the isolation and dissemination of single cells, which was essential for the preparation of an absolutely pure culture. Through his researches it is now possible to discover very small proportions of wild yeast in yeast cultures. This discovery is all the more important as the wild yeasts are most abundant during certain periods of the year. Hansen showed that they exist on the surface of ripe fruit, and also that they are carried by air currents into the fermenting vats. Hansen further showed that the wild yeasts formed deposits much slower than culture yeasts, so that in barrelling beer fermented with a yeast contaminated with wild yeast, most of the latter remained in the beer. Moreover, the yeast resulting from such beer, whilst appearing perfectly sound when viewed under the microscope, becomes more and more infected by wild yeast, so that after a few generations it may cause diseases in the beer quite as serious as those produced by bacterial infection. Hansen also observed that the development of the diseased yeasts is particularly favoured by attenuation, and that a beer containing more than 6·5 per cent. of extract was unfavourable to their growth when they are added at the end of the principal fermentation. But, on the contrary, all beers are attacked by the yeasts if they appear in it before the principal fermentation. In consequence, the examination of the yeast worts, not only for the bacteria present in them, but also for wild yeast they may contain, has become of great importance. In possession of a method for the isolation and identification of different species of yeast, Hansen investigated the question as to whether the action of tartaric acid was as efficacious against wild yeast as against bacteria, but he found that not only could the former not be suppressed by this means, but that they resisted it so completely that tartaric acid could be employed to free the wild yeasts almost entirely from yeasts of culture. Moreover, he observed in the course of these investigations that two yeasts of culture, designated respectively Carlsberg I. and II., each of which by itself produced bright and palatable beer, when used together, produced a turbid beer, one of the two races of yeast in the mixture behaving like a wild yeast. This explains Hansen's mistrust of mixed yeast cultures. On the other hand, however, it was pointed out by Velten, and also by Van Laer, that previous to Hansen's investigations beer of good keeping qualities was obtained from yeasts containing several races, and, indeed, in many instances beer is so brewed to-day. Van Laer, moreover, made the observation that on disseminating in two vats filled with the same wort and standing in the same cellar, the air of which contained much wild yeast, pure yeast in one vat and a mixed culture in the other, the former at the end of 15 days was found suffering from an energetic secondary fermentation, whilst the fermentation of the other proceeded in a perfectly normal way. From a discussion of this observation at the Institute of Brewing, it seems to follow that unless fermentation with pure yeast cultures be carried out under absolutely aseptic conditions, the pure yeast is crowded out by the wild races. According to the ideas of Van Laer, Morris, Miller, and others, it appears that if a pure yeast culture in practice gives rise to abnormal secondary fermentation, this must be due to its being contaminated either with some other race of yeast or with wild yeast. Against this statement Wilson, and subsequently Jörgensen, advance strong objections, the latter declaring that he had observed repeatedly secondary fermentation arising when using pure yeast cultures prepared according to Hansen's method, and in which not a trace of foreign yeast could be discovered. This brings us face to face with an important question regarding mixed yeast cultures, namely, whether after a number of consecutive generations the cultures obtained contain the various races used in their original proportions, or whether one species becomes predominant at the expense of the others? Also, at the Laboratory of Brewing at Nancy, defective clarification of beer was repeatedly observed, caused either by badly developed cells or by refermentation, although the yeast used was from pure cultures, and no wild yeasts could be found in it. On the other hand, in a series of experiments carried out with pure yeast cultures on a commercial scale, most satisfactory results were obtained, and even second generations from these yeasts were found to still represent pure cultures. The author surmises that the unsatisfactory results which have been frequently obtained in the use of high fermentation yeast consisting of a single race only, are often due to some defect of the wort. The same yeast with which in the above-mentioned experiments such excellent results were obtained, turned out much less satisfactory on being used in another brewery, the beer obtained being rather cloudy. Analysis of both wort and beer showed that the apparent attenuation reached after the first fermentation did not exceed from 48 to 50 per cent., and 100 c.c. of the beer were found to contain more than 5 grms. of dextrin. No yeast could satisfactorily develop in such a medium, so that in this case the wort and not the yeast was at fault. In a series of experiments 17 individual cells were isolated by Hansen's method from a pure yeast which for some time had been in use in a brewery. Each of these cells was propagated separately, and the attenuation obtained with each respectively, likewise the clarification and nature of the deposit, were examined. The results were that attenuations were produced ranging from 69 to 76 per cent., forming deposits, greatly differing in their nature and producing very variable clarifications. These differences seem undoubtedly to point to a variation of species, caused by adaptation to the conditions presented by the wort. In a similar series with a mixed yeast (Grüber's), nine individual cells produced results, the individual differences of which appear to be much more considerable than in the former series. The various species contained in the yeast seem to develop in different proportions according to the condition of the wort. It appears, therefore, that from a practical point of view the controversy regarding yeast composed of a single race, and mixed yeast, is not of very great moment, though for low fermentation the single-race yeast appears to be distinctly preferable. On the other hand, however, it must be admitted that artificially prepared mixed yeast maintains its composition after several generations. For practical purposes excellent results are often obtained by disseminating industrial yeast upon gelatinised wort, cultivating separately 10, 20, or 30 of the colonies obtained, thus eliminating all wild yeast. On mixing together the liquids containing these cultures, a yeast of exactly the same composition as the original, but free from bacteria and wild yeast, is obtained. This method has been advantageously employed in urgent cases, and no irregularities were observed on subsequently substituting a pure race culture for the mixed yeast.—C. O. W.

### *Enzymes, Influence of Configuration on the Action of. III.* E. Fischer. Ber. **28**, 1429—1438.

In his previous papers (this Journal, 1895, 337) the author has shown that the hydrolysis of glucosides by emulsin and by the enzymes of yeast is dependent upon the molecular configuration of the former. Further experiments have confirmed the truth of the principle involved, and have shown that it also holds good for derivatives other than those of glucose. Thus β-methylgalactoside is hydrolysed by emulsin, and this fact is in agreement with the hydrolysis of milk-sugar, which the author also regards as a galactoside of the β-series. The methyl derivatives of glucoheptose, rhamnose, arabinose, and xylose are not hydrolysed by emulsin and yeast-extract.

The action of enzymes is, on the other hand, limited by structure, as is shown by the fact that glucose-ethylmercaptal and glucose-methylacetal are, like the glucosides, hydrolysed by dilute acids, whilst emulsin and yeast-extract are without action. In the case of polysaccharides, the question of structure and configuration is much more complicated, but the action of enzymes promises to be of assistance towards its solution. For the differentiation of the three disaccharides, cane-sugar, maltose, and milk-sugar, we already have the enzymes invertase, maltase, and lactase, or emulsin. Trehalose, which, according to Bourquelot, is not acted upon by invertase, is found by the author to be slowly hydrolysed by yeast: it is also hydrolysed by diastase prepared from green malt.

In opposition to the opinion generally held that maltose is directly fermented by yeast, the author showed some time ago that the latter contains an enzyme which hydrolyses maltose (*loc. cit.*). Morris (this Journal, 1895, 499) repeated the author's experiments and in part confirmed them; he found, however, that fresh, pure Frohberg yeast had no action on maltose in the presence of chloroform. In order to determine whether the enzyme maltase is present in fresh yeast, the author has made a number of experiments with different yeasts and different anæsthetics. He finds that the action depends not merely on the degree of moisture of the yeast, but also on its age, on the quantity and kind of anæsthetic employed, and also on the fact that α-methylglucoside and maltose behave very differently. In water saturated with chloroform, Frohberg yeast was without action on both α-methylglucoside and maltose, whilst Saaz yeast hydrolysed 25 per cent. of the α-methylglucoside, although it had no action on maltose. When, however, thymol or toluene is employed in place of the the chloroform, both α-methylglucoside and maltose are hydrolysed, the Saaz yeast acting more energetically than Frohberg yeast. The same also occurs when the aqueous solution is saturated with ether and the latter then allowed to evaporate. From these results the author concludes that the enzyme is not formed by the drying of the yeast, but that it is present in normal yeast. The drying of the yeast enables the water to extract the enzyme. As long as the yeast is quite fresh and moist hydrolysis only occurs within the cells, for the maltase does not, even in the presence of the anæsthetics, become dissolved out.—A. K. M.

### *Production of Wine in connection with Fertilisers employed.* A. Muntz. Bull. de la Soc. d'Encouragement, 1895, 410—412.

Practically the only thing removed from a vineyard is the wine; the leaves, the shoots, the skins—all these are returned, more or less, to the soil which has produced them. The loss thus occasioned is very small; the only ingredient that need be taken into account is the potash, which occurs as bitartrate in the wine. Theoretically, then, the vine should be one of the least exhausting crops, and should require little or no manuring. But practice is entirely at variance with this theoretical deduction. In an earlier paper (this Journal, 1895, 876) the author has shown that the use of manure is almost universal, and does not injure the quality of the wine. The bulk of the fertilising matters goes to build up the organs of vegetation, the wood and leaves; only a small proportion is found in the grapes, and the yield of grapes has only a small *direct* influence upon the amount of nutritive matter absorbed from the soil. In the districts which are more noted for quality than quantity the production of a given amount of wine necessitates a larger supply of fertilising matter than does the production of the same quantity of *vin ordinaire* in the southern districts. The choice wines of the west and east are richer in nitrogen and phosphoric acid than the common and abundant wines of the south. The following results show this. They are expressed in grammes per litre, and relate to clear, racked, red wines :—

| — | Nitrogen. | Phosphoric Acid. | Potash. |
|---|---|---|---|
| Wine of the south..... | 0·278 | 0·203 | 1·150 |
| „ Burgundy.... | 0·768 | 0·369 | 1·180 |
| „ Médoc ....... | 0·381 | 0·333 | 1·646 |
| „ Saint-Emilion | 0·435 | 0·320 | 1·670 |

The results obtained with white wines are in general similar.—D. E. J.

### *The Spirit Industry, Recent Improvements in.* L. Lindet. Bull. Soc. d'Encouragement, August 1895, **94**, 911—925.

I. *Preparation of the Wort.*—In order to prepare a wort from beetroot, it has been found advisable to adopt the diffusion process as used in sugar refineries. As a diffusion battery cannot be economically worked with less than 100,000 kilos., this process cannot be made use of in small distilleries which only use 25,000—50,000 kilos. of beetroot per day. The roots should be cut into irregularly shaped pieces so as to allow a free passage of liquid.

It would be of great advantage to use the spent wash for extraction, but it is acid and attacks the material of the diffusion battery. If pure water be used, lactic and butyric ferments are very liable to be produced; in order to check this it is usual to add a trace of mineral acid. In order to permit of the employment of spent wash for extraction, diffusers lined with wood have been used; these are very difficult to keep clean, and need frequent repairs. Diffusers of cast-iron have also been used for this purpose; they are said not to be attacked by the spent wash.

The diffusion batteries used in distilleries are usually of a simpler nature than those employed in sugar refineries. The wort is warmed in the battery by injecting steam, and is led from the bottom of one vessel to the top of another; a battery usually containing ten vessels; on emerging from the last the wort usually requires but little cooling before adding yeast. Cold water is used by some for the final exhaustion of the roots, as such washed roots press better.

The juice is not obtained in such a concentrated state as in refineries, about 13—15 hectolitres being obtained from 1,000 kilos. of roots, whereas about 11—12 hectolitres are obtained in a refinery from the same quantity of roots. Only 0·1—0·25 per cent. of the sugar remains in the exhausted roots, whilst in the older maceration process 0·5 per cent. loss was considered very satisfactory. Besides this the juice obtained by a diffusion battery is freer from butyric and lactic ferments, and is generally purer than that extracted by the old maceration process.

II. *Fermentation of the Wort.*—The employment of pure yeast has not the advantages in the distillery which it possesses in the brewery, as the wort cannot be sterilised before pitching, because, if this were done, the diastase would be destroyed, which it is necessary to retain during the fermentation in order that all dextrin may be converted into sugar. In spite of this the use of pure yeast is said to be advantageous.

It has long been known that acid worts give the best results, and this has led to the addition of sulphuric, hydrochloric, and lactic acids. Inspired by this knowledge, Effront was led to study the effect of hydrofluoric acid and the alkaline fluorides (this Journal, 1890, 1055; 1892, 50 and 931; 1894, 968 and 1079). He finds that the employment of hydrofluoric acid has many advantages over that of other acids; its antiseptic power is much greater, and under its influence the yeast becomes more active. It has not the same effect on all yeasts, acting very slightly on *S. Pastorianus I.*, feebly on Carlsberg yeast, and most energetically on *S. Cerevisiæ.* The most striking of Effront's experiments is that showing that yeasts can be inured to gradually increasing doses of hydrofluoric acid, up to 10—20 times as much as would previously arrest their development. Also a yeast inured to hydrofluoric acid, when transplanted into a solution free from the acid, does not give such good results as an ordinary yeast, but behaves as an untreated yeast would if suddenly transplanted into a solution containing hydrofluoric acid.

It has been suggested that other noxious micro-organisms might be similarly inured to hydrofluoric acid, but there does not appear to be any evidence for this.

In order to make practical use of his observations, Effront inures a yeast to a moderate amount of hydrofluoric acid, and with this pitches the wort, to which has already been added about half the proportional quantity of hydrofluoric acid. This procedure is said to result in the production of 5—10 per cent. more alcohol, and this statement is borne out by several distillers. The last runnings from this process contain more of the higher alcohols, but less bases, acids, and ethers, these last products being the most difficult to remove by rectification. This process has been more useful to distillers using grain and potatoes than to others.

Recently formaldehyde has been used for the same purpose as hydrofluoric acid, and appears to have the same effect.

In the fermentation of beetroot worts, it has been found useful to add a small quantity of young and vigorous pitching yeast once or twice every twenty-four hours during the fermentation. This carries the fermentation more quickly and more completely to a conclusion.

Molasses are often found difficult to ferment, and many reasons have been given in order to explain this. Effront considers it due to bacteria, and proposes to add white of egg to the molasses, which, when coagulated by heat, removes the bacteria, and the clarified molasses may be filtered off. Neale and Moerker attribute it to the presence of volatile acids, and propose to add tartaric acid to set them free, and expel them by boiling; other observers recommend the addition of some yeast food.

*III. Distillation.*—The stills used in large distilleries have not been improved of late years, but a demand has arisen for small stills which would be useful on the farm, &c. What is required is a compact apparatus which will produce a continuous flow of spirit whilst being fed with the fermented wash—a condition, however, which militates against the production of the highest quality of spirit. Sorel has devised a still quite different to those in common use. The column, instead of being vertical, is horizontal—a point of advantage, in that it may be placed in one of the ordinary outbuildings of the farm instead of requiring a specially constructed lofty house. The rectifying column is of copper, and 2—3 metres long; it is divided internally by vertical plates, the plates being pierced to allow of the flow of wash from one compartment to the other. Through the centre of the vessel pass two shafts bearing discs, one of which lies in each compartment. These shafts rotate in opposite directions. The fermented wash enters at one end of the rectifier and flows through it; the discs as they revolve take up a small portion of the wash and bring it into contact with the alcoholic vapours, which enter at the opposite end of the rectifier; in this way they become richer in spirit, and pass out at a strength of 60° Gay-Lussac.

*IV. Purification and Rectification of the Distillate.*—Many methods for improving the quality of the raw spirit have been suggested, but the success of most is questionable. The most useful appears to be filtration through charcoal, which in some cases appears to yield good results.

*V. Utilisation of the Residues.*—The residue which remains from maize after the starch has been removed is rich in oil. This may be extracted by pressing the grains in a filter press, drying *in vacuo*, and treating with petroleum spirit, which extracts the oil. The residue may be used as a manure.

The liquid residue which is produced in a distillery using potatoes, is in too dilute a condition to be valuable; it has been found possible to concentrate it by means of a Sorel column, and to obtain a pasty mass which can be handled with a spade, and will keep in a silo for some months.—A. L. S.

*Volatile Acids of Wines.* H. Jay. Bull. Soc. Chim. 1895, **13**, 642.

*See under* XXIII., *page* 993.

### PATENTS.

*Mashing and Brewing in Breweries, an Improved Process and Appliances for.* L. Prochazka, Prague, Austria. Eng. Pat. 14,919, August 3, 1894.

This is a modification of the well-known German decoction method, and consists in separating nearly the whole of the wort from the mash before pumping the grains and residue of wort into the boiling copper. After boiling the grains, &c., they are mixed in the mash tun with the first wort, and the process conducted as usual.—A. L. S.

*The Maturing or Improving of Alcoholic Liquors, Vegetable Oils, Tobacco, and other Substances, and in Apparatus connected therewith, Improvements in.* H. A. Leverett, London. Eng. Pat. 20,974, November 1, 1894.

This is said to be effected by passing a current of hydrogen through the substances to be matured, or keeping them in an atmosphere of hydrogen.—A. L. S.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

*Viscosimetric Examination of Butter for Foreign Fats.* Newmann Wender. J. Amer. Chem. Soc. 1895, **17**, 719.

*See under* XXIII., *page* 993.

### PATENTS.

*Manufacture of Food for Cattle and other Animals, Improvements in the.* B. R. Phillipson, Dublin. Eng. Pat. 20,003, October 20, 1894.

The inventor prepares a cattle food from the sediment of spent liquor commonly called "wash."

The wash is passed through deep covered vats, made of timber, by means of inlets placed near the bottom. The heavy sediment remains at the bottom, whilst the thinner part keeps on overflowing. When a quantity has collected, it is bagged, pressed hot, and then mixed with ground seed of fenugreek, coriander, or aniseed, or a mixture of these spices, in the proportion of about 10 lb. to 1 ton of sediment. A good food for poultry is made by mixing the unspiced sediment with about 10 per cent. of ground oyster shells.—L. de K.

*The Preservation of Liquid and Semi-Liquid Food, and Receptacles therefor, Improvements relating to.* P. Reichard, Berlin, Germany. Eng. Pat. 20,692, October 29, 1894.

The receptacles containing the sterilised articles of food, or in which they are boiled or steamed, are not to be made, as hitherto, of rigid or elastic sheet metal or glass, but from very thin, pliable, non-elastic metal, which can be easily pressed inwards, and then has no tendency to return to its original position. When the food, which must be, of course, in a liquid or semi-liquid condition, is wanted it is not got at by opening the tin, but by squeezing out such quantities as may be required for immediate use, the remainder not coming in contact with air, and consequently not being infected by germs.

The cover and bottom of the receptacle consists of thick metal which cannot be pressed inwards, but the sides are pliable; and after removing a screw-plug or pinch-cock (in case of liquid food) the contents are forced out by pressing the bottom and cover towards each other.—L. de K.

*The Manufacture of Margarine and in Apparatus therefor, Improvements in.* J. H. Theberath, Goch, Germany, and A. de Kunwald, Paris, France. Eng. Pat. 22,018, November 14, 1894.

The manufacture of margarin closely resembling butter in flavour and appearance, is claimed.

For continuous work, oleomargarin is fed alternately into two cylinders provided with cut-off valves and pistons attached to screw spindles with suitable gearing. The valves are connected to a mixing cylinder into which the oleomargarin and milk are fed under pressure from separate openings, and an intimate mixture of the consistency of cream is produced by the up and down motion of a series of perforated discs, the whole being kept at a temperature of between 15° and 20° C., since a higher temperature destroys the aroma imparted by the milk. The existing pressure forces the mass into another and similar cylinder where a rapid cooling is effected by cold water, the margarin being separated from the whey and the consistency of the product varied by the temperature to which it is cooled. Modifications of the cylinders are given in which the perforated discs are made hollow, and cooling is produced by a current of water. The valuable properties of the milk-serum are thus preserved by non-admixture with water, and the processes of mixing and cooling may be carried on in the same cylinder when a continuous production is not desired.—L. de K.

*A New or Improved Medicinal and Nutritive Compound or Preparation.* G. A. Clowes, Needham Market. Eng. Pat. 23,270, November 30, 1894.

This is said to be a new preparation of malt extract, malto-peptone, and cod-liver oil made into a jelly with the aid of gelatin. The most suitable proportions, it is said, are 60—65 per cent. of malt extract, 5—10 per cent. of malto-peptone, 20—25 per cent. of cod-liver oil, and 5—6 per cent. of gelatin.

The heat during the melting of the mixture should not exceed 90° F. In order to prevent the jelly from becoming mouldy, it may be covered with a thin layer of paraffin wax. The patentee prefers in some cases to mix with the ingredients above named, a suitable preservative, such as, *e.g.*, boric acid, in due proportion.—L. de K.

*Fish Extracts, Improvements in the Production of.* F. E. Sahlfeld, Ganisker, Germany. Eng. Pat. 25,311, December 31, 1894.

The useful and fleshy parts of fish are extracted in a steam-jacketed vessel with water at 300° F. under a pressure of about 7 atmospheres, obtained by introducing compressed air into the vessel. The fatty matter is then skimmed off and the dark liquid is subsequently concentrated in a vacuum pan until it has acquired the desired consistency, when it is ready for preserving, and using as food.
—L. de K.

*The Method of and Means employed for Impregnation of Meat and Food Substances with a Preserving Medium, Improvements in.* J. B. Howard, Halifax. From H. Opperman, Bernburg, Germany. Eng. Pat. 8093, April 24, 1895.

The inventor's chief claim is that the preserving process shall take place immediately after the killing of the cattle, and that, in consequence, a more digestible and nourishing quality of meat is obtained.

A cap or mask hermetically enclosing the respiratory organs is placed on the head of the animal, which is then quickly killed by the introduction of low pressure carbonic acid. As soon as the animal is dead, the heart is opened, and the water and blood drawn off by means of a perforated funnel or cannula. A preserving fluid is then injected, and remains in the flesh.

This fluid is prepared from a powder consisting of a mixture of 50—80 per cent. of milk sugar, 15—40 per cent. of cream of tartar, 3—10 per cent. of carbonate of magnesia, and 0·5—2 per cent. of biphosphate of potash. Instead of the potash salts, the soda compounds may be utilised. Previously-preserved blood may be added to prevent the meat from losing albumin, which would diminish its nourishing value. The preserving solution when used boiling hot will also preserve meat or fish.
—L. de K.

*Preserving Organic and more particularly Alimentary Substances, an Improved Process for, and Apparatus therefor.* P. A. Bachelerie, Asnières, France. Eng. Pat. 12,759, July 2, 1895.

Food and similar organic matter is preserved by exposing it in a vacuum to a sufficiently low temperature, so as to destroy all putrefactive germs. A chamber is constructed of iron plate, or other suitable material, and in this, the substances to be preserved are exposed in proper receptacles to a sufficient degree of cold *in vacuo*. When this is effected, a man clothed in diving costume enters without admitting air and closes the receptacles.

For other purposes the receptacle itself is exhausted and exposed to cold without the aid of the vacuum chamber, and is then hermetically sealed.—L. de K.

*Salt, Improvements in.* R. W. Barker, London. From M. Sommer, Louisiana, U.S.A. Eng. Pat. 15,429, August 16, 1895.

A table salt is prepared, which is said to be free from the objectionable property of caking, by mixing 125 lb. of common salt with 1 oz. of glycerin or with 2 or 3 oz. of glycerin and 1 to 3 oz. of cotton-seed oil.—L. de K.

## (*B.*)—SANITARY CHEMISTRY.

### PATENTS.

*Treating, Purifying, and Sterilising Water or Contaminated Liquids, and in Apparatus therefor, Improvements in.* W. Lawrence, Chiswick, Middlesex. Eng. Pat. 17,372, September 12, 1894.

Vessels are constructed with horizontal perforated diaphragms, dividing them into a number of shallow compartments. The water is made to flow through such vessels downwards, heat being applied at the bottom so as to boil the water in the lowest compartment, the steam evolved being condensed in the cold water descending from above. The hot water drawn off from the lowest compartment passes through a cooler, in which it gives up its heat to the incoming cold water. The temporary hardness of the water is said to be thus removed.

A form of bag filter is described, in which the bags are fixed by their necks to perforations in a horizontal perforated partition dividing the filter-tank into an upper and lower compartment. The liquid to be filtered is forced into the lower compartment, and distends the bags upwards. On releasing the pressure and drawing off sludge from the lower compartment, the bags collapse, and by turning inside out discharge their sediment into the lower compartment.—L. A.

*Filtering and Purifying Liquids, Improved Compounds for.* C. D. Abel, London. From A. Schlumberger, Montreuil, Paris. Eng. Pat. 20,790, October 30, 1894.

Aluminium benzoate, or other "insoluble antiseptic compound," is precipitated in the pores of pumice, asbestos, porcelain, &c. "Manganic charcoal" is prepared by pouring upon charcoal a boiling solution of potassium permanganate so long as it is decolourized, and then washing. Either material may be employed as a filtering medium, separately, or two vessels may be connected so that the liquid to be purified after passing through the first filter is then made to pass through the second.—L. A.

*The Precipitation of Sewage and Waste Liquids, and the Utilisation of the Products, Improvements relating to.* W. E. Adeney and W. K. Parry, Dublin. Eng. Pat. 21,635, November 9, 1894.

The precipitate produced by adding aluminium or iron salts to sewage is decomposed by dilute acid, and after filtration, the solution is used for purifying more sewage. If oxides of manganese are present in the sludge, they are left in the insoluble residue, and may be recovered by suitable means. Waste products and solutions containing manganese may therefore be used for purifying sewage, and the manganese recovered in a useful form.—L. A.

*Wash Waters, Sewage, and other Fouled Waters in order to Purify the same, Improvements in the Treatment of.* T. Craig and A. E. Raper, Bradford, Yorks. Eng. Pat. 25,119, December 27, 1894.

Clay, shale or other silicious earth is made into a cream with water. The waste water to be purified is rendered slightly acid, if not already so, and then a suitable quantity of the cream of clay is stirred up with it. A flocculent precipitate is thus formed which settles rapidly, carrying down nearly all the grease and leaving the water quite clear. —L. A.

*Gas, Sewage, and the like, Improvements in the Manufacture or Preparation of Materials for the Purification of.* J. E. Campbell, Bradford, Manchester. Eng. Pat. 4799, March 6, 1895.

*See under* II., *page* 956.

*Purifying and Softening Water, Improvements in Apparatus for.* W. S. B. McLaren, Maidenhead, Berks, and H. Carrod, Croydon, Surrey. Eng. Pat. 16,295, August 30, 1895.

The water to be purified is admitted into a small tank, and the reagent solution is admitted into a similar small tank on the same level. These tanks discharge their contents, through suitably proportioned nozzles, into a third intermediate tank, from which the mixture falls through a ball-valve into a vertical pipe, which passes to the bottom of the settling tank, in which inclined slotted plates are suitably arranged so as to arrest the precipitate whilst allowing the clear water to rise and be drawn off for use. —L. A.

## (C.)—DISINFECTANTS.

### PATENTS.

*Disinfecting Powders, Improvements in.* F. M. Spence, Manchester. Eng. Pat. 22,494, November 21, 1894.

Spent shale of the alum manufacture, dried and powdered, is used as the basis of carbolic and other powders; and powders are made by mixing sulphate of alumina or "aluminoferric" with the above or other suitable base, with or without carbolic, cresylic, or allied "acid." The aluminoferric fixes ammonia, and the iron in it fixes sulphuretted hydrogen given off in the decomposition of animal refuse. —L. A.

*A New or Improved Antiseptic and Preservative Preparation.* A. Lenhardtson, Stockholm, Sweden. Eng. Pat. 16,009, August 26, 1895.

An antiseptic and preservative preparation, of which it is alleged that whilst innoxious to the human system, it destroys micro-organisms. It consists of terpineol, a solvent, soap, water, and glycerin, with one or more aromatic substances.—J. J. K.

## XIX.—PAPER, PASTEBOARD, Etc.

*The Imitation Leather Wall-Paper of Japan.* From the Report of Mr. Enslie, Her Majesty's Consul at Hiogo (Foreign Office Annual Series, No. 1638).

Not long after the establishment of the Insetsu Kioku, or imperial printing bureau, the question was raised as to whether it would be possible to manufacture a sort of leather paper suitable for covering walls, in imitation of the stamped and raised (and exceedingly costly) leather wall-coverings made in America. The better class of Japanese paper possesses two important requisites—great strength and remarkable pliability. It remained, therefore, to make the article waterproof and attractive externally. The manufacturing of lacquered wall-paper was begun tentatively in 1879, but in five or six years the favour it met with abroad was so considerable, and the comparatively modest prices demanded were so attractive, that the factory seemed likely to outgrow the boundaries of the printing bureau. In 1889, the Government permitted the withdrawal of the factory from the Insetsu Kioku. It was felt that the work should not be kept a Government monopoly; and so the present Heikishi Kwaisha, or wall-paper company, was formed.

In the process of manufacture everything is done by hand, from the stamping of the dyes on the moist, heavy sheets, to the delicate painting of the raised arabesques and quaint flowers. The dies, made of flawless trunks of cherry trees, are cylindrical, and from 1 to $1\frac{1}{2}$ ft. in diameter. These dies are most carefully carved, and, despite the rough treatment to which they are necessarily subjected, they last for a considerable period, owing to the tough, close grain of the wood used, "*Prunus pseudocerasus.*" Wet sheets of greyish paper, measuring $38\frac{1}{2}$ ins. by $26\frac{1}{2}$ ins., are carefully laid on the dies, and the mass is beaten in by long-handled brushes with bristles taken from the deer, which are much more pliable and wear better than hog bristles. Sheet after sheet is laid on, generally in double thickness, until a roll of stamped paper 12 yds. long by 1 yd. in width is turned out. This roll is next taken to the drying room. After a preliminary drying, it is some six or seven times covered with "nori," a sort of thin paste, being allowed to dry between each fresh coating. In this way the paper receives the required rigidity and smoothness of surface. The next step is to the lacquering room. If the paper is to be gilded or bronzed, a coating of silver varnish is first given it, after which the lacquer is applied, thus lending the ground-colour a reddish-golden tinge or lustre, which is either made to look like dull gold or deep bronze by a less or greater quantity of lacquer being applied to the surface. The lacquer itself is the well-known product of the lacquer tree, "*Rhus vernicifera,*" which the Americans are now hoping to grow in their own soil. The rubbing-in of this lacquer takes time, and after the whole roll is smoothly covered, the drying process consumes another period of about three days. The floor of the drying room is covered with moist, loose straw. Screens of rice-matting are suspended everywhere from the low ceiling, and these, as well as the carpeting of straw, must be kept constantly wet. The dampness generates a low, even grade of heat both in summer and winter, and this is vital in making the lacquer adhere firmly and evenly. Warm, wet weather is the best; the chills of winter greatly protract the process; so in summer by far the greater quantity of first-class paper is produced.

After being thoroughly dried, the lacquered roll goes back to another long room, where the various colours demanded by the pattern are applied. In case the pattern is a simple one, this is done by a stencil and brushes of deer bristles, the more intricate or elaborate parts being afterwards gone over with a simple paint-brush. One of the favourite colours is a dull, deep red for background, with raised gold or bronzed flowers and arabesques. All this delicate work is done by women. The roll is now finished; all that remains is the final drying. About 30 days are thus consumed in turning out each roll.

In a similar way, patterns for ceilings are made, and consist of solid masses of leather-paper, as firm as, and much more durable than, wood. These beautiful ceiling-papers are sold at 2 yen the yard.

*Sulphite Cellulose Liquors for Tanning Purposes, Preparation of* C. Opl, Hruschau. Ger. Pat. 75,351, May 19, 1893.

*See under* XIV., *page* 976.

### PATENTS.

*Cellulose Acetate, Manufacture of.* C. F. Cross and E. J. Bevan, London. Eng. Pat. 9676, May 17, 1894.

*See under* XX., *page* 987.

*Waterproof Paper or Fabrics, specially applicable for use in the Manufacture of Cartridge Cases, Trunks, Drapers' Boxes, Postal Tubes, and Fireworks, Improvements in the Manufacture of.* C. J. Fox, Chingford, Essex. Eng. Pat. 11,261, June 8, 1895.

*See under* XIII., *page* 976.

*Applying Colouring or Staining Material to Paper and the like, Method of and Apparatus for.* N. Browne, London. From A. Koebig, Dresden, Saxony. Eng. Pat. 12,746, July 2, 1895.

*See under* VI., *page* 967.

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## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*Liquid Air and Oxygen, their Commercial Manufacture.* M. Schröter. The Engineer, October 4, 1895, 325.

Herr Linde has succeeded in liquefying air and oxygen on a commercial scale by a method which is all the more remarkable because the physical principle involved is one the effects of which at first sight seem quite inadequate to produce the desired result.

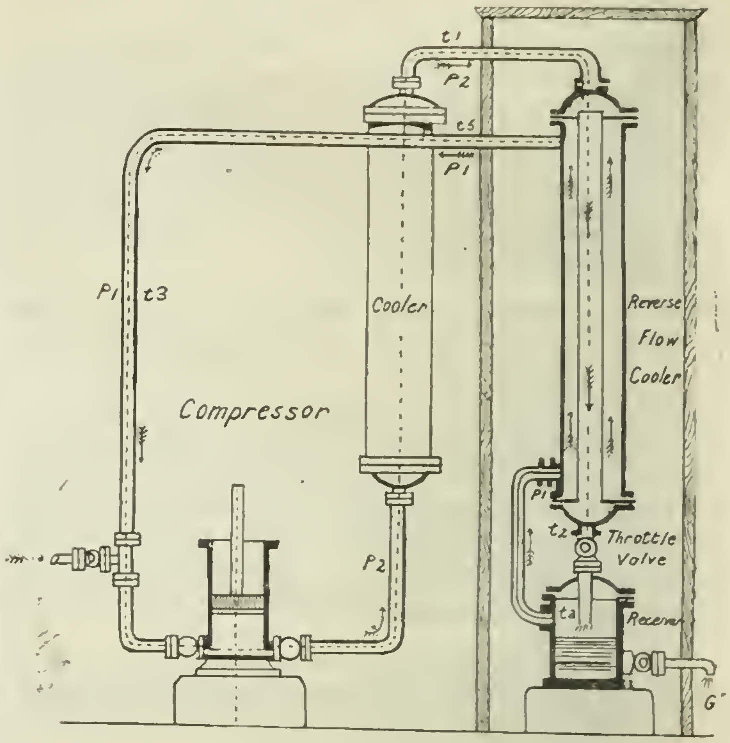
In practice it is generally assumed that if no external work be done in the expansion of compressed air, the final temperature after expansion, when all parts of the system have attained equilibrium, will be equal to the initial temperature, and no cooling will be effected. This is not strictly correct, for it presupposes that air is a perfect gas in which no inter-molecular work is possible. It is true that the amount by which air departs from the behaviour that may be postulated for a perfect gas is not great, but it is perceptible, and indeed was measured by Joule and Thomson 40 years ago. They found that air under pressure, in rushing through a porous plug was slightly cooled. [The same is true for other gases, excepting hydrogen which becomes slightly warmer.] The amount of cooling is given in degrees Centigrade by the expression

$$\frac{p_2-p_1}{4}\left(\frac{289}{T_1}\right)^2$$

when $p_2$ is the higher and $p_1$ the lower pressure in atmospheres, and $T_1$ is the absolute temperature of the compressed air just before it passes the point of expansion. Thus, with a pressure of 75 atmospheres on the one side of a throttle valve, and one of 25 atmospheres on the other, air at an initial temperature of 10° C. should be cooled through 12·76° C. These are the conditions employed by Herr Linde, the inventor of the refrigerating apparatus shown in Fig. 1. It is remarkable that he should have succeeded in utilising this comparatively small cooling effect in such a way as to cause it to yield a cumulative effect great enough to permit the attainment of the critical temperature of air, and as a consequence, of temperatures still lower, *e.g.*, − 200° C. or − 328° F., by simply handling liquid air like any other volatile liquid.

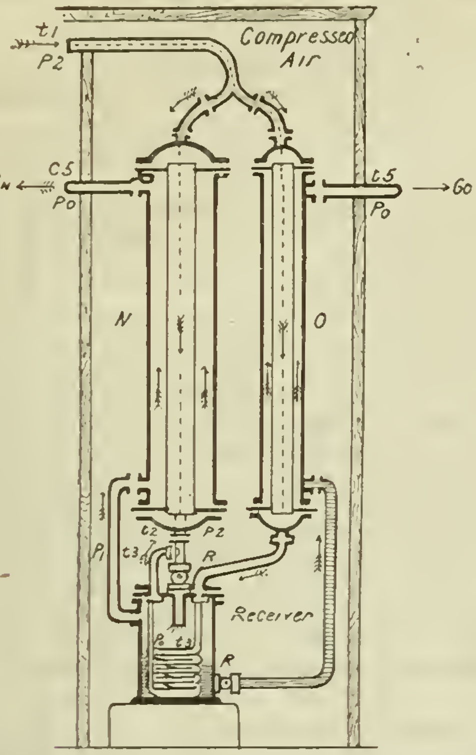
In Fig. 1 $P_1$ is the inlet and $P_2$ the outlet pipe of a compressor. The compressed air is cooled to 10° C. = 58° F. by the "cooler." It then passes down the "reverse-flow cooler"; connection with the outer annular space of this is cut off by a diaphragm at each end. The air passes through the throttle valve, expands, and is cooled through 12·76° C. The slightly cooled air flows through the side tube into the annular casing of the reverse-flow cooler. In flowing through this it receives heat from the air streaming through the inner tube in the opposite direction; this latter is cooled, passes through the throttle valve and is further cooled, then serves to cool the next portion about to pass the throttle, and so on. In practice, the reverse-flow cooler —shown for simplicity as two straight concentric tubes—consists of two spiral tubes, one within the other, 100 m. long and 10 and 4 cm. in diameter respectively. The whole is of course elaborately lagged to prevent absorption of heat from external sources. The cycle of operations continues until the temperature in the receiver falls below the critical temperature of air. A portion of the air thereupon liquefies, and a fresh quantity is accordingly supplied by a second compressor (not shown in the figure) which serves to feed the main or circulating compressor. The process continues until a sufficiency of liquid air has collected in the receiver. In one of the earliest trials made at the Munich testing station of the Linde Freezing Machine Company, the initial temperature was below 0° C., cooling being effected by an ammonia freezing machine instead of by water. At the first trial, about eight litres of liquid, slightly blue in colour, were obtained.

Fig. 1.



Analysis of the gas produced by the evaporation of the liquid obtained showed that it contained 70 per cent. of oxygen, in place of 21 per cent., the quantity present in normal air. The explanation of this is that, as nitrogen boils off from liquid air more quickly than oxygen does, the residual liquid contains more oxygen than is present in normal air. Hence it is practicable to manufacture oxygen from air by purely mechanical means. In carrying this out it is advisable to modify the apparatus so as to utilise the cooling effect of both liquefied constituents and evolve them at the same temperature as at the beginning of the operation, but as separate gases. The additional arrangements shown in Fig. 2 suffice for this purpose. The reverse-flow cooler is duplicated, the second member being connected with the first above the the throttle-valve through the spiral tube shown coiled in the receiver. As the gas condenses in the receiver, oxygen is its preponderating constituent ; and this is allowed to flow out by the pipe R, which is trapped by liquid oxygen into the cooler O, nitrogen correspondingly finding its way from the space above the liquid into the outer jacket of the cooler N. In these two coolers the expansion of each gas on its relase by drawing off through the pipes *Gn* and *Go* respectively, aids in the cooling of the air delivered by the compressor down the inner tube of each cooler. The richness in oxygen of the gas passing out through *Go* can be controlled by regulating the throttle valve. Calculation shows that a horse-power-hour should give about 1 cubic metre of 70 per cent. oxygen by this method.—D. E. J.

Fig. 2.



*Bark of Ailanthus Excelsa.* D. Hooper. Pharm. Journ. **55**, 345.

The tree known as *Ailanthus excelsa*, Roxb. occurs in many parts of India, and its bark is held in repute there for medicinal purposes, chiefly as a febrifuge and tonic. Daji (Pharm. Journ. [3], **1**, 193) isolated from it an acid principle which he named ailanthic acid. This was a reddish-brown, very bitter, deliquescent substance, easily soluble in water. He also found a bitter, non-crystallisable principle. According to the author, the bitter principle is a light brown, granular substance, not distinctly crystalline, intensely bitter, neutral in reaction, and soluble in water and spirit with fluorescence. It gives a purplish colour with sulphuric acid and is precipitated from solution by tannin. The author considers it has no claim to be called an acid, but belongs to a neutral class of substances related to quassiïn and may probably prove to be identical with cedrin and samaderin, which have been obtained from other members of the *Simarubaceæ*.

—J. G. W.

*Acokanthera Schimperi : its Natural History, Chemistry, and Pharmacology.* T. R. Fraser and J. Tillie. Proc. Roy. Soc. **58**, 70—73.

An examination of the arrow poisons of East Africa indicate that they are prepared from the wood and not from the seeds of the genus *Acokanthera*. The poison from the coast regions near Mombasa contains a crystalline glucosidal active principle which is identical with that separated from the wood of *Acokanthera Schimperi*. Its composition by combustion corresponds with the formula $C_{30}H_{48}O_{13}$. This is identical with the formula $C_{30}H_{46}O_{12}.H_2O$, obtained in 1888 by Arnaud from an unidentified species of *Acokanthera*, and to which formula the name *Ouabaïn* was given. Lewin, in 1893, obtained an amorphous glucoside of a slightly different composition, to which the same name was given, and which was erroneously stated to be the active principle of *Acokanthera Schimperi*. Another glucoside which was named Ouabaïn was obtained in 1882, but its composition varied widely from the foregoing. The present material crystallises from water and alcohol, in both of which it is slightly soluble at low temperatures. It is insoluble in ether and chloroform. The solution is tasteless, neutral, and unaffected by most reagents. Strong sulphuric acid produces a red colour, and subsequently develops a green one, whilst the dilute acid gives the reaction of a glucoside. The melting-point is about 186° C. Owing to the name Ouabaïn being given to three quite different substances, the authors suggest that the crystalline active principle of *Acokanthera Schimperi* should be named Acokantherin.—A. W.

*Vesicating Constituent of Croton-Oil.* Wyndham R. Dunstan and Miss L. E. Boole. Proc. Roy. Soc. 1895, **58**, 238.

According to Buchheim and to Kobert and Hirscheydt, the vesicating constituent of croton-oil is the so-called croton-oleic acid, a substance closely allied to oleic acid, and which is prepared on the large scale in Germany by the process devised by the last-named authors. This consists in saponifying with baryta the portion of the croton-oil which is readily soluble in strong alcohol. The resulting barium salts are washed with water, dried, and repeatedly extracted with ether. The barium salts of oleic and crotonoleic acids are dissolved out by the ether, and are subsequently separated by treatment with ether, which dissolves only the barium crotonoleate.

The authors have submitted the lead salt of crotonoleic acid prepared thus to fractional precipitation, by adding successive quantities of water to its solution in alcohol. In this way they found that the true pustule-producing constituent remained chiefly in the last fractions, and formed but a small portion of the original substance. It was finally isolated as a resinous substance possessing extraordinary power as a vesicant, which the authors propose to call croton resin. Its empirical formula is $C_{13}H_{18}O_4$. It is a hard, pale-yellow, brittle resin, nearly insoluble in water, light petroleum, and benzene, but easily soluble in alcohol, ether, and chloroform. On heating it softens gradually, and is quite fluid at 90° C. It has neither acid nor basic properties, and is decomposed by boiling with alkalis, yielding a mixture of acids, and losing its vesicating properties. Its reactions seem to indicate that it is a lactone or anhydride of complicated composition.—T. E.

*Essential Oils, Notes on.* (Mainly from Schimmel's Reports.) Pharm. J. 1895 (1320 and 1321), 307—309, 328—329.

*Anise Oil.*—Anethol, now introduced as an article of commerce, possesses a solubility in spirit of different degrees of strength, which varies considerably. The following data are given as the result of exact determination :—

*Solubility of Anethol in 1 litre of Spirit at* 20° C.—

| | | | | | |
|---|---|---|---|---|---|
| Per cent. alcohol by volume ... | 20, | 25, | 30, | 40, | 50. |
| Quantity of anethol dissolved.. | 0·12, | 0·2, | 0·32, | 0·86, | 2·3. |

Experiments by Hell and Gärtner have shown that with one sample of anethol from "star anise oil" (b. pt. 228°—232°) the constitution was correctly represented by the formula $(CH_3O).C_6H_4.CH:CH.CH_3$ *p*-methoxy-propenyl benzene, whilst in another sample of uncertain origin, the presence of another isomeric anethol was indicated :—$(CH_3O).C_6H_4.CH_2.CH:CH_2$, methoxyallylbenzene or methyl chavicol. Further work in the laboratory of Schimmel and Co. confirm this, and show that the oils of *Illicium anisatum* and *Pimpinella anisum* probably contain both methyl-chavicol and ordinary anethol. On refrigerating these oils, the crystalline anethol separates, and a thin fluid oil remains. On boiling this with alcoholic potash the boiling point is raised, the index of refraction increased, and on cooling a further yield of crystalline anethol is obtained. With regard to star anise oil, Messrs. Schimmel lay stress on the solidification test. The higher the solidification point the larger the amount of anethol present. On the average the solidifying point is 16° C., the highest limit being 17·5°, the lowest 14° C.

*Cassia Oil.*—This oil is occasionally found adulterated with rosin and petroleum, and one sample was found containing 10 per cent. of alcohol, which would render incorrect the determination of the cinnam-aldehyde present. But it is pointed out that oil of cassia with 80 per cent. of aldehyde is now a rarity, and oils with 70 to 75 per cent. of aldehyde may be deemed satisfactory, providing no adulterant be also present.

*Citronella Oil.*—There is an increased consumption of this oil in soap manufacture, and prices have accordingly risen. Specimens have recently been found to contain instead of paraffin oil, the usual adulterant, an admixture of what appears to be East Indian gurgun or wood oil.

*Bergamot Oil.*—The value of this oil is regulated by the percentage of ester present. A known quantity of the oil is heated for 10 minutes with semi-normal alcoholic potash in a flask connected with reflux condenser. If the ordinarily recommended process of heating in sealed tubes, with 10 per cent. alcoholic potash be followed, then linalool is attacked, and the potash consumed in saponification of the ester, plus that which has attacked the linalool is erroneously calculated as ester present.

*Cedro Oil.*—This oil which contains citral is from the rind of the fruit of *Citras medica*, Risso. It is of yellow colour and with an odour like that of citral and lemon oil. Sp. gr. = 0·871 at 15° C.; rotation + 67° 8′ at 18° C. The greater part distils between 177° and 220° C. The presence of citral is proved by the formation of citryl-β-naphthocinchoninic acid (melting-point 197°—200° C.) on boiling the oil with alcoholic solution of β-naphthylamine and pyrotartaric acid.

*Fennel Oil.*—Wallach has shown that fenchol yields *m*-cymene under the same conditions as those under which camphor yields *p*-cymene, and recently he has established the identity of this *m*-cymene with that obtained from rosin oil.

*Pine Needle Oil.*—This is the oil distilled from the needles of *Pinus pumilio.* Extra fine pine needle oil is prepared exclusively in Switzerland from the young cones of *Abies excelsa*, Link. The oil obtained by Umney from young needles and cones of *Pinus sylvestris*, contains levopinene, whilst the foregoing is dextro-rotatory. The oil of *Pinus nigra* contains upwards of 50 per cent. of bornyl acetate (E. Kremers).

*Heracleum Oil* from the fruit of *Heracleum sphondylium L.*, consists chiefly of octyl acetate.

*Pastinac Oil* from the fruit of *Pastinaca sativa, L.*, consists chiefly of octyl butyrate.

*Carraway Oil.*—Normal oil should have a sp. gr. of 0·908 to 0·910 at 15° C., when less, the oil is deficient in carvol, and inferior.

*Lavender Oil.*—Production this year is most deficient in the departments Drôme, Gard, and Herault, which furnish oil of good quality with 28—32 per cent. of ester. The extra fine oil with 38—40 per cent. of ester comes from the highest parts of the Alpes Maritimes and Basses Alpes towards the Italian frontier.

*Linaloe Oil.*—The Mexican oil is said to be frequently adulterated with fat oil, and the amount of linalool present subject to great variation. Barbier and Bouveault recognise the identity of linalool and licareol, and according to them the oil contains licareol (linalool) 90, licarhodol (geraniol) 2, and sesquiterpene 3 per cent. with methylkeptenone, diatomic and tetratomic terpenes respectively 0·1 per cent. each.

*Oil of Cloves.*—Clove oil appears to consist of eugenol, a heavy phenol, and caryophyllen, a light sesquiterpene. Nevertheless, clove oil cannot be produced by mixture of these two substances: there is an absence of the peculiar aromatic odour of the clove blossom, which furnishes the best means of distinguishing clove oil from the oil of clove stalks. The specific gravity of the oil is from 1·05—1·068 at 15° C., that of the very best oil from 1·050 to 1·056.

*Peppermint Oil.*—The experimental culture of peppermint in Saxony is being continued, and the yield of oil this year amounts to about 400 pounds.

*Tansy Oil.*—This oil has acquired interest, since it has been found to be the best source of tanacetone (thujone) $C_{10}H_{16}O$. Schimmel's investigations showed that by fractionally distilling tansy oil, the fraction boiling at 205° C. deposited a crystalline mass of borneol and camphor. The camphor was separated after converting the borneol into the sodium salt of acid succinic ester (Haller's method). It turned out to be the rarer levo-camphor, and not the ordinary dextro variety. The oil from fresh grown cultivated tansy has singularly little resemblance to that distilled from the wild plant. Its optical behaviour is especially different from the American oil, and it is levorotatory, almost in the same degree as the American oil is dextro-rotatory.

*Rosemary Oil* (pure) is dextrorotatory and perfectly miscible with more than half its volume of 90 per cent. alcohol; its specific gravity should not be less than 0·900.

*Sandal-wood Oil.*—Messrs. Schimmel test this oil by an acetylation process, in which they prefer to use acetic anhydride with addition of some anhydrous sodium acetate, and they calculate the results on the assumption that santalol, the alcohol of sandal-wood oil, has the composition of a sesquiterpene alcohol, $C_{15}H_{20}O$. On this basis sandalwood oil appears to contain about 90 per cent. of santalol.

*Thyme Oil.*—The quality of red as well as white thyme oil is proportionate to the amount of phenols (thymol and carvacrol) present. The amount of phenols should not be less than 25 per cent. Both phenols are also present in the oil of various kinds of *Monarda* (E. Kremers). The chief constituent of the oil of *Monarda punctata* is believed to be thymol, but that of *M. fistulosa* contains carvacrol along with cymene and a substance resembling alizarin.

*Wintergreen Oil.*—An examination showed that oil of *gaultheria procumbens* contains 99 per cent. of methyl salicylate, together with some paraffin, "probably triacontane $C_{30}H_{62}$," an aldehyde or ketone, a secondary alcohol, $C_8H_{16}O$, and an ester $C_{14}H_{24}O_2$. The optical activity of the oil is considered to be due to these latter ingredients. It is suggested that they are decomposed or altered during the fermentation which gives rise to birch oil, thus prepared. Pure fresh gaultheria oil should exhibit a left rotation of not less than 0° 25′.

*Birch Oil* contains about 99·8 per cent. of methyl salicylate, and when unrectified also minute quantities of the paraffin $C_{30}H_{62}$ and the ester $C_{14}H_{24}O_2$, whilst the alcohol $C_8H_{16}O$ characteristic of gaultheria oil is absent. Birch oil is always optically inactive. The specific gravity of both oils is 1·180 and 1·187 at 15° C. Like synthetic methyl salicylate they give with 5 parts of 70 per cent. alcohol, a perfectly clear solution at about 20° C.

*Cinnamon Oil.*—The fact that the oil from cinnamon bark contains 60—85 per cent. of cinnamic aldehyde, and from 4—8 per cent. of eugenol, whilst cinnamon leaf oil contains much eugenol and only about 1 per cent. of cinnamic aldehyde affords a satisfactory basis for testing cinnamon oil and detecting admixture of leaf oil.

Messrs. Schimmel consider Umney's limitation as to sp. gr. 1·024 to 1·030 at 15° C., too narrow, and suggest an extension to 1·038. The oil they also state is seldom quite inactive, being generally slightly levo-rotatory.—W. S.

*Use of Carbon Tetrachloride for the Separation of Methyl from Ethyl Alcohol.* M. Cari-Mantrand. Monit. Scient. June 1895, **45**, 415.

For the separation of methyl alcohol, empyreumatic impurities and petroleum spirit from the ethyl alcohol of methylated alcohol, the author proposes to add to the methylated alcohol one quarter of its volume of carbon tetrachloride, and subsequently $2\frac{1}{2}$ volumes of saturated brine. This mixture is well agitated, and the carbon tetrachloride allowed to settle. Its volume will be found to be augmented by the amount of the above-named impurities contained in the methylated spirit. The alcoholic solution which contains nearly all the acetone and methyl alcohol of the methylated spirit, is now separated from the tetrachloride by means of a separating funnel, filtered, and then distilled through a dephlegmator of much the same construction as the ordinary stills which yield at once an alcohol of from 96·5 to 97 per cent. All the distillate passing over above 78° C. is alcohol without a trace of either acetone or methyl alcohol.—C. O. W.

*Linalool Ester in Bergamot Oil, Determination of.* H. Helbing and F. W. Passmore. Chemist and Druggist, 1895, **47**, 585.

*See under* XXIII., *page* 993.

*Compound of Chloral Hydrate with Caffeine, Process for Preparing.* Chem. Fabrik auf Actien vorm. E. Schering, Berlin. Ger. Pat. 75,847, October 6, 1892.

Caffeine and chloral hydrate or chloral, are brought together in aqueous or alcoholic solution in molecular proportions, when they combine to form an addition product of the formula:—

$$C_8H_{10}N_4O_2 + H_2O + CCl_3.CH(OH)_2.$$

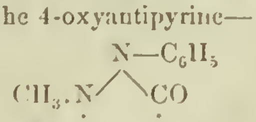
This compound may be recrystallised from a little water at 30° C., without decomposition. It is decomposed on attempted dry distillation as well as on boiling its solution. Because of its easy solubility as opposed to the difficult solubility of caffeine, it is considered likely that this compound will prove of medicinal value.—W. S.

*Diacet-p-phenetidide, Process for the Preparation of.* Aug. Bistrzycki and F. Ulfers, Charlottenburg. Ger. Pat. 75,611, July 21, 1893.

By the conjunction of a second acetyl group with mono-acetamidophenol ether, the antipyretic properties of that body are considerably increased. For the preparation of di-acet-*p*-phenetidide, phenacetine or *p*-phenetidine is heated with acetic anhydride (or analogous acetylising agent) either in open or closed vessels for several hours at a high temperature, and the raw product obtained is purified by suitable treatment with benzene and petroleum spirit. The diacet-*p*-phenetidide melts at 55°—56° C. —W. S.

*1-Phenyl-2, 3-Dimethyl-4-Oxy-5-Pyrazolone, Preparation of.* L. Knorr and R. Pschorr, of Jena. Ger. Pat. 75,378, September 7, 1893.

1-Phenyl-2, 3-dimethyl-4-amidopyrazolone (Annalen **238**, 189) under the influence of oxidising agents such as ferric chloride, yields 1-phenyl-3-methyl-4-ketopyrazolone. This body melts at about 119° C., sublimes in lustrous red plates, is easily soluble in the ordinary solvents, and forms as ketone, a sodium bisulphite compound. In contact with moist air it is converted into the ortho-compound. By reducing agents, the ketone is converted into the corresponding alcohol—the 1-phenyl-3-methyl-4-oxypyrazolone, which melts close upon its decomposition point 189° to 193° C., and is soluble in dilute acids and alkalis. From this alcohol the 4-oxyantipyrine—



is easily prepared by means of the well-known methylating processes.

The 4-oxyantipyrine exerts physiological action like antipyrine, melts at 182° C., is easily soluble in alkalis and hot water, with difficulty in ether, petroleum spirit, and toluene. It possesses the property both of a phenol and a weak base, and is capable, through the agency of its hydroxyl group, of reacting with acid anhydrides and chlorides—the benzoyl derivative melting at 139° C. The 4-methoxyantipyrine obtained in the usual way, melts at 75° C.—W. S.

### PATENTS.

*Cellulose Acetate, Manufacture of.* C. F. Cross and E. J. Bevan, London. Eng. Pat. 9676, May 17, 1894.

A compound of cellulose with zinc acetate is claimed, which is prepared by mixing cellulose hydrate (obtained in any of the known ways, viz., by precipitating the solution of cellulose in zinc chloride or in cuprammonium solution, or by acting on cellulose with caustic soda and carbon bisulphide) with zinc acetate. The cellulose hydrate from about 100 parts of dry cellulose is mixed with 150 parts of crystallised zinc acetate in solution, and the mixture evaporated and dried at 110°. The second claim is for an acetate of cellulose prepared by treating the zinc acetate compound in a finely-powdered condition with acetyl chloride, the temperature not being allowed to rise above 30° C. Two molecules of acetyl chloride are taken to one of zinc acetate in the compound. The product is washed with water and dried. It may be purified by treatment with chloroform, which dissolves the acetate of cellulose, leaving any unchanged cellulose undissolved. The product closely resembles the nitrates of cellulose in its physical properties, but is not explosive. From its solution in chloroform it is obtained in transparent films or sheets, and so may be used as a substitute for collodion in surgical work, and also as a varnish in special cases, such as those in which collodion is now used. It has also the property of uniting with oils in suitable solvents of both. It holds the oils in such a way as to give films of much softer texture without any loss of transparency.—T. E.

*Pharmaceutical Compounds, the Manufacture or Production of.* The Farbenfabriken vorm. F. Bayer and Co. Eng. Pat. 22,617, November 22, 1894.

The patentees had formerly found that acetylamidophenyl salicylate does not possess the toxic properties of salol, and can be substituted for it with advantage.

They now find that the lactylamidosalol is superior to the acetyl compound, owing to its greater solubility in water. They claim the lactylamidophenyl salts of salicylic acid, and of ortho-, meta-, and para-cresol carboxylic acids. These are made by acting on amidosalol or the corresponding compounds of the cresol-carboxylic acids, with lactic acid, lactic anhydride, lactide, or an ethereal salt of lactic acid. They may also be obtained from lactamide and a salt of amidosalol.—T. E.

*The Manufacture of Acetone and in Apparatus therefor, Improvements in.* R. Jürgensen, Prague, and A. Bauschlicher. Eng. Pat. 23,438, December 3, 1894.

The claim is for an improved process for the manufacture of acetone by distilling, in a retort jacketed with molten lead, a basic calcium acetate which is made by adding 5 per cent. of lime to a very concentrated solution of calcium acetate and evaporating to dryness. The jacket of molten lead is used in order to avoid overheating the contents of the retort, and consequent formation of by-products. The contents of the retort are stirred during the distillation, and the acetone formed is carried off by a current of indifferent gas (such as generator gas, water-gas, or superheated steam). The mixture of gas and vapour passes through a box where dust is deposited, after which the acetone is condensed. The crude product is purified by mixing it with water, which dissolves the acetone and leaves the tarry impurities undissolved. After these have been removed, the clear aqueous solution is submitted to fractional distillation. From 100 parts of acetate of lime, 25—26 parts of pure (99·5 per cent.) acetone are obtained.—T. E.

*Citrates, Tartrates, and Mandelates of Para-anisidine and Para-phenetidine, Manufacture of.* J. Roos, Frankfort-on-the-Maine. Eng. Pat. 11,288, June 8, 1895.

The claim is for the bodies named in the title of the patent. They are made by mixing the theoretical quantities of the acid and base in any suitable solvent, and recrystallising the product. They may be used for medical and other purposes.—T. E.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

*Composite Heliochromy.* F. E. Ives. Tech. Quarterly, **7**, 317—323.

In composite heliochromy the colours of any objects that may be photographed are automatically reproduced, although the direct action of light upon the sensitive plate does not produce colours. Three negatives are required, because there are three primary colours that can be made to reproduce all others by suitable mixtures.

These colours are the spectrum red below the line C, the spectrum green at E, and the violet above G. The explanation is that there are three fundamental colour sensations, and that most of the spectrum rays excite two fundamental sensations at once, in different degrees. Maxwell was the first who pointed out these facts, and although it has more recently been discovered that the green of the spectrum does not accurately represent the fundamental green sensation, the difference is stated to be of little practical importance for reproduction purposes in composite heliochromy. Maxwell's curves, which show exactly what mixture is necessary to reproduce the colour of any part of the spectrum, have therefore been used by the author in his investigations on composite heliochromy. The first of the above-mentioned three negatives represents the red, and all rays between the spectrum lines A and E must act in producing it in strict accordance with Maxwell's density curve between these lines. This is done by exposing, through a suitable orange-coloured screen, a rapid gelatino-bromide plate, sensitised by cyanine; or by exposing an isochromatic plate through a compound-colour screen of Brilliant yellow and Fuchsine. The second of the negatives, representing the green, must be in accordance with Maxwell's density curve between the spectrum lines C and G; and the third negative, representing the blue-violet, must correspond to Maxwell's curve between the spectrum lines E and H. The author states that these last-named negatives can also be made on isochromatic plates by exposing through suitable colour screens.

Now, if lantern slides are made from these three negatives, and projected upon the screen, one with red light, one with green, and one with blue-violet, the mixture, according to the author, will produce a perfect reproduction of the spectrum photographed.

The author further states that, although this process seems complicated, it has been simplified by the invention of a special camera, by means of which the three images may be taken by simultaneous exposure on a single plate. Moreover, instead of the lantern projection, the author uses a "photochromoscope," and he is of opinion that with this camera and instrument his method of reproducing the natural colours is as simple in operation as stereoscopic photography.

In conclusion, it is mentioned that colour prints, on glass as well as on paper, can also be made; but in both respects, especially in the latter, the process is at present not yet sufficiently developed to be of practical importance.—H. S.

## PATENTS.

*Imparting a Predetermined Temperature to Liquids for Use in Developing Photographic Plates and for other Purposes, Improvements in Apparatus for.* C. E. Hearson, Camberwell, Surrey. Eng. Pat. 22,013, November 14, 1894.

*See under* I., *page* 951.

*Engraving and Preparing Rollers and Surfaces with the aid of Photography for Printing upon Calico, Paper, and other Fabrics and Materials, Improvements in the Methods of and in Apparatus for.* C. A. Burghardt and H. Meller, Manchester. Eng. Pat. 32,513, November 21, 1894.

*See under* VI., *page* 966.

*Papers for Photographic Purposes, Improvements in.* H. Wandrowsky, Ehrenfeld, Germany. Eng. Pat. 14,104, July 24, 1895.

Photographic printing-paper becomes brown on being stored for a length of time, owing to the silver nitrate, which is present in the sensitive layer, penetrating into and affecting the paper. This is prevented from occurring by introducing into the paper, either during its manufacture or afterwards, salts of certain organic acids, which yield, by interaction with the silver nitrate, salts which are insoluble in water, but soluble in sodium thionate. Such salts are those of acetic, oxalic, succinic, tartaric, citric, and benzoic acids. They must be present in the paper in quantity sufficient to wholly decompose the silver nitrate which is brought into contact with them. As they are applied to the paper only, some silver nitrate remains undecomposed in the printing surface, and sensitiveness is, therefore, unaffected.—E. B.

## XXII.—EXPLOSIVES, MATCHES, Etc.

*Measurement of Pressures by the Crusher Gauge.* W. Kellner and W. H. Deering. Proc. Roy. Soc. 1895, **57**, 404—410.

The indications of the crusher gauge were checked by a simultaneous determination of the dead load that could be lifted by the explosion of a small charge of cordite. To effect this, a steel cylinder of about 120 c.c. capacity was closed by a screw-plug with an axial aperture $\frac{1}{4}$ in. in diameter, but otherwise gas-tight. The copper crusher gauge, previously compressed in the usual way by a load of one ton less than the expected pressure, was fixed within the cylinder, the cordite charge was placed in position with a wire bridge to ignite it, the cap was screwed down, and the central aperture closed by a $\frac{1}{2}$-in. steel ball, such as is used for ball bearings. Weights in excess of the amount calculated to be required were then supported upon the ball, which thus acted as a valve, and the whole arrangement being held firmly by suitable means, the cordite was fired by the electric current. If the weights were sufficiently heavy, no gas escaped at the valve, the explosion was without report, and no damage was done to the steel ball; other experiments were then tried with gradually diminishing loads of weights, until the explosion caused the gases to blow out with a loud report, the hole in the stopper being in this case injured, and a ring melted in the steel ball. For a few experiments at low pressures the mouth of the orifice in the stopper was enlarged to 0·35 or 0·4 in. in diameter, but for all charges producing pressures in excess of 13 tons the original size of aperture was used. In every case the diameter was accurately measured by means of a microscope provided with cross-wires and a vernier. The results show that the pressure indicated by the weights was invariably higher than that shown by the crusher; at 5 tons (by crusher) the difference was about 11 per cent., at 6 tons about 9 per cent., at 13 tons about 11 per cent., and at 16 tons about 16 per cent. At 5, 6, and 13 tons there was usually, but not always, less difference between the individual pressures shown by the crusher than between those shown by the weights; and at 16 tons there was a decidedly greater regularity in the crusher results than in the others. But each recorded crusher result was the mean of a series of tests, whilst the others were the single observations obtained in the last experiment, when the escape of the gas first occurred by reason of the diminished load upon the stopper. The compression of the crusher was the same in all experiments of a series, whether the gases blew out or not, the weights apparently not being raised until the compression of the copper had come to an end.—W. G. M.

## PATENTS.

*Manufacture of a New Explosive* [*Ammonium Nitrate, &c.*]. O. Imray, London. From F. C. Glaser, Berlin. Eng. Pat. 18,921, October 5, 1894.

This new explosive consists of a mixture of ammonium nitrate and animal or vegetable fats or oils, as distinguished from resin, paraffin, mineral, or ethereal oil.—W. M.

*Improvements in Explosives* [*Nitrocellulose*]. A. F. Hargreaves, Roslin, Midlothian. Eng. Pat. 24,235, December 13, 1894.

The inventor takes cotton cloth or a woven or netted web and nitrates the cellulose in this form. The nitrated web is then run through solutions containing nitrates and other ingredients, and, after evaporation of the solvents, is ready to be cut up into strips, &c., for use as a propulsive powder.—W. M.

*An Improved Manufacture of Explosives [Ammonium Nitrate, &c.].* L. W. Buse, Bochum, Germany. Eng. Pat. 15,834, August 22, 1895.

Permanganates, chromates, or bichromates are added to ammonium nitrate explosives with the object of increasing their power and of insuring increased safety in their use in fiery mines.—W. M.

# XXIII.—ANALYTICAL CHEMISTRY.

## *APPARATUS, ETC.*

*Absorbent Blocks.* P. T. Austen and W. H. Broadhurst. Amer. Chem. J. **17**, 1895, 472—473.

Porous blocks, suitable for use in the laboratory for drying purposes, may be inexpensively prepared in the following manner:—An intimate mixture of equal parts of infusorial earth and plaster of Paris is moistened with water and poured into a glass mould to set. When set, the slabs which are formed are placed in an air-oven and heated at 100°—120° for a day or two. They are then ready for use.—E. B.

*Measurement of Pressures by the Crusher Gauge.* W. Kellner and W. H. Deering. Proc. Roy. Soc. 1895, **57**, 404.

*See under* XXII., *page* 988.

## *INORGANIC CHEMISTRY.— QUANTITATIVE.*

*Fluoriferous Hydrogen Peroxide in Estimating Titanium, Warning against the Use of.* W. F. Hillebrand. J. Amer. Chem. Soc. 1895, **17**, 718.

Hydrogen peroxide does not produce a yellow colour at all in titanium solutions that contain hydrofluoric acid or fluorides, whilst the colour is weakened if hydrofluosilicic acid be present. The hydrogen peroxide should therefore always be tested for fluorine, before use, especially in such a method as Weller's, for the estimation of titanium in minerals.

When minerals are dissolved by means of hydrofluoric and sulphuric acids, previous to analytical estimation, care should be taken to expel all fluorine.—A. S.

*Metals, their Electrolytic Separation.* E. F. Smith and D. L. Wallace. J. Amer. Chem. Soc. 1895, **17**, 612—615.

Cadmium, mercury, gold, and silver have each been completely separated electrolytically from many other metals by using cold solutions of double cyanides; but from 12 to 14 hours were always required for that purpose. Smith and Spencer (this Journal, 1895, 190) accelerated the deposition of both mercury and silver by heating the electrolyte to from 65—70° C. The authors now show that by operating at 65° C., mercury can be quantitatively separated from cadmium, zinc, nickel and cobalt, in cyanide solution, containing a little free potassium cyanide, by using a current density of from 0·02 to 0·08 (preferably 0·06) ampère per 100 sq. cm. of electrode surface. Similarly, and at the same temperature, gold could be separated from cobalt, arsenic, zinc, and nickel by a current of 0·1 ampère, or from copper by one of 0·07 ampère, per 100 sq. cm. Whilst silver was separated from zinc, nickel, and cobalt, as well as from copper and cadmium, by a current of 0·04 ampère per 100 sq. cm. The precipitates were pure, and the time required ranged from 3 to 3½ hours. The conditions for the separation of silver from gold, and of mercury from gold or silver in cyanide solution, have not been accurately determined, traces of impurity having generally been found in the deposit.—W. G. M.

*Potash as Potassium Platinichloride, some Conditions affecting the Accuracy of the Determination of.* A. L. Winton. Amer. Chem. J. **17**, 1895, 453—466.

Potassium platinichloride, as precipitated from a concentrated solution of potassium chloride, forms, for the most part, microscopic, radiating crystals, consisting of three bars interpenetrating one another at right angles and containing globular cavities filled with liquid. This is not wholly removed on drying at less than 160°.

As formed, however, in solutions so dilute that evaporation is necessary to cause it to deposit, it is obtained in octahedra, usually attached to one another forming plates which are almost free from cavities, and are practically deprived of moisture by drying for three hours at 100°.

Sodium chloride and magnesium sulphate prevent the complete precipitation of potassium as potassium platinichloride, but the precipitation is not affected by the presence of free hydrochloric or sulphuric acid, or by the temperature of evaporation of the solution.

For calculation of the results, the factors 0·30688, for potassium chloride, and 0·1939, for potassium oxide, are recommended instead of those given by Fresenius.—E. B.

*Determination of Nitrogen in Fertilisers containing Nitrates.* H. C. Sherman. J. Amer. Chem. Soc. 1895, **17**, 567—576.

The author describes an elaborate series of experiments the results of which seem to warrant the following conclusions:—

1. For ordinary fertilisers containing little or no chlorides the official methods are perfectly reliable if the directions are followed closely and the digestion in the modified Gunning method be continued for at least a short time after the liquid has become practically colourless. The discrepancies which sometimes occur under these circumstances are believed to be due to faulty preparation of the sample.
2. In the case of samples containing considerable amounts of chlorides, it is advisable to use the modified Kjeldahl method (with zinc dust), and to cool the acid mixture before adding it to the substance. It appears advisable also to digest for some time at ordinary temperature before adding zinc dust. No way has been found by which equally accurate results can be obtained by the modified Gunning method in the presence of large amounts of chlorides, together with high percentages of nitric nitrogen.
3. When determining high percentages of nitric nitrogen by the modified Gunning method, it is necessary either to continue the boiling for some time after the contents of the flask have become colourless, or to use permanganate to complete the action.—A. K. M.

*Determination of Small Quantities of Phosphoric Acid by the Citrate Method.* E. G. Runyan and H. W. Wiley. J. Amer. Chem. Soc. 1895, **17**, 513—516.

The experiments described in the paper have led the authors to the following conclusions:—(1.) In all cases of samples of tricalcium phosphate, or acid phosphates made therefrom, containing the usual accompanying substances, the phosphoric acid may be correctly estimated by direct precipitation with magnesium citrate. (2.) In the case of samples of natural rock phosphates containing less than five per cent. of phosphoric acid, it is necessary to fortify the solution before precipitation by adding a measured quantity of a solution of phosphoric acid of known strength. (3.) The fortifying solutions employed may be made either from natural tricalcium phosphates or from a chemically pure phosphate. (4.) The direct precipitation of the phosphoric acid in the presence of ammonium citrate by ammoniacal magnesia mixture is a quicker and less expensive process than the official molybdenum method and leads to results equally accurate.—A. K. M.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

### Detection of Artificial and Natural Colouring Matters on the Fibre. (Supplementary Tables.) (*Continued from page 893.*)

(Specially contributed by Messrs. Brooke, Simpson, and Spiller.)

| Commercial Name of Colouring Matter. | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Caustic Soda. | Ammonia. | Stannous Chloride and Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Primuline. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—Fibre orange-yellow; on addition of water:—fibre golden-yellow:—liquid yellowish.<br>*Dil.*:—Fibre golden-yellow, liquid colourless or slightly yellowish. | *Conc.*:—Little change; on addition of water—fibre golden or orange-yellow, liquid light yellow.<br>*Dil.*:—(Hot), fibre golden-yellow, liquid light yellow. | *Conc.*:—Nearly colourless.<br>*Dil.*:—Same as hydrochloric acid. | *Conc.* or *dilute*:—(Whether hot or cold) no action. | No action. | Fibre orange-yellow; no further change. | Fibre unchanged: the liquid takes a slight greenish fluorescence. | *Nitrous acid* diazotises it. It then gives "ingrain" colours on immersion in solutions of amines and phenols (*e.g.*, an alkaline solution of β-naphthol gives a red). |
| Turmerine. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—Fibre bright reddish-orange, liquid colourless; on heating, it is slowly decolorised; on then adding water, fibre and liquid are both nearly colourless.<br>*Dil.*:—Fibre orange, liquid colourless; decolorised slowly on boiling. | *Conc.*:—(Cold), nearly decolorised; on dilution—fibre nearly colourless, liquid yellowish.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—(Cold), fibre yellow, liquid colourless.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.* or *dilute*:—Fibre bright scarlet-red; no further change on heating or dilution; liquid nearly colourless. Fibre restored to original colour by cold dilute acids. | Fibre orange; on heating—fibre is not further changed, liquid becomes light yellow. | Same as conc. hydrochloric acid. | Fibre unchanged, liquid yellowish. | .. .. |
| Atlas Red. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—(Cold or hot), no action, solution colourless.<br>*Dil.*:—No action, liquid pinkish. | *Conc.*:—Fibre and liquid brown; on warming and adding water—fibre nearly colourless, liquid brown.<br>*Dil.*:—Fibre much paler, liquid reddish-brown. | *Conc.*:—Fibre and liquid crimson; on adding water—reddish-brown precipitate.<br>*Dil.*:—Same as dilute hydrochloric acid. | *Conc.*:—No action.<br>*Dil.*:—(Hot), fibre unchanged, liquid pale reddish-brown. | Same as dilute caustic soda. | Decolorised on warming to a light yellow (primuline), the liquid remaining colourless. | Liquid pale brown on boiling, fibre unchanged. | It is reduced by stannous chloride or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic tests as above. Atlas Red is diazotised by nitrous acid, and then gives deep "ingrain" browns on immersion in a solution of phenylene diamine, &c. |
| Dianthine + B. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—Fibre darker; original colour restored on adding water.<br>*Dil.*:—No action. | *Conc.*:—(Cold), fibre darker; (on warming and adding water), fibre much paler, liquid colourless.<br>*Dil.*:—No action. | *Conc.*:—Fibre and liquid dark crimson-red on dilution with water.<br>*Dil.*:—No action. | *Conc.*:—Fibre more orange.<br>*Dil.*:—(Cold), fibre orange. Boiling, fibre nearly decolorised, liquid orange, and giving a bright red precipitate on acidifying. | On boiling—fibre much paler, liquid reddish-orange, and giving a bright red precipitate on acidifying. | Fibre completely decolorised and liquid colourless. Colour does not return on washing with water. | Liquid pinkish, fibre unchanged. | .. .. |
| Ingrain Maroon. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—No action.<br>*Dil.*:—No action, liquid colourless. | *Conc.*:—Fibre and liquid maroon. On warming and adding water—fibre decolorised, liquid yellowish.<br>*Dil.*:—(Cold), no action. Boiling, fibre paler. | *Conc.*:—Fibre and liquid maroon.<br>*Dil.*:—No action, liquid colourless. | *Conc.*: No action.<br>*Dil.*:—Little action, fibre rather darker, liquid pinkish. | No action, liquid pinkish. | Fibre golden-yellow, liquid colourless; on washing, the fibre becomes primrose-yellow (primuline). | No action, liquid colourless. | It is reduced by stannous chloride and hydrochloric acid or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic reactions (*q.v.*) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Acid Milling Scarlet.<br>[B.S.S.]<br>(On wool.) | *Conc.* :—Fibre dark brownish-red, liquid colourless.<br>*Dil.* :—No action. | *Conc.* :—Fibre brownish-maroon, quickly becoming red, and finally yellow; liquid colourless.<br>*Dil.* :—(Hot), fibre becomes pink and finally yellow, liquid colourless. | *Conc.* :—Fibre and liquid maroon.<br>*Dil.* :—No action. | *Conc.* :—Fibre darker.<br>*Dil.* :—Fibre paler, liquid orange-red. | (Hot), same as dilute caustic soda. | Fibre bluish-pink, liquid colourless. | No action, liquid pinkish. | .. . .. |
| Rock Scarlet Y. S.<br>[B.S.S.]<br>(On wool.) | *Conc.* :—Fibre darker and browner, liquid colourless.<br>*Dil.* :—No action. | *Conc.* :—Fibre at first darker, but rapidly becoming paler, and finally yellow; liquid colourless.<br>*Dil.* :—(Hot), fibre becomes pink, and finally yellow; liquid colourless. | *Conc.* :—Fibre and liquid maroon.<br>*Dil.* :—No action. | *Conc.* :—No action.<br>*Dil.* :—Scarcely any action. | (Hot), no action. | Fibre completely decolorised, liquid colourless. | No action, liquid pinkish. | Distinguished from other scarlets by its extreme resistance to boiling soap solution. |
| Rock Scarlet B. S.<br>[B.S.S.]<br>(On wool.) | *Conc.* :—Fibre darker and browner, liquid colourless.<br>*Dil.* :—No action | *Conc.* :—Fibre brownish-maroon, quickly becoming paler, and finally yellow; liquid colourless.<br>*Dil.* :—(Hot), fibre becomes pink, and finally yellow; liquid colourless. | *Conc.* :—Fibre and liquid brownish-maroon.<br>*Dil.* :—No action. | *Conc.* :—No action.<br>*Dil.* :—(Warm), fibre rather paler, liquid orange, and giving a scarlet precipitate when acidified. | (Hot), little action, liquid light pink, bluer when acidified. | Fibre completely decolorised, liquid colourless. | No action, liquid colourless. | Distinguished from other scarlets by its extreme resistance to boiling soap solution. |
| Ingrain Yellow.<br>[B.S.S.]<br>(On cotton.) | *Conc.* :—Fibre maroon, liquid colourless.<br>*Dil.* :—Fibre browner, liquid colourless. | *Conc.* :—Fibre bright red, liquid red; on warming and adding water—liquid and fibre light yellow.<br>*Dil.* :—(Cold), fibre brown, liquid colourless; on warming—fibre bright yellow. | *Conc.* :—Fibre and liquid scarlet-red; yellowish-brown on adding water.<br>*Dil.* :—Fibre brown, liquid colourless. | *Conc.* or *Dil.* :—Fibre orange-red, liquid slightly coloured. | Same as dilute caustic soda. | Fibre golden-yellow, liquid colourless; on washing, the fibre becomes primrose-yellow (primuline). | No action. | It is reduced by stannous chloride and hydrochloric acid or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic reactions (*q.v.*); *e.g.*, formation of "ingrain red" by treatment with nitrous acid and β-naphthol. |
| Ingrain Orange.<br>[B.S.S.]<br>(On cotton.) | *Conc.* :—Fibre brownish-red, liquid colourless.<br>*Dil.* :—Fibre rather browner, liquid colourless. | *Conc.* :—Fibre and liquid brownish-red; on adding water the fibre is nearly colourless.<br>*Dil.* :—(Hot), fibre orange-red, liquid yellow. | *Conc.* :—Fibre dark brown.<br>*Dil.* :—Fibre redder, liquid colourless. | *Conc.* :—Fibre deep maroon, liquid colourless.<br>*Dil.* :—Fibre brownish-maroon, liquid slightly coloured. | Fibre rather browner, liquid nearly colourless. | Fibre golden-yellow, liquid colourless; on washing, the fibre becomes primrose-yellow (primuline). | No action. | It is reduced by stannous chloride and hydrochloric acid or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic reactions (*q.v.*) |
| Ingrain Red.<br>[B.S.S.]<br>(On cotton.) | *Conc.* :—Fibre darker, liquid colourless; on adding water, original colour is restored.<br>*Dil.* :—No action, liquid colourless. | *Conc.* :—Fibre and liquid maroon; on warming, the colour is destroyed.<br>*Dil.* :—(Cold), no action. (Boiling), fibre paler, liquid yellow. | *Conc.* :—Fibre and liquid purple.<br>*Dil.* :—No action, liquid colourless. | *Conc.* :—Fibre maroon, liquid colourless.<br>*Dil.* :—Fibre rather darker, liquid colourless. | No action. | Fibre golden-yellow, liquid colourless; on washing, the fibre becomes primrose-yellow (primuline). | No action, liquid pinkish. | It is reduced by stannous chloride and hydrochloric acid or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic reactions (*q.v.*). |

| Commercial Name of Colouring Matter. | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Caustic Soda. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Ingrain Crimson. [B.S.S.]<br>(*On cotton.*) | *Conc.*:—Fibre darker, liquid colourless; on adding water, original colour is restored.<br>*Dil.*:—No action. | *Conc.*:—Fibre and liquid crimson; on warming, the colour is destroyed.<br>*Dil.*:—(Cold), no action: (Boiling), fibre paler, liquid yellow. | *Conc.*:—Fibre and liquid maroon.<br>*Dil.*:—No action. | *Conc.*:—Fibre dark maroon, liquid colourless.<br>*Dil.*:—Fibre dark maroon, liquid slightly coloured. | Same as dilute caustic soda. | Fibre golden yellow, liquid colourless; on washing, the fibre becomes primrose-yellow (primuline). | No action. | It is reduced by stannous chloride and hydrochloric acid or by sodium hydrosulphite to primuline, which remains upon the fibre and gives the characteristic reactions (*q.v.*) |
| Hofmann Violets. [B.S.S.]<br>(*On wool.*) | *Conc.*:—Fibre yellow, liquid colourless: on addition of water—fibre blue, and finally violet.<br>*Dil.*:—Fibre blue, and then green; on warming—fibre light green, liquid yellowish; on adding water—fibre violet, liquid pale blue. | *Conc.*:—Fibre greyish-yellow, liquid colourless; on addition of water—fibre yellow.<br>*Dil.*:—Fibre brown, and then yellow; no further change on adding water. | *Conc.*:—Fibre yellow; on adding water—blue, and finally violet.<br>*Dil.*:—Fibre dark greyish-green; on warming—fibre nearly colourless, liquid yellow; on adding water—fibre blue, and finally violet, liquid bluish. | *Conc.* or *Dil.*:—Nearly colourless. | Fibre rather paler. | Fibre yellow, violet on washing with water. | Fibre much paler, liquid violet. | .. .. |
| Regina Purple. [B.S.S.]<br>(*On wool.*) | *Conc.*:—Fibre pale brown, liquid colourless; on adding water—original colour returns.<br>*Dil.*:—Fibre greyish-blue, liquid colourless. | *Conc.* or *Dil.*:—Fibre yellow, liquid colourless; no further change or return of colour on addition of water. | *Conc.*:—Fibre brown, liquid colourless.<br>*Dil.*:—Fibre bluish-grey, on washing with water—original colour returns. | *Conc.* or *Dil.*:—Fibre nearly decolorised. | Fibre and liquid colourless. | Fibre pale brown, violet on washing with water. | Fibre rather paler, liquid pale reddish violet. | .. .. |

*The differentiation of Lactose and Glucose.* L. Ruizand. Bull. Soc. Chim. **13**, 1895, 665. J. de Pharm. et de Chim. **1**, 232.

The melting point of phenyl-lactosazone (200°—202° C.) differs but little from that of glucosazone (204°—205°). Their solubility in boiling water is a better means of separation. The author, however, prefers to invert the lactose with hydrochloric acid, transform into the two osazones, and filter whilst warm. The glucosazone remains on the filter whilst the galactosazone crystallises out on cooling the filtrate. The melting point of the latter is 188°—191°.

Cupric acetate is reduced by glucose on heating, but is not so by lactose. If one treats lactose with hydrochloric acid, glucose is formed, and cupric acetate will be reduced. —J. G. W.

*Carboxyl Groups in o-Position, Tests for.* R. v. Rothenburg. J. prakt. Chem. **51**, 578—580.

The presence of two carboxyl groups in the ortho position cannot be correctly inferred from the fact that a particular substance when heated with resorcinol gives a fluorescent compound, since a whole series of bodies, such as glycol, glycollic acid, glycerol, glyceric acid, erythrite, mannite, &c., when heated with resorcinol give rise to strongly-coloured compounds which fluoresce in an alkaline solution. In fact, resorcinol itself, when heated above 100° C., gives a strongly fluorescent melt, due to the formation of an inner condensation product, a reaction which has not been explained. As a test for the presence of carboxyl groups in the ortho position, it is proposed to employ *m*-amidophenol in place of resorcinol, since this compound, when heated by itself, does not yield fluorescent substances. The author also compares the formations of the fluoresceïns, fluoramines, rhodamines, and pyronines, all of which compounds possess allied constitutions.—T. A. L.

*Notes on Essential Oils.* Pharm. J. 1895 (1320 and 1321), 307—309 and 328—329.

*See under* XX., *page* 985.

*Comparative Dye Tests, Accuracy of the Method of.* C. S. Boyer. Amer. Chem. J. **17**, 1895, 468.

*See under* VI., *page* 965.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

*Kjeldahl's Method of Organic Nitrogen Determination.* H. Causse. Bull. Soc. Chim. **13**, 1895, 636—642.

Several modifications have been proposed of the original method, all with the object of shortening the duration of the operation. The addition of a metal (copper or mercury) or a metallic oxide, which is one of these modifications, may lead to considerable error, the author showing that with more than small quantities of metal or oxide, the time of decoloration does not correspond to the time of complete change of the organic nitrogen into ammonia. The addition of sodium sulphide to the alkaline liquid prior to distillation is also of no avail, and the employment of potassium permanganate is also open to objection, its action varying with the substances treated. The author recommends the use of copper sulphate in quantities of not more than 0·25 to 0·30 grm., and obtains in this way results closely approximating to those given by the soda-lime process.

Berthelot showed that the liberation of the last portions of the ammonia is very difficult, and that the error increases with the excess of alkali present, being still greater in the presence of sodium carbonate.

The author proposes the following modification of Kjeldahl's method:—A round-bottomed flask of 125 c.c. capacity, with a long and narrow tapering neck, is taken, and from 0·3 to 0·8 grm. of substance—according to its richness in nitrogen—added, together with 0·3 grm. of copper sulphate and 20 c.c. of sulphuric acid. A glass tube, fitting into the tapering neck, and bent at an angle of 45°, serves to condense and lead back the sulphuric acid vapours, and to convey any uncondensed vapours into a flask containing sodium carbonate solution. The flask is then heated till decoloration takes place and the liquid resembles a solution of copper sulphate in water, which takes from three to three and a quarter hours. The distillation flask is fitted with a cork pierced with two holes, through one of which the tube connected to the condenser passes, while in the other is fitted a stoppered pipette, through which is delivered the strong pure sodium hydrate solution, together with some litmus solution, the latter to enable the amount of soda required to be more accurately gauged. (See also this Journal, 1895, 694.)—J. G. W.

*Extracts of Fustic, Interpretation of some Results in the Analysis of.* C. B. Boyer. J. Amer. Chem. Soc. 1895, **17**, 518—520.

The method of analysis adopted consisted in carefully drying five to six grms. of the extract in a water-bath, the loss being regarded as water; the dried product is extracted with absolute alcohol in a Soxhlet apparatus, and the residue ignited for the determination of the ash, and organic matter insoluble in alcohol. The results were as follows:—

| — | I. | | II. | | III. | | IV. | | V. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Per Cent. | On Dry Solids. | Per Cent. | On Dry Solids. | Per Cent. | On Dry Solids. | Per Cent. | On Dry Solids. | Per Cent. | On Dry Solids. |
| Water ................ | 67·09 | .. | 50·42 | .. | 36·48 | .. | 49·62 | .. | 6·18 | .. |
| Organic matter soluble in absolute alcohol. | 31·34 | 95·23 | 38·57 | 77·79 | 52·85 | 83·20 | 47·41 | 91·11 | 75·55 | 80·53 |
| Organic matter insoluble in absolute alcohol | 1·05 | 3·19 | 5·47 | 11·03 | 9·43 | 14·85 | 1·92 | 3·81 | 10·65 | 11·35 |
| Ash ................. | 0·52 | 1·58 | 5·54 | 11·18 | 1·24 | 1·95 | 1·05 | 2·08 | 7·62 | 8·12 |
| | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 | 100·00 |

Sample IV. was made in an open extractor, the water used being heated to boiling before it was run on the wood; eight "waters" were used, each remaining in contact with the wood for 15 minutes. Sample V. was obtained by extraction under a pressure of five pounds.

From the similarity of I. to IV. and of II. to V., the conclusion is drawn that I. was made entirely by the "open-extraction" method, and II. by the "closed-extraction" method; also that III. was extracted in open vessels, but that pressure was used with the changes of "waters." The latter conclusion is based upon the low percentage of ash taken in conjunction with the high percentage of organic matter insoluble in alcohol.—A. K. M.

*Viscosimetric Examination of Butter for Foreign Fats.* Newmann Wender. J. Amer. Chem. Soc. 1895, **17**, 719.

The author draws the following conclusions from the viscosimetric examination of samples of butter and margarin:—

1. The viscosity of butter, either pure or in solution, is greater than that of margarin when similarly determined.

2. Different samples of butter only show a small difference of viscosity, whilst samples of margarin show much larger differences.

3. Viscosimetric examination will distinguish butter-fat from margarin, and will indicate approximately the amount of margarin in adulterated butter.—A. S.

*Estimation of Sugar by Copper-Potassium Carbonate Solution.* H. Ost. Chem. Zeit. 1895, **19**, [79], 1784—1785, [81], 1829—1830.

Some years ago the author recommended the use of a modification of Soldaini's reagent for the estimation of sugar. He now employs a solution of copper-potassium carbonate containing less copper than formerly, viz., $CuSO_4 + 5H_2O$ (17·5 grms.), $K_2CO_3$ (250 grms.), $KHCO_3$ (100 grms.), in water (1,000 c.c.). The potassium carbonate must be chemically pure. The copper sulphate solution is slowly added to it, so as to prevent the escape of large quantities of carbon dioxide. If necessary, the solution is filtered through asbestos, the first portions of the filtrate being rejected. The estimation is carried out in the following manner:—

For every 100 c.c. of copper solution contained in a spacious narrow necked flask, 50 c.c. of the sugar solution to be examined are added; the solution is quickly raised to the boiling point, and maintained in ebullition for 10 minutes over wire gauze, then cooled and filtered under diminished pressure through a glass tube packed with asbestos. The precipitate is washed with potassium bicarbonate solution, hot water, alcohol, and ether, and, after drying, it is reduced in a current of hydrogen.

Invert sugar was prepared by mixing dextrose and levulose; the reducing power of the mixture agreed well with that of an invert sugar solution obtained from cane sugar in accordance with Soxhlet's method. Maltose in the form of hydrate ($C_{12}H_{22}O_{11} + H_2O$) dried over sulphuric acid was used. Tables are constructed for the estimation of dextrose, levulose, invert sugar, and maltose.

The use of this modified solution in the manner described, meets all the objections raised against the author's method by Schmöger. The solution has many advantages over Fehling's solution, one of the most important being that cane sugar has less action on it.

When small quantities of invert sugar are to be estimated, the author makes use of the following solution:—$CuSO_4 + 5H_2O$ (3·6 grms.), $K_2CO_3$ (250 grms.), $KHCO_3$ (100 grms.), in water (1,000 c.c.) This solution remains unchanged, and can be boiled with several times its volume of water without precipitation of oxide of copper.—J. L. B.

*Volatile Acids of Wines.* H. Jay. Bull. Soc. Chim. 1895, **13**, 642—644.

The volatile acids of wine can be determined with precision by distillation in a current of steam, titrating the distillate with standard alkali. When the volatile acidity does not amount to one-half of the total acidity of the wine, one may take the figure as being correct, but any appreciable excess above the half points to neutralisation with an alkali having been practised, and distillation should be again carried out after the addition of a small crystal of tartaric acid. The author considers that, when the volatile acidity does not exceed one-half the total acidity, the absence of combined volatile acids may be regarded as proved.

The neutralisation of wines is extensively practised, but is rarely effected with neutral potassium tartrate, chalk or potassium carbonate or ammonia being more convenient and less costly. Ammonia has the advantage of not increasing the mineral matter, and is rarely directly tested for by the expert.

Genuine French and Spanish wines contain between 0·38 and 0·8 grm. per litre of volatile acids, expressed as sulphuric acid, while Algerian wines vary between 1·30 and over 1·60 grms. (See also this Journal, 1895, 830.) —J. G. W.

*Linalool Ester in Bergamot Oil, Determination of.* H. Helbing and F. W. Passmore. Chemist and Druggist, 1895, **47**, 585.

Messrs. Schimmel and Co. have found that the authors' method—saponification with 10 per cent. alcoholic potash in closed vessels on the water-bath—gives higher results than their own process, in which semi normal (2·8 per cent.) potash is employed in open vessels with return condensers. This result was shown to be due to the decomposition of the linalyl alcohol formed, by the stronger potash at the higher temperature attained in a closed vessel. The authors recommend that the oil should be heated in a vessel with return condenser for half an hour with semi-normal alcoholic potash, when the saponification value reaches a practically constant value, as shown by the following table:—

| Oil. | Time of Heating. | Ester Percentage. |
|---|---|---|
| Grms. | | |
| 2·32 | 15 minutes | 41·33 |
| 2·57 | 15 „ | 41·52 |
| 2·46 | 15 „ | 41·63 |
| 2·45 | 30 „ | 42·23 |
| 2·98 | 30 „ | 42·35 |
| 3·32 | 1 hour | 42·35 |
| 2·55 | 1 „ | 42·48 |

But if semi-normal or 10 per cent. potash be employed in a closed vessel, the ester percentage increases with the time of heating. 10 per cent. potash in open vessels gives almost the same results as semi-normal potash under the same conditions.—A. C. W.

ERRATUM.

This Journal, 1895, 887, col. 1, line 14 from bottom:—For "warmed in a flask" read "let stand in a flask."

## Prizes.

*Programme of Special Prizes offered by the Société d'Encouragement pour l'Industrie Nationale.* Bull. de la Soc. d'Encouragement 1895, 433—440. (See this Journal, 1895, 608.)

In addition to the general prizes and medals, the following special prizes are offered by the Society in the Department of Chemical Arts. They will be awarded (if at all) in 1896:—

1. *For the Utilisation of Waste Products.* (Prize of 1,000 francs.)

2. *For a Publication of Service in Chemical or Metallurgical Industry.* (2,000 fr.)—On account of the rapid progress of applied science, technological treatises soon get behind date, and persons engaged in industrial occupations can only keep themselves posted up by reading memoirs which are often difficult to procure. To such persons treatises on the scientific methods involved in industrial operations, showing how the latter depend generally upon chemical reactions and physical properties, are of great service. A treatise on metallurgical chemistry is suggested.

3. *For an Experimental Study of the Physical or Mechanical Properties of one or more Metals or Alloys used in the Arts.* (2,000 fr.)—Many industrial operations depend on the utilisation of certain properties of bodies (coefficient of expansion, tenacity, malleability, fusibility) of which our knowledge is in general purely qualitative. A study of the changes of volume of cast iron and steel is suggested.

4. *For a New Method of Manufacturing Fuming Sulphuric Acid or Anhydrous Sulphuric Acid.* (2,000 fr.)—The manufacture of Nordhausen sulphuric acid has hitherto been the monopoly of certain works in Germany. Its use is now indispensable in the preparation of such substances as artificial alizarin. The discovery of a cheaper method of production, which would avoid the expense of carriage from Germany, is desirable.

5. *For New Methods of Manufacturing Chlorine.* (2,000 fr.)—The Leblanc process of manufacturing soda is being gradually displaced by the ammonia process; but the development of the latter is limited by the fact that it leaves the chlorine originally contained in the salt as a waste product, generally calcium chloride. The chlorine is needed for bleaching, paper-making, &c., so that the Leblanc process must go on side by side with the newer one until the latter can be modified and completed so as to furnish the chlorine in a useful form. Such a modification is also desirable in the interests of public health.

6. *For the Discovery of a New and Useful Alloy.* (1,000 fr.)

7. *For a Scientific Study of Furnaces Heated by Gas.* (2,000 fr.)—Since the classical researches of Ebelmen on gaseous fuel, no thorough examination of this subject has been made in France. Numerous analyses have been made, but all are more or less incomplete or unreliable; *e.g.*, the weight of water vaporised is not measured, the conditions of production are not specified, or the products of combustion are not examined. A series of *complete* analyses is required.

8. *For a Study of the Dilatation, Elasticity, and Tenacity of Ceramic Bodies and Glazes.* (2,000 fr.)—This would assist in solving one of the most difficult problems in ceramics—the adjustment of the properties of body and glaze—a problem at present solved only in particular cases, more or less satisfactorily, after costly trials.

9. *For the Discovery of a Substance to replace Sulphuric Acid in Dyeing (especially of Silks), and which shall not have the same destructive action.* (1,000 fr.)

10. *For a Scientific Study of the Physical and Mechanical Properties of various kinds of Glass.* (2,000 fr.)—Among desirable data are:—The coefficients of elasticity and of expansion; the temperature of initial deformation; the lowest temperature at which bubbles of gas can rise to the surface; the tenacity at different temperatures. Unless accompanied by precise information as to chemical composition, conditions of cooling, &c., the results will be of no value.

11. *For the Discovery of Methods of Preparing Useful Organic Substances, such as Quinine, Cane-Sugar, &c.* (2,000 fr.)—The Society does not require that the methods should be capable of commercial exploitation.

12. *For a Scientific Study of an Industrial Process of which the theory is not yet fully understood.* (2,000 fr.)

13. *For the Manufacture of Steel or Cast Iron possessing Special Useful Properties owing to the presence of a Foreign Substance.* (2,000 fr.)—Faraday showed that very small quantities of platinum, palladium, chromium, &c. greatly modify the properties of steel. Attention is directed to the effects produced by incorporating tungsten and manganese. The Society requires that the product should be manufactured on a large scale, and used in workshops or in the arts.

All models, memoirs, descriptions, and specimens must be addressed to the *Secretariat de la Société d'Encouragement pour l'Industrie Nationale, 44, Rue de Rennes,* and must be delivered by the 31st December 1895.—D. E. J.

## New Books.

CHEMISCH-TECHNISCHES REPERTORIUM. Uebersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. EMIL JACOBSEN. 1895. Erstes Halbjahr. Erste Hälfte. Mit in den Text gedruckten Illustrationen. 1896. R. Gaertner's Verlagsbuchhandlung, Hermann Heyfelder, Schönebergerstr. 26, Berlin, S.W. H. Grevel and Co., 33, King St., Covent Garden, London.

THE first issue for the first half-year of 1895, of Dr. Jacobsen's Repertory of Chemical Technology. It contains reports of the progress of the following branches of chemical industry:—I. Building Materials, Cements, Artificial Stone. II. Dyes, Colours, and Calico Printing. III. Fats, Oils, Illuminating and Heating Materials. IV. Fermented Liquors. V. Tanning, Leather and Glue Manufacture. VI. Textiles. VII. Glass and Earthenware. VIII. Wood and Horn. VIII. India-Rubber and Gutta-Percha. IX. Cements and Adhesives, &c. X. Lakes, Varnishes, and Paints. XI. Metals. This number contains 160 pages of subject-matter and is illustrated with numerous woodcuts.

EXERCISES IN THE PREPARATION OF ORGANIC COMPOUNDS. By Prof. EMIL FISCHER, Berlin. Translated, with permission of the Author, from the fourth German edition, by ARCHIBALD KLING, F.I.C. Wm. Hodge and Co., 26, Bothwell Street, Glasgow. Messrs. Williams and Norgate, London. 1895. Price 2*s.* 6*d.*

8vo. volume, containing Preface by translator, an Author's Preface, Table of Contents, 78 pages of subject-matter, and an Alphabetical Index. The text is illustrated with 20 woodcuts representing arrangements of apparatus used in the preparations described. In his preface the author (Prof. E. Fischer) states that this collection of exercises was originated when he was at Erlangen about four years ago. A year ago they were revised for the use of students in the Würzburg laboratory. In the selection and arrangements the author was guided chiefly by practical considerations, such as the price of materials and apparatus, and the facility, quickness, and freedom from danger in the making of the preparations. All the exercises, it is stated, can be performed in one session with an outlay of about 40*s.* for materials. The list of preparations comprises 63 of these, commencing with nitrobenzene and ending with thiophene.

Recent Progress in the Industries of Dyeing and Calico Printing, being a Supplement to "The Printing of Cotton Fabrics" and "Dyeing." By Antonio Sansone. Abel Heywood and Son, 56 and 58, Oldham Street, Manchester. Simpkin, Marshall, and Co., Ltd., Stationers' Hall Court, London. 1895. Price 9*s.*

This work, as stated in the preface, is intended to comprise the most important discoveries and inventions introduced in Dyeing, Bleaching, and Printing, during the last few years, and so will serve too as a Supplement to the author's works on Printing and Dyeing (this Journal, 1888, 698). It is an 8vo. volume, containing frontispiece, illustrative of the Bentz-Edmeston Bleaching Plant, Preface, Table of Contents, List of Plates, five in number, and 53 pages of subject-matter, followed by 84 pages with pattern sheets of new dye and print effects with recipes for obtaining the same.

The work is arranged as follows:—Changes in Bleaching and in Calico Printing. Further Developments in Wool Printing. Changes in Cotton Dyeing. Aniline Black. Substantive Colouring Matters. Natural Organic Dyestuffs. Chemistry of Cotton Dyeing. Dyestuff Manufacturers. Countries engaged in Dyeing and Calico Printing. The Fastness of Colours to Light, Soap, Alkalis, Acids, &c. Substantive Colours.

# Trade Report.

## TARIFF CHANGES AND CUSTOMS REGULATIONS.

(*From the Board of Trade Journal.*)

### Tariff Changes in Italy.*

By Article VI. of the law of the 8th August last, certain modifications have been introduced into the Customs tariff of Italy. The following is a list of the articles on which the duties have been altered, the duties hitherto leviable being also shown for purposes of comparison:—

| Tariff No. | Tariff Classification. | New Rates of Duty. | Old Rates of Duty. |
|---|---|---|---|
| | | Lire cts. | Lire cts. |
| 30*j* | Salicylic acid ........... | Quintal 80 00 | Quintal 10 00 |
| 31 | Ammonia ............... | „ 5 00 | „ 5 00 |
| 32 | Potash and caustic soda | „ 2 00 | „ †0 50<br>‡5 00 |
| 36 | Acetate of lime, impure . | „ 1 00 | „ 4 00 |
| 43*a* | Sulphate of alumina and alum cake. | „ 1 00 | „ 0 50 |
| *g* | Sulphate of potash ..... | Free. | „ 0 50 |
| *h* | Sulphate of ammonia: | | |
| | Impure ............... | Free. | „ 0 50 |
| | Purified ............... | Quintal 1 00 | „ 0 50 |
| 48 | Phosphorus, white or red (Phosphorus for use in the manufacture of matches of all kinds is admitted free of duty, on compliance with certain conditions to be established by the Minister of Finance. The importation of phosphorus for other uses is subject to the permission of the Minister of Finance and to the observance of special regulations to be established by him.) | „ 100 00 | Free. |
| 50 | Acetates and pyrolignites not separately tariffed, exclusive of acetates of alkaloids, of ammonia, and of mercury. | Quintal 4 00 | Quintal 4 00 |
| 51 | Other chemical products: | | |
| *c* | Bromine or iodine .... | Free. | „ 4 00 |
| *d* | Salts of bismuth ...... | Quintal 100 00 | „ 4 00 |
| *e* | Bromides and iodides, exclusive of those of alkaloids. | „ 50 00 | „ 4 00 |
| *f* | Corrosive sublimate ... | „ 30 00 | „ 4 00 |
| *g* | Salts of mercury, not otherwise mentioned. | „ 100 00 | „ 4 00 |
| *h* | Salicylates, exclusive of those of alkaloids. | „ 80 00 | „ 4 00 |
| *i* | Oxide of hydrated alumina (pure alumina). | „ 4 00 | „ 4 00 |
| *l* | Unenumerated ....... | „ 10 00 | „ 4 00 |
| 63 | Gums, resins, and gum-resins: | | |
| *a* | Indigenous, raw, and colophony (common rosin). | „ 2 00 | Free. |
| *b* | Other kinds ........ | „ 9 00 | Free. |
| 73 | Varnishes: | | |
| *b* | Without spirit: | | |
| | 1. Containing mineral oils. | „ 40 00 | Quintal 20 00 |
| | 2. Other kinds ..... | „ *30 00 | „ *20 00 |
| 190 | Hides and skins: | | |
| *d* | Tanned without the hair: | | |
| | 1. Unfinished sheep and goat skins. | „ 25 00 | „ 25 00 |
| | 2. Do., other kinds | „ 25 00 | „ 25 00 |
| | 6. Finished kid and lamb skins, for gloves. | „ 20 00 | „ 20 00 |
| 315 | Fatty acids having the point of solidification at a temperature higher than 40° but lower than 48°. | „ 4 00 | „ 4 00 |

* From the "Bollettino di Notizie Officiali."
† Impure. ‡ Pure.

* Will continue to pay the old rate of 20 lire per quintal, in virtue of the commercial treaty between Italy and Germany.

## EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.

### Importation of Sugar into Japan.

In a recent report to the Foreign Office, Mr. J. J. Emslie, Her Majesty's Consul at Hiogo, says that before Japan opened her ports to foreign trade she was, as a matter of necessity, self-supplying as regards sugar; of late years the demand for this commodity has vastly increased.

In 1872 the amount imported was 56,000,000 lb., valued at 1,750,000 dols.; 10 years later the amount was 107,000,000 lb., representing a value of 4,500,000 dols.; in 1893 some 253,000,000 lb. were imported, as against 93,000,000 lb. produced in the country.

Among the staples imported, aggregating some 70,000,000 dols., cotton heads the list and sugar comes next.

In regard to cotton, Japanese economists feel no uneasiness, as it is imported for the purpose of being manufactured. Japan, moreover, expects ultimately to become an exporter of cotton yarns and piece goods, and she therefore views with complacency the ever-increasing supplies of raw cotton.

But the case is quite different as regards sugar. The consumption of this article is increasing rapidly; in 1888 the average per head was $7\frac{1}{3}$ lb., and in 1892, $8\frac{2}{3}$ lb., an increase of nearly 20 per cent. in four years.

The consumption of sugar is generally regarded as a trustworthy test of national prosperity, and though the Japanese doubtless take the same view, they are alarmed at the idea of paying some 16,000,000 dols. annually for that luxury. Moreover, the Japanese are becoming epicures in the matter of sugar, and whereas in 1872 they consumed four times more brown sugar than white, they now use far more of the latter.

Japan, however, is perfectly able to increase the area of its sugar-cane plantations, and there are sundry signs proving that it will not permit the present state of things to continue.—(*Foreign Office Annual Series, No.* 1638.)

### The Whale Fishery of New Zealand.

A report on the whale fishery of the Bay of Islands, New Zealand, has been forwarded to the chief inspector of factories, of Wellington, in that colony.

This report, which is published in the *Journal of the Department of Labour*, New Zealand, is drawn up by the inspector of factories of the district, who visited the manure works at Whangamumu in connection with the whaling industry for the purpose of registering it as a factory.

Up to the present season the establishment whaled for oil only. This season, however, a bone-dust and manure factory has been added to the premises, with a view to utilising the carcase. The carcase of a whale is estimated to contain from 20 to 30 tons of matter, which can be turned into a high-class manure. Last season's bone treated by the process has given an analysis of 54 per cent. of phosphates and 3 and 4 per cent. of ammonia. The flesh of this season's "take" is being treated also, and it is confidently expected a higher-class manure will be the result. The plant erected is similar to that in use at other manure works. It was thought it would be capable of extracting the oil from the blubber and treating the flesh of the carcase at the same time, but, mainly owing to the smallness of the plant, the old system of "trying out" had to be continued. In treating the flesh of the carcase, however, sufficient oil is recovered to cover the labour involved.

In addition to the Whangamumu depôt, another has been established this season at Whangaruru, a few miles further south. The "take" of whales by the combined parties has, so far, amounted to 17; the carcases of these, it is estimated, will turn out from 250 to 300 tons of manure. Should anticipations be realised—and there is no reason to suppose they will not be, in a measure—this industry should have a very beneficial effect on agriculture. The raw material costs nothing, the expense of production being only the labour employed, and as this is in a great measure covered by the extra oil obtained from the carcase, it should be possible to place the product in the market at a price well within the reach of anyone in need of an artificial fertiliser.

The whales caught at Whangamumu are "humpbacks," and the demand for the oil is limited. It is chiefly used in soapworks in New Zealand and Australia. With increased capital and improved appliances, the business of manufacturing manure from the carcase of the whale is capable of considerable expansion. Between the months of May and August large numbers of whales pass north, and again between October and December they return south.

### Articles of Import into Egypt.

The *Moniteur Officiel du Commerce* states that the French Ministère du Commerce et de l'Industrie has just received precise information as to certain articles, the importation of which into Egypt might be developed with advantage. These are the following:—Candles. Corn and maize flour. Preserved vegetables. Refined sugar. Spices. Alcohol and liqueurs. Oils of various kinds. Writing and printing paper. Paper for cigarettes. Ordinary paper and cardboard. China, pottery, glass, and crystal ware. Chemical products. Perfumery and perfumed soaps. Copper.

### Adulteration of Dyes and Colours in Germany.

*U.S. Consular Reports, October* 1895, 245.

Consul Theodore M. Stephan, Annaberg, May 27, reports that in the Laboratory of the Association for the Promotion of Rational Decorative Art, in Munich, a large number of dyes and colours used in trade have been repeatedly analysed, and, according to a published report, it appears that the materials for decorative and house painting particularly were adulterated in a most unscrupulous manner. Especially the genuine green and blue dyes and the green and blue ultramarine are displaced by imitation blues and greens and ultramarines to the disadvantage of the buyer. These substitutes, blue as well as green, consist frequently of clay or spar, and are brightened by small admixtures of aniline or tar colours. When exposed to the light, these colours disappear in the course of a few hours, whereas the genuine ultramarine dyes are quite unaffected by light or atmosphere.

### Marbles, Earthenware, and Minerals in Spain.

*U.S. Consular Reports, October* 1895, 171.

#### *Marbles.*

The U.S. Consul-General at Barcelona reports as follows:—

Spain contains many fine marble quarries, but neither in times remote nor modern has she made any serious efforts to bring them into competition, either at home or abroad, with the quarries of Italy, France, and Belgium. The best Spanish marbles are the white, of Fuenteheridos, in the Province of Huelva; the coloured, of Navalmoral, Santa Marta, Galicia, the Asturias, Almeria, Malaga, and Murcia; the greyish-black, of Jaca; the spotted, of San Esteban de Castellá; the yellow, of Tortosa and Azpeitia; the whitish-grey, of Figueras; the azure, of Gerona; and the blood-red, of Vizcaya. The industry of sawing marble is developing rapidly in Barcelona, Bilbao, Macael, and Malaga, owing to the duties imposed on the importations of like material from other countries.

#### *Bricks and Tiles.*

Barcelona, Valencia, Alicante, and Seville are all producing large quantities of bricks and tiles, and are now able to meet more than the native demand for them. The mosaics and painted tiles for floors that are made in Barcelona, and which are in general use here, are excellent, not only as to design, but as to durability.

#### *Ceramics, Delft, and Porcelain.*

The various arts of producing useful and ornamental objects from earth are cultivated seriously and successfully in Spain. Some of the Spanish jars, vases, and plates are of exquisite workmanship, and are purchased in considerable numbers by the Cubans and South Americans, as well as by the French. Much work is also done here for the Germans after German designs.

#### *Glass and Crystal.*

There are 87 glass and crystal manufactories in Spain, and they produce not only enough for ordinary native use but for exportation. Bottles for wines, liquors, and oils are turned out on a grand scale in Barcelona, and demijohns innumerable proceed from the factories of Palma.

Fancy glass and stained windows are also manufactured in and near Barcelona, and are comparable with the best work done in Italy and France.

Looking glasses are made in Saragossa, Valencia, Madrid, and Barcelona, but they are inferior to those produced in England, France, Germany, Austria, and the United States.

#### *Minerals.*

Spain is exceedingly rich in minerals. In the north, she has iron in Vizcaya, Santander, and Oviedo; pit coal in Oviedo, León, and Pavencia; zinc in Santander, Guipúzcoa, and Vizcaya; cobalt in Oviedo; and sulphate of soda in Burgos. In the centre, she has quicksilver in Ciudad Real, pit coal in Córdoba, phosphorus in Cáceres and Huelva, and salt and silver in Guadalajara. In the south, she has lead mines in Murcia, Jaen, and Almeria; iron in Huelva and Seville; and sulphur in Murcia and Almeria.

The annual production of these mines is about 50,000,000 dols., and it could be very much greater if the machinery employed were better, if the railways were conveniently near, if freights were cheaper, and if the employers had more capital and the employees more energy.

The quantity of minerals obtained from the Spanish mines during the year 1894 was as follows:—Quicksilver, 19,728 tons; lead, 151,000 tons; iron, 4,972,655 tons; copper, 2,270,000 tons; zinc, 34,000 tons; tin, 23 tons; antimony, 15 tons; salt, 533,280 tons; and silver, 59,000 kilos.

### *Mineral Water.*

Spain has numberless mineral springs. The best known of her waters are the Rubinat, Mondariz, Loeches, and Esperanza. The Rubinat is exported in large quantities.

### IMPORTS AND EXPORTS OF SPAIN.

*Engineering and Mining Journal, November 2nd*, 1895, 422.

The Spanish imports of fuel for the seven months ending July 31st, according to the Customs report, included 976,884 tons of coal and 81,637 tons of coke. The imports of coal showed but little difference from the corresponding period last year, but in coke there was a decrease of about one-third. Imports of metals included 11,308 tons of pig iron and castings, 4,855 tons of wrought iron, 11,176 tons of steel, and 1,018 tons of tin-plate, all showing a slight decrease from last year.

Exports of minerals from Spain for the seven months are reported as follows, in metric tons:—

| —— | 1894. | 1895. | Changes. |
|---|---|---|---|
| Iron ore........ | 3,012,767 | 2,846,579 | D. 196,188 |
| Copper ore...... | 350,752 | 332,251 | D. 18,501 |
| Zinc ore........ | 20,141 | 18,195 | D. 1,946 |
| Lead ore........ | 8,475 | 4,913 | D. 3.562 |
| Salt............ | 126,215 | 126,565 | I. 350 |

Exports of metals this year included 15,271 tons of pig iron, a decrease of 12,919 tons; 18,922 tons of copper, an increase of 795 tons; and 87,034 tons of lead, a decrease of 4,854 tons from last year.

## *GENERAL TRADE NOTES.*

### DEVELOPMENT OF THE MANGANESE ORE TRADE IN THE CAUCASUS.*

The exports of manganese ore through the ports of Poti and Batoum during 1894 show an increase of 24,345 English tons (of 62 pouds) over those for 1893, the figures being 157,275 and 132,930 respectively. Of these exports Great Britain took 65,110 tons in 1894, against 49,230 in 1893, whilst Germany received 51,455 tons in 1894, as compared with 40,405 in the previous year, the remainder of the exports being divided between North America, Russia, and Belgium.

The narrow-gauge railway from Chiaturi to Shoropan, communicating with the Trans-Caucasian line, was opened for traffic at the end of May 1894. The hopes which exporters had founded on the opening of this line were not realised to any great extent, owing especially to the want of a sufficient number of engines to haul the trucks laden with ore. New engines, however, came to hand early in 1895, and it is hoped these will enable the railway to meet the demands made upon it more satisfactorily than hitherto.

A considerable number of the workmen employed in the carting of the ore to the Trans-Caucasian Railway, who were thrown out of employment by the opening of the branch to Chiaturi, are now occupied in conveying the ore from the mines to that place; this has caused a diminution in the wages paid from 5 copecks to $2\frac{1}{2}$ to 3 copecks per poud. Owing to this decrease, the present price of a pond of manganese ore, f.o.b. Poti, is about 25 copecks. As the price abroad for each metallic unity is from 10*d*. to $10\frac{1}{4}$*d*. per ton, equivalent to about $20\frac{1}{2}$ or 21 copecks per poud, f.o.b. Poti, it follows that the producer and exporter are selling at a loss of from 1 to $1\frac{1}{2}$ copecks per poud. The foreign consumer has reaped all the benefits from the opening of the new line. The causes of the reduction in the price of the ore are principally the facilitation of transport by the opening of the new railway, the large accumulation of stocks at Chiaturi, the general instability of the manganese ore trade, and the increase of competition consequent on the opening of the railway, and the efforts of firms to secure for themselves a portion of the trade even at a pecuniary loss.

Many large firms are endeavouring to get rid of their stocks of ore and to retire from the trade until a healthier state of things becomes apparent. A reduction of freight on the Chiaturi line could hardly effect an improvement in the market, for although the present charge of 10 copecks per poud for a distance of scarcely 40 versts must be considered high, any reduction would only benefit the foreign consumer.

In Kutais, where most of the mine-owners and a large number of manganese ore merchants live, preparations are said to be on foot to form a general committee for the sale of the ore. Importers in Hamburg, which receives a considerable proportion of the exports of Caucasian ore, have complained of the excessive Russian charges for freight, &c., and of the deficiency of proper loading-wharves at Poti. Only three vessels can load at once, the rest have to wait in the roadstead sometimes for three weeks without being able to ship cargo. This is a source of considerable expense to shipowners, and increases the freights from Poti, and consequently the price of ore.

### INDIAN MANGANESE.

*Chem. Trade Journal, November 2nd*, 1895, 277.

Speaking of the pyrolusite deposits at Gosalpur, Jabalpur district, Mr. F. R. Mallett says:—

The existence of manganese ore at Gosalpur appears to have been known for a long time past, and the mineral has been in use to some little extent amongst native glassmakers in the neighbourhood.

It was first brought to the notice of Government by Mr. W. G. Olpherts, in 1875, to whom we are indebted for the specimens subsequently received.

Although the nature of the deposit is more or less obscure, I see no reason to doubt that a large supply of this ore may be depended on at Gosalpur.

The ore is a dark steel-grey, finely-crystalline pyrolusite, mixed with a varying proportion of psilomelane; it contains 54·66 per cent. of manganese and 3·17 of iron, with 0·28 of (phosphorous) phosphoric acid, and no sulphuric acid. It contains 15·26 per cent. of available oxygen = 83 per cent. of peroxide; as an oxidising agent, therefore, it is of high value, the average run of manganese ores met with in commerce containing only 60 to 75 per cent., but the presence of some psilomelane reduces it some $3\frac{1}{2}$ per cent.

I have before pointed out that a considerable quantity of psilomelane occurs with the manganiferous micaceous iron at Gosalpur. If the latter were worked in connection with iron making, the psilomelane would be raised at the same time, and would be available as an ore of manganese.

On assay it yielded 83·20 per cent. of available peroxide, or about the same amount as the lateritic pyrolusite.

From both sources combined, it may reasonably be hoped that a considerable supply of the ore will be procurable when there is a demand for it.

The following are analyses of the ores as mined:—

*Indian Manganese Ores.*

Pyrolusite from Gosalpur.

| | |
|---|---|
| Silica.................................. | 3·27 |
| Peroxide of manganese .................. | 82·40 |
| Protoxide of manganese.................. | 2·84 |
| Peroxide of iron ....................... | 2·01 |
| Alumina................................. | 3·19 |
| Lime ................................... | traces. |
| Baryta ................................. | 2·94 |
| Magnesia ............................... | traces. |
| Phosphoric acid ........................ | 0·36 |
| (= Phosphorus 0·16). | |
| Sulphuric acid ......................... | traces. |
| Carbonic acid........................... | nil. |
| Oxide of zinc .......................... | traces. |
| Combined water.......................... | 2·81 |
| Moisture................................ | 0·44 |
| | 100·26 |
| Metallic manganese, per cent. .......... | 54.29 |

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* *Deutsches Handels Archiv*, September 1895.

Psilomelane from Gosalpur.

| — | No. 1. | No. 2. |
|---|---|---|
| Iron oxide | 3·13 | 9·13 |
| Alumina | 0·14 | 0·60 |
| Manganese oxide | 75·34 | 73·00 |
| Lime | 1·66 | 2·40 |
| Copper oxide | 0·40 | nil. |
| Cobalt | 0·51 | nil. |
| Nickel | 0·16 | nil. |
| Phosphoric acid | 0·39 | 0·27 |
| Silica | 8·20 | 5·20 |
| Water | 7·75 | 7·32 |
|  | 97·68 | 97·92 |

### CUBAN MANGANESE ORE FOR THE UNITED STATES.

*U.S. Consular Reports, October* 1895, 215.

Consul Pulaski F. Hyatt, of Santiago de Cuba, August 23, reports that the Ponupo Mining Company, composed mostly of Pennsylvanians, organised under the laws of West Virginia, dispatched their first shipload of 600 tons of manganese ore to Philadelphia by the Norwegian steamer "Jaetern." This company recently completed a short railroad to connect with the Sabanilla and Maroto Railroad, which gives them rail facilities to Santiago Bay, and they now have a capacity of 200 tons per day, and the demand for their ore from the United States is far beyond their ability to supply. But, after making so propitious a start, the company have been compelled to shut down by the exigencies of war.

Two Spanish officers derive a tonnage royalty from these mines, which caused a body of insurrectionists to fire upon a train of working men, and caused such a stampede that the company have been unable to induce the miners to return to work, notwithstanding the insurgent General Maceo condemned the act and promised protection.

As manganese is a necessity in the manufacture of steel, and we are mostly dependent on a foreign supply, which comes now principally from the Black Sea region of Europe, it is greatly to be hoped that these near-by mines, controlled and operated by American citizens, will soon be able to resume operations.

### CANADIAN WOOD-PULP INDUSTRY.

The *Canadian Gazette* of 26th September last says that slowly but surely a new item is forcing its way into the returns of Anglo-Canadian trade in the British importation of Canadian wood pulp. Last year Canada stood third in the list of countries supplying British needs. That is to say, Norway exported to the United Kingdom to the value of 694,919*l.*, Sweden came next with 344,021*l.*, and Canada third with 82,841*l.*, the export from the United States being only 48,489*l.* Much of this United States export is, no doubt, also really Canadian, being classed as "United States" because of exportation *viâ* Portland and other United States ports.

Beyond question, there is a great future before this Canadian pulp-making industry. It should outdistance all competitors. Of these the chief are Norway and Sweden. Norway has hitherto supplied nearly one-half of British imports, and Sweden another quarter. Yet inquiries which the High Commissioner has made in the chief centres of the paper trade, viz., in London, Lancashire, and in Scotland, show practical unanimity as to the superiority of the Canadian article over Scandinavian, the former being more evenly made and the texture better adapted to paper-making. The president of the Darwen Paper Mills, in Lancashire, went so far as to declare that Canadian pulp would eventually command from 5*s.* to 10*s.* per ton more than Scandinavian if the quality be kept up, and it is worth noting that of the 10,000 tons of dry pulp used in these mills in the year, 1,500 tons are Canadian as it is. "The Canadian fibre," says the president, "seems to mill better, and is certainly of a finer and tougher texture." This testimony is generally corroborated throughout the trade, and at once opens up a great field for Canadian enterprise, for the British imports of mechanical and chemical pulp were, in 1894, 280,188 tons, of the value of 1,132,747*l.*

### ILLUMINATING-GAS FROM WOOD.

*Engineering and Mining Journal, November 2nd*, 1895, 416.

The town of Deseronto, in Canada, where there are several large lumber mills, is partially lighted by gas made from sawdust. The sawdust is charged in retorts, which are heated by a wood fire, the gas from the retorts passing into a series of coils, and thence into the purifiers, which are similar to those used for coal-gas. Lime is the principal purifying agent employed. When it passes out of the retorts the gas possesses an odour much less disagreeable than that of ordinary lighting-gas, and resembles somewhat that of the smoke from a fire of green-wood or leaves. The works in use are small, turning out daily 540 cb. m. of gas, for the production of which about 2 tons of sawdust are required. A man and boy furnish all the labour needed at the works. The gas in an ordinary burner gives an illumination of about 18 c.p. The best quality comes from resinous woods. A quantity of 100 kilos. of sawdust leaves a residue of 20 kilos. of charcoal.

### A NEW LIGHT METAL.

*Ironmonger, November 16th*, 1895, 291.

The metal glucinum, it is stated, is emerging from its position as a chemical rarity, and is coming to the front much as aluminium did some few years ago. It is even lighter than aluminium, but its chief value consists in the fact that its electrical conductivity is as high as that of silver, and consequently higher than that of copper. It is less extensible than iron, and more durable. At present its value is 71*s.* 4*d.* per lb., which is prohibitive for large quantities; but this is only one-tenth of the price of platinum weight for weight, and one hundred-and-sixtieth of the price of platinum volume for volume.

### SOME GERMAN CHEMICAL DIVIDENDS.

*Chemist and Druggist, November 9th*, 1895, 703 *and November 23rd*, 1895, 759.

The profits of the United Chemical Factories at Leopoldshall for the year 1894–95 have been 582,426 m., out of which the holders of preference shares will receive 5, and those of ordinary shares 4½ per cent. dividend. The increase of profit has been due chiefly to the greater output of chlorate of potash (312,047 cwt., against 290,797 cwt. in 1893-94), and to economies effected in the working of the factory. The chemical-works "Concordia," also at Leopoldshall (800,000 m. capital), have made a profit of 374,979 m., against 251,986 m. in 1893–94. The dividend will be 28 per cent.; last year it was 27 per cent. The Strassfurt chemical works, formerly Vorster-Grüneberg, will pay 11 per cent. dividend, and the United Brush-factories (Vereinigte Pinselfabriken) at Nüremburg (capital 3,750,000 m.), 9 per cent. The profit of the last-mentioned works for 1894–95 was 453,492 m.

It is stated that the low average price of chemicals has adversely affected the profits of Schering's chemical factory in Berlin during the past business-year; this applies particularly to salicylic acid and salicylates, which form a considerable part of the firm's output. The dividend for 1894–95 of the chemical-works "Union" at Stettin will only be 3 per cent. In the preceding year it was 8 per cent. The Verein für Chemische Industry at Mayence will pay 16 per cent., against 20 per cent. last year. The Heilbronn saline works have made a net profit for 1894–95 of 561,224 m., out of which they will pay 10 per cent. dividend. The United Chemical Works at Ottensen, near Brandenburg, are about to reduce their capital from 850,000 m. to 810,000 m. It has already been reduced once before from 1,000,000 m.

### The Metric System of Weights and Measures.

*Pharm. J., November 23rd*, 1895, *Supplement.*

A large and influential deputation of the Associated Chambers of Commerce of the United Kingdom, waited upon the Right Hon. A. J. Balfour, M.P., First Lord of the Treasury, on Wednesday the 20th inst., by appointment, to urge upon the Government the desirability of early legislation on the above subject, and to inform Mr. Balfour of the almost unanimous support that the Chambers of Commerce are prepared to give to the recommendations of the Select Committee of the House of Commons, which are as follows:—

(*a*) That the Metric System of Weights and Measures be at once legalised for all purposes.

(*b*) That after a lapse of two years the Metrical System be rendered compulsory by Act of Parliament.

(*c*) That the Metric System of Weights and Measures be taught in all public elementary schools as a necessary and integral part of arithmetic, and that decimals be introduced at an earlier period of the school curriculum than is the case at present.

It was strongly urged by the Select Committee that a Bill should be brought into Parliament with the above objects.

The deputation was introduced by Sir A. Rollit, M.P., who stated that 67 Chambers of Commerce were in favour generally of the above recommendations, and that only one was against them. He also laid before Mr. Balfour in a very forcible speech the great inconvenience and loss that is occasioned by our present system, and gave instances where orders from abroad had been lost to this country simply and solely owing to our weights and measures not being in accordance with the metric system. Sir Henry Roscoe also laid great stress upon the benefit to all classes of the community by the adoption of the metric system, and insisted that not merely was it most convenient to the scientific man but also to every class of trade. Sir S. Montague followed on the same lines, and, in fact, all the members of the deputation who spoke were most earnest as to the importance of the matter from every point of view.

In his reply, Mr. A. J. Balfour, with whom was the Right Hon. C. T. Richie, M.P., stated that he was fully in accord with the opinions and wishes of the gentlemen present, and he thought that clauses (*a*) and (*c*) ought certainly to become law; but he was not sure the time suggested in clause (*b*), viz., two years, was long enough to make this great change; he therefore reserved his final opinion upon that. On the whole the deputation were assured of his personal conviction of the utility of the change; but he could not promise more than that careful attention should be given to the various points which had been so powerfully brought before him by the deputation.

A vote of thanks was cordially given to the Right Hon. gentleman for his courtesy and attention.

It will be remembered that Mr. Carteighe, President of the Pharmaceutical Society, gave evidence before the Select Committee on this subject, and pointed out how important it is that pharmacists should be able legally to use the metric system in their profession, and Sir Henry Roscoe (who was Chairman of the Select Committee), in his remarks to Mr. Balfour, stated he was glad to see it was intended in the new British Pharmacopœia to insert the Metrical System of Weights and Measures.

With respect to Mr. Balfour's objections to the term of two years not being long enough to make the system compulsory, no doubt if Parliament thinks so, the time must be extended; but many members of the deputation seemed to think it was desirable to make the transition period as short as possible, consistently with reasonable allowance of time being given, and it is to be hoped the great importance of the subject will entitle it to the early consideration of Parliament.

### Congress of Applied Chemistry.

*Chemist and Druggist, November 23rd*, 1895, 719.

The second International Congress of Applied Chemistry will be held in Paris in 1896. There will be ten sections in the congress, amongst them official and commercial analyses of substances liable to duty, industrial chemistry, photography, and biology; medical, pharmaceutical, and hygienic analysis. An International Exhibition of chemical and agricultural industries will be held during the congress in the Palais de l'Industrie.

### Potash Imports into Smyrna.

*Chemist and Druggist, November 23rd*, 1895, 771.

The Government authorities of Smyrna have issued a decree forbidding the importation of potash containing less than 50 or more than 64 per cent. of $K_2CO_3$. One of the chief uses to which potash is put in Smyrna is for drying grapes in the raisin industry. It has been found that several parcels of potash have lately been imported which injuriously affected the grapes to which the substance was applied, and on this account the authorities recently refused to admit a big consignment of potash, their refusal being followed shortly afterwards by the decree referred to. Upon representations made by the trading interests concerned, the authorities have consented, however, that the decree should be suspended in respect to parcels of potash already ordered for this season's raisin crop.

### American Tartaric Acid.

*Chemist and Druggist, November 2nd*, 1895, 672.

An American correspondent writes, under date of October 21st: "Tartaric acid is, and has been for the past year, quietly exported from New York to London. The manufacture of this article in the States is practically controlled by two firms who prepare baking powder, and the exports to London represent, it seems, their residual stock. The acid is sent over by the American Transport Line (ss. "Mississippi," &c.), and is consigned invariably as "chemicals." Thirty barrels, I understand, are being shipped this week, and the total amount forwarded last year was some 300 barrels. The business is being done very quietly, so as not to affect the market either here or on the other side, and very few persons appear to know of it."

## *BOARD OF TRADE RETURNS.*

### Summary of Imports.

| Articles. | Month ending 31st October. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,575,963 | 1,647,964 |
| Chemicals and dyestuffs | 416,432 | 447,312 |
| Oils | 733,159 | 721,726 |
| Raw materials for non-textile industries. | 4,536,262 | 4,533,819 |
| Total value of all imports | 35,668,385 | 36,854,168 |

### Summary of Exports.

| Articles. | Month ending 31st October. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,505,735 | 2,764,583 |
| Chemicals and medicines | 725,772 | 706,716 |
| Miscellaneous articles | 2,617,506 | 2,951,370 |
| Total value of all exports | 19,147,996 | 20,828,836 |

### IMPORTS OF METALS FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Copper :— |  |  |  |  |
| Ore ............ Tons | 7,062 | 11,897 | 40,116 | 53,007 |
| Regulus ........ „ | 4,587 | 8,690 | 120,901 | 216,355 |
| Unwrought..... „ | 4,667 | 2,977 | 190,287 | 111,075 |
| Iron :— |  |  |  |  |
| Ore............ „ | 353,327 | 408,125 | 225,554 | 276,586 |
| Bolt, bar, &c. ... „ | 7,689 | 7,472 | 66,839 | 59,958 |
| Steel, unwrought.. „ | 411 | 2,056 | 3,093 | 15,868 |
| Lead, pig and sheet „ | 13,254 | 14,541 | 130,670 | 157,659 |
| Pyrites .......... „ | 39,699 | 40,359 | 71,881 | 65,920 |
| Quicksilver ....... Lb. | 28,800 | 42,840 | 2,225 | 3,577 |
| Silver ore....... Value £ | .. | .. | 184,325 | 115,146 |
| Tin .............. Cwt. | 73,883 | 74,443 | 236,461 | 240,822 |
| Zinc ............. Tons | 6,499 | 6,751 | 104,759 | 103,178 |
| Other articles ...Value £ | .. | .. | 198,852 | 198,819 |
| Total value of metals | .. | .. | 1,575,963 | 1,647,964 |

### IMPORTS OF OILS FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Cocoa-nut......... Cwt. | 52,782 | 30,849 | 63,924 | 34,562 |
| Olive.............. Tuns | 2,588 | 1,625 | 86,616 | 53,319 |
| Palm .............. Cwt. | 81,342 | 68,630 | 86,474 | 71,830 |
| Petroleum ........ Gall. | 18,498,358 | 15,248,848 | 250,398 | 309,430 |
| Seed .............. Tons | 3,546 | 2,640 | 76,060 | 55,451 |
| Train, &c.......... Tuns | 2,616 | 1,462 | 43,158 | 23,882 |
| Turpentine ....... Cwt. | 22,542 | 64,315 | 22,979 | 65,400 |
| Other articles .. Value £ | .. | .. | 103,550 | 107,852 |
| Total value of oils... | .. | .. | 733,159 | 721,726 |

### IMPORTS OF RAW MATERIAL FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Bark, Peruvian .. Cwt. | 3,248 | 2,629 | 7,287 | 4,271 |
| Bristles.......... Lb. | 441,477 | 477,786 | 68,971 | 73,437 |
| Caoutchouc ...... Cwt. | 27,658 | 29,777 | 307,484 | 323,109 |
| Gum :— |  |  |  |  |
| Arabic......... „ | 6,185 | 8,151 | 14,044 | 24,967 |
| Lac, &c......... „ | 5,802 | 7,558 | 30,175 | 43,574 |
| Gutta-percha .... „ | 2,953 | 2,538 | 18,828 | 22,886 |
| Hides, raw :— |  |  |  |  |
| Dry........... „ | 25,332 | 46,969 | 59,146 | 120,340 |
| Wet ........... „ | 72,459 | 52,650 | 153,455 | 120,380 |
| Ivory......... .. „ | 876 | 1,304 | 38,456 | 52,980 |
| Manure :— |  |  |  |  |
| Guano ......... Tons | 1,059 | 1,425 | 7,506 | 10,985 |
| Bones ......... „ | 8,345 | 4,568 | 38,801 | 18,964 |
| Nitrate of soda... „ | 13,019 | 7,237 | 117,226 | 53,880 |
| Phosphate of lime „ | 25,047 | 23,458 | 55,050 | 39 723 |
| Paraffin.......... Cwt. | 69,134 | 70,168 | 69,143 | 79,283 |
| Linen rags....... Tons | 2,719 | 2,665 | 21,536 | 20,647 |
| Esparto.......... „ | 15,503 | 15,042 | 71,659 | 64,590 |
| Pulp of wood .... „ | 22,225 | 28,114 | 139,402 | 143,208 |
| Rosin............ Cwt. | 49,916 | 114,494 | 10,126 | 29,791 |
| Tallow and stearin „ | 174,915 | 136,463 | 222,993 | 164,596 |
| Tar ..............Barrels | 5,810 | 20,607 | 4,222 | 13,674 |
| Wood :— |  |  |  |  |
| Hewn ......... Loads | 192,726 | 231,330 | 387,442 | 402,637 |
| Sawn .......... „ | 683,679 | 705,062 | 1,463,800 | 1,439,140 |
| Staves......... „ | 14,539 | 18,414 | 57,982 | 70,998 |
| Mahogany ... . Tons | 11,751 | 1,727 | 94,110 | 13,961 |
| Other articles....Value £ | .. | .. | 1,077,118 | 1,181,498 |
| Total value ....... | .. | .. | 4,536,262 | 4,533,819 |

Besides the above, drugs to the value of 101,478*l*. were imported, as against 65,675*l*. in October 1894.

### IMPORTS OF CHEMICALS AND DYESTUFFS FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Alkali............ Cwt. | 15,148 | 13,042 | 7,695 | 9,605 |
| Bark (tanners', &c.) „ | 29,280 | 38,810 | 12,002 | 11,638 |
| Brimstone ........ „ | 55,205 | 39,663 | 11,854 | 8,523 |
| Chemicals...... Value £ | .. | .. | 105,743 | 135,829 |
| Cochineal ......... Cwt. | 607 | 725 | 3,635 | 4,544 |
| Cutch and gambier Tons | 1,711 | 1,812 | 36,429 | 27,916 |
| Dyes :— |  |  |  |  |
| Alizarin ....... Value £ | .. | .. | 26,492 | 27,596 |
| Anilin and other „ | .. | .. | 45,463 | 39,317 |
| Indigo ............ Cwt. | 693 | 1,590 | 7,776 | 17,984 |
| Nitrate of potash . „ | 23,067 | 19,333 | 21,019 | 18,476 |
| Valonia ........... Tons | 855 | 1,833 | 10,761 | 20,310 |
| Other articles... Value £ | .. | .. | 127,563 | 123,204 |
| Total value of chemicals | .. | .. | 416,432 | 447,342 |

### EXPORTS OF METALS (OTHER THAN MACHINERY) FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Brass............ Cwt. | 8,217 | 9,263 | 34,170 | 37,320 |
| Copper :— |  |  |  |  |
| Unwrought ..... „ | 42,419 | 70,388 | 92,868 | 172,606 |
| Wrought ....... „ | 26,564 | 24,132 | 70,715 | 71,370 |
| Mixed metal.... „ | 30,575 | 20,061 | 64,689 | 45,456 |
| Hardware ..... Value £ | .. | .. | 171,589 | 181,166 |
| Implements ...... „ | .. | .. | 117,936 | 115,863 |
| Iron and steel..... Tons | 241,270 | 268,333 | 1,750,126 | 1,910,208 |
| Lead ............. „ | 3,838 | 4,227 | 43,464 | 53,108 |
| Plated wares... Value £ | .. | .. | 31,605 | 40,056 |
| Telegraph wires „ | .. | .. | 22,262 | 39,769 |
| Tin ............... Cwt. | 9,168 | 10,899 | 33,861 | 37,665 |
| Zinc .............. „ | 13,735 | 18,449 | 9,426 | 12,016 |
| Other articles .. Value £ | .. | .. | 63,024 | 47,980 |
| Total value ......... | .. | .. | 2,505,735 | 2,764,583 |

### EXPORTS OF MISCELLANEOUS ARTICLES FOR MONTH ENDING 31ST OCTOBER.

| Articles. | Quantities. |  | Values. |  |
|---|---|---|---|---|
|  | 1894. | 1895. | 1894. | 1895. |
|  |  |  | £ | £ |
| Gunpowder...... Lb. | 575,600 | 971,900 | 16,127 | 20,322 |
| Military stores.. Value £ | .. | .. | 164,999 | 171,671 |
| Candles.......... Lb. | 1,950,800 | 2,181,500 | 33,160 | 35,589 |
| Caoutchouc ..... Value £ | .. | .. | 112,017 | 113,903 |
| Cement.......... Tons | 23,301 | 31,532 | 53,574 | 53,218 |
| Products of coal Value £ | .. | .. | 101,844 | 126,671 |
| Earthenware ... „ | .. | .. | 177,782 | 181,931 |
| Stoneware ...... „ | .. | .. | 9,920 | 12,814 |
| Glass :— |  |  |  |  |
| Plate........... Sq. Ft. | 149,004 | 147,035 | 7,979 | 8,122 |
| Flint........... Cwt. | 8,458 | 8,771 | 21,469 | 22,015 |
| Bottles......... „ | 56,052 | 62,247 | 27,149 | 29,438 |
| Other kinds.... „ | 19,297 | 23,968 | 16,228 | 18,526 |
| Leather :— |  |  |  |  |
| Unwrought .... „ | 12,782 | 13,473 | 112,252 | 126,918 |
| Wrought ..... Value £ | .. | .. | 32,894 | 45,514 |
| Seed oil.......... Tons | 4,115 | 3,995 | 87,702 | 83,211 |
| Floorcloth ..... Sq. Yds. | 1,597,100 | 1,440,900 | 62,216 | 65,641 |
| Painters' materials Val. £ | .. | .. | 116,184 | 145,542 |
| Paper ........... Cwt. | 81,365 | 79,479 | 128,718 | 132,340 |
| Rags............. Tons | 4,946 | 3,881 | 31,449 | 22,946 |
| Soap ............ Cwt. | 52,764 | 73,165 | 57,025 | 74,848 |
| Total value .......... | .. | .. | 2,617,506 | 2,951,370 |

### Exports of Drugs and Chemicals for Month ending 31st October.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............ Cwt. | 645,470 | 624,089 | 171,190 | 159,314 |
| Bleaching materials „ | 145,653 | 131,355 | 56,201 | 46,117 |
| Chemical manures. Tons | 18,475 | 23,093 | 136,914 | 130,319 |
| Medicines....... Value £ | .. | .. | 91,655 | 93,886 |
| Other articles.. „ | .. | .. | 269,812 | 277,080 |
| Total value .......... | .. | .. | 725,772 | 706,716 |

## Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

### I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

#### Applications.

19,356. E. Thomas. Improvements in continuous kilns. October 15.

19,623. A. Thomson. Improvements in and relating to apparatus for evaporating and condensing. October 18.

19,626. H. Windoff and H. Schneider. Improvements in apparatus for vaporising spirit and the like. Complete Specification October 18.

19,716. W. T. Griffin, J. Lewis, and G. H. Llewellyn. *See* Class VIII.

19,738. J. G. Chapman. Improvements connected with charging liquids with gases. October 21.

19,754. H. W. Godfrey. Improvements in masticators or mixers suitable for the preparation of linoleum and other plastic materials. October 21.

20,225. G. L. Videau. An improved furnace for use in the manufacture of gas and for other purposes. October 26.

20,292. S. S. Bromhead.—From C. Dicker. An improved distilling apparatus. October 28.

20,426. P. C. Hewitt. Improvements in evaporators. October 29.

20,687. S. D. La Grange Williams. *See* Class IX.

20,770. W. Büsche. *See* Class IX.

20,817. R. J. A. Hankow. Improvements in and relating to refrigerators or cooling-plants. Complete Specification. November 4.

20,931. T. Cudlipp. Improvements in or connected with hydro-extractors. November 5.

20,998. W. H. Stead. Improvements in or appertaining to apparatus for forming into cakes, pulverulent, granular, or pasty coherent material, such, for instance, as oil-seed meal. November 6.

21,180. A. Forstreuter. Improvements in evaporators or vacuum-pans. November 8.

21,168. W. Calver. Improvements in apparatus for the manufacture of gases. Complete Specification. November 12.

21,671. J. O. Wallace. Improvements in or relating to drums for holding mixtures used as paints. November 14.

#### Complete Specifications Accepted.*

1894.

17,818. C. J. Olagoier. *See* Class XVII.

21,631. E. Orval. Improvements in drying kilns. October 30.

21,946. W. Thomson and P. J. Worsley. Furnaces for treating chemicals, ores, or the like. November 13.

23,961. J. Weir. Steam-heated evaporators. November 13.

24,447. M. Otto. Apparatus for distillation. November 6.

24,457. E. G. Scott. Evaporating brine and other liquors, and apparatus therefor. October 23.

24,672. G. Field. *See* Class XVII.

24,829. J. McNeil and H. W. Aitken. Multiple-effect evaporators. October 30.

25,361. C. W. H. Bullard. Improvements connected with thermometers for ascertaining temperatures of liquor in mash tuns, vats, and other vessels. November 6.

1895.

219. F. Woodhead. Apparatus for the manufacture of saggars and quarries. November 13.

2485. J. Patterson. Apparatus for utilising the waste heat of furnace gases. October 30.

4684. C. Kramer. Improvements in wooden vessels for the transportation of acids and other corrosive liquids. October 30.

7947. C. Bateson and C. Bateson. Improvement in furnace for melting glass, puddling iron, or like operations. November 6.

18,190. J. B. Graham. Apparatus for generating carbon dioxide and sulphur dioxide, especially for use in extinguishing fires. November 6.

### II.—FUEL, GAS, AND LIGHT.

#### Applications.

19,243. C. Weygang. Improvements in the manufacture of artificial fuel. October 14.

19,615. A. Bourgoin. Improved apparatus for making gas of carburetted air and carbonic oxide. October 18.

19,771. J. C. Bayley. An improved method of and apparatus for generating and regulating the consumption of acetylene gas. October 21.

19,779. J. H. Exley. Improvements in apparatus for generating acetylene gas. October 22.

19,830. A. Devis. Improvements in and apparatus for the production or generation of gas for artificial lighting and motive-power purposes. Complete Specification. October 22.

19,915. W. Ewing and J. Meikle. Improvements in apparatus for enriching illuminating gas. Complete Specification. October 23.

19,922. T. Hawkins. An improved apparatus to be used for the production of explosive and other gases for motive-power and illuminating purposes, and for carburetting said gases. October 23.

20,072. C. G. Luis. An improved process of and apparatus for producing acetylene gas. October 24.

20,225. G. L. Videau. An improved furnace for use in the manufacture of gas and for other purposes. October 26.

20,312. C. V. Potter. An improved method of and means for increasing heat production and more perfect combustion in furnaces. October 28.

20,430. A. Clouard. An improved gas producer. October 29.

20,441. C. J. Yarnold. Improvements in or relating to the manufacture of ozone, and apparatus therefor. October 29.

20,453. J. H. Exley. Improvements in apparatus for generating acetylene gas. October 30.

20,468. J. E. Atkinson. Improvements in automatic apparatus for the manufacture of acetylene gas. October 30.

20,496. W. Irwin. Improvements in apparatus for carburetting or enriching gas. October 30.

20,667. N. Notkin. Method and apparatus for automatically and continuously carburetting air for illuminating and heating. November 1.

20,727. J. H. Exley. Improvements in apparatus for generating acetylene gas. November 2.

20,889. E. Harrison. An improved asbestos fuel for gas fires. November 5.

20,961. T. G. Marsh, T. Thorp, and T. O. Paterson. Improvements in or connected with gas condensers. November 6.

21,089. J. McL. McMurtrie and Lucal, Lim. Improvements in and relating to apparatus for the burning of fluid hydrocarbons for lighting and heating purposes. November 7.

21,381. J. Roubal. Improved manufacture of carbon rods for arc lights. Complete Specification. November 11.

21,498. W. H. Clegg. Improvements in carbons for electric arc lamps. November 13.

21,512. T. H. Gittins. Improved fuel. November 13.

21,517. W. Thorneycroft. Improvements in the manufacture of coke. November 13.

21,545. G. C. Fowler and M. B. Fowler. Improvements in night lights, and in cases and holders for the same, and in apparatus employed in the manufacture of the said night lights. November 13.

21,519. W. Smith, jun. An improved method of preparing peat and peat briquettes for fire-lighting, heating, and analogous purposes. Complete Specification. November 13.

21,611. S. H. MacLachlan, A. B. Anderson, and F. A. Lacaille. An improved fire-lighter. November 14.

21,793. P. Pinckney. Improvements in artificial lighting. November 16.

### Complete Specifications Accepted.

1894.

20,253. P. C. Tennant and J. E. Hall. Apparatus for regulating or controlling the supply of fluids, chiefly designed for use in connection with apparatus for carburetting or enriching gas. October 23.

21,222. T. L. Willson. Improvements in the manufacture, distribution, and use of gas for illumination, heating, and other purposes, and in apparatus therefor. October 30.

21,441. R. Denormandie and H. Hennebutte. Manufacture of petroleum briquettes or blocks. October 30.

23,559. F. J. Kooppmann. Manufacture of artificial fuel. November 6.

1895.

748. M. Otto. Apparatus for transforming oxygen into ozone November 13.

7664. L. G. Harris. Manufacture of artificial fuel. November 6.

11,848a. H. H. Lake. — From E. N. Dickerson. Apparatus for mingling gas or air and acetylene gas or other enriching gas for illuminating purposes. November 20.

14,883. G. Bacher. Treatment of coal slime, and apparatus therefor. October 23.

15,268. F. W. H. Hempel and M. Gumpel. Incandescent gas lamps. October 2.

15,990. W. S. Hazelton. An improved method of and firebox for consuming fuel so as to prevent the formation of smoke. October 30.

16,927. O. N. Guldlin. Improvements in oil atomising and carburetting apparatus for gas generators. November 13.

17,212. F. Forst. Improvements in furnaces and furnace-feeding apparatus for utilising small coal and the like as fuel. October 23.

17,268. J. E. Pfiel. Method and apparatus for vaporising solid and liquid fuels, and utilising the vapour for heating purposes. November 13.

17,851. H. Zening. Incandescence lamps for liquid fuel. November 6.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

### Complete Specification Accepted.

1894.

25,173. J. Meikle. Improvements in treating coal or carbonaceous minerals for the obtainment of ammonia and other products. November 6.

## IV.—COLOURING MATTERS and DYES.

### Applications.

19,253. H. H. Lake.—From The Farbwerke Muhlheim. Improvements in the manufacture of sulpho acids of the naphthalene series, and of colouring matters derived therefrom. October 14.

19,559. I. Levinstein and Levinstein, Lim. Production of a new sulpho acid, and of colouring matters derived therefrom. October 18.

20,185. I. Levinstein and Levinstein, Lim. Improvements in and connected with azo colouring matters. October 26.

20,313. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of azo dyestuffs from new *m*-nitraniline sulphonic acid. October 28.

20,530. H. H. Lake.—From K. Oehler. Improvements in the manufacture of colouring matters. October 30.

20,548. I. Levinstein and Levinstein, Lim. Improvements in the manufacture of a sulpho acid which may be employed in the production of colouring matters. October 31.

20,941. A. G. Green and H. Benfey. Improvements in the treatment of technical nitro-toluene. November 5.

21,092. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of dyestuffs of the Rosinduline series. November 7.

21,093. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of sulpho acids of the naphthalene series, and of colouring matters therefrom. November 7.

21,342. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of new trisazo colouring matters. November 11.

### Complete Specifications Accepted.

1894.

22,276. W. W. Horn.—From W. Maybury. Improvements in thickeners or vehicles for colours, mordants, and the like. November 20.

23,927. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of derivatives of hydroxyanthraquinone. November 6.

25,018. S. Pitt.—From L. Cassella and Co. New processes for producing polyazo dyestuffs from amido-naphthol-sulpho acids. October 23.

25,213. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo colours on fibre. November 6.

25,214. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters and a new material therefor. November 6.

25,273. H. Imray.—From P. Monnet. Manufacture of toluene sulpho-chlorides. November 6.

1895.

676. H. H. Lake.—From K. Oehler. Manufacture of colouring matters. October 23.

1002. J. Y. Johnson.—From The Badische Anilin and Soda Fabrik. Manufacture of azo dyes, and in the production of black shades on cotton or other vegetable fibre, or on silk or the like. November 20.

1352. J. Y. Johnson.—From The Badische Anilin und Soda Fabrik. Manufacture and production of new basic colouring matters. November 20.

14,483. O. Imray.—From The Society of Chemical Industry in Basle. Manufacture of new "coupled tetrazo compounds" and of complex polyazo colouring matters resulting therefrom. November 13.

15,457. O. Imray.—From The Society of Chemical Industry in Basle. Manufacture of black-blue to black diazo colouring matters for wool. November 6.

16,407. H. Loesner. Process for the utilisation of the sulphides and sulphydrates of alkaline earths, and the production of anilin, toluidine, or amidobenzaldehydes by the treatment of the said substances with nitro bodies. October 30.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

20,433. H. E. Newton.—From J. H. Wingfield. Improvements relating to the removal of suint from wool, recovering or separating certain constituents from the suint, and obtaining certain valuable products therefrom. October 29.

20,501. C. Geige. A new or improved process for the manufacture of chemically-prepared peat fibres applicable to various useful purposes. Complete Specification. October 30.

20,669. F. Walton. Improvements in the manufacture of floor cloth. November 1.

20,670. F. Walton. Improvements in the manufacture of mosaic floor cloth and apparatus therefor. November 1.

### Complete Specifications Accepted.

1894.

19,485. A. F. B. Gomess. An improved process for the treatment of textile vegetable fibres, more especially applicable to those of the urtica family. October 23.

23,118. P. P. Faure. Improvements in the method of and machinery for decorating ramie and other textile plants and leaves. November 20.

1895.

11,335. L. Rousseau. Improved means applicable for use in the removal of dark spots from scoured wool or from worsted or woollen goods. October 30.

16,889. E. Maertens. Process and apparatus for treating raw wool and similar animal fibres with solvents. October 23.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

19,213. H. J. Brierley and T. Brook. Improvements in machines for scouring and dyeing warps. October 14.

19,444. R. Michel. Producing print patterns in colours on cotton fabrics by the aid of safranine azo dyestuffs. October 16.

19,928. H. McBeath. An improved method of dyeing yards and worsteds. October 23.

20,153. T. F. Hassler. An improved process for dyeing and drying yarn. Complete Specification. October 25.

20,652. J. Tait. *See* Class XIX.

21,032. W. Hepworth-Collins. Improved apparatus and plant for scouring, bleaching, dyeing, impregnating, digesting, drying, carbonising, and otherwise treating cotton, wool, silk, jute, rhea, china grass, and other fibrous materials in a raw, manufactured, or partly manufactured state. November 7.

21,355. L. C. G. Sharp. Improvements in the production of coloured border effects on fast black dyed grounds upon ordinary grey cotton cloths, especially suitable for umbrella cloths, selvedges, and the like. November 11.

21,393. M. Walton. Improvements in bleaching kiers. November 12.

21,511. L. Mistovski. Improvements in the production of ornamental and other designs upon waterproof, textile, and other fabrics. November 13.

### Complete Specifications Accepted.

1895.

256. J. Robb and J. Grime. Producing white and coloured patterns on cotton fabrics in combination with azo dyes. November 13.

693. E. Heppenstall and E. Sykes. Apparatus for dyeing loose cotton, wool, and other fibres. November 13.

18,570. N. Browne.—From A. A. Vogelsang. Bleaching, dyeing, and otherwise treating yarn in cops and the like, and fabrics in bales, and apparatus therefor. November 20.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

19,270. A. E. Hetherington, J. Raschen, F. Hurter, and J. Brock. Improvements in the manufacture of sulphocyanides and in apparatus therefor. October 14.

19,445. H. S. Elworthy and P. D. Henderson. Improvements in the manufacture of carbonic acid gas by the utilisation of waste product produced in making calcium carbide. October 16.

19,692. A. R. Davis. An improved apparatus for the manufacture of salt. October 19.

20,377. W. Mills. Improvements in manufacturing metallic fluorides. October 29.

20,448. P. Cannell-Bunn. Conversion of the waste products from the manufacture of alkalis, and known as Weldon mud, into a marketable pigment. October 30.

20,752. F. W. Saatmann. Improvements in apparatus for the manufacture of ammonia. November 2.

21,068. G. C. Kinloch and J. H. Butterworth. A new preparation of compounds of alumina and iron to be used for dyeing purposes and the arts generally. November 7.

21,199. J. Renshaw. Improved process of salt manufacture. November 8.

21,379. C. F. Claus. Improvements in and relating to the recovery of oxide of zinc from solutions of zinc sulphate obtained in the treatment of ores containing zinc sulphide. November 11.

21,380. C. F. Claus. Improvements in the roasting of sulphide ores. November 11.

21,678. J. Raschen and J. Brock. Improvements in the manufacture of cyanides and ferrocyanides from sulphocyanides and in the recovery of by-products. November 14.

### Complete Specifications Accepted.

1894.

21,945. W. Thomson and B. J. Worsley. Apparatus for use in the decomposition of common salt, in the production of sulphate of soda, or for analogous purposes. November 20.

21,652. J. S. Wallace and F. L. Ball. Manufacture of carbon dioxide. October 23.

24,811. J. Raschen, R. H. Davidson, and J. Brock. Manufacture of cyanides or ferrocyanides from their corresponding sulphocyanides. October 30.

24,859. T. Parker. Improvements in the utilisation of waste or spent acid pickle from galvanising works or other works where iron is treated by acid, and in the treatment (for the recovery or obtainment of chlorine) of other products containing chlorine. November 13.

25,860. T. Parker. Manufacture of potassium chlorate. November 20.

1895.

199. C. Raspe. Manufacture of pure ammonium carbonate. October 23.

882. J. J. Hood. Manufacture of gold solvents. November 20.

993. A. Goldberg and W. Siepermann. Process for the preparation of sulphocyanides. November 20.

1348. H. Brewer. Utilisation of liquors from chlorination-roasted ores or tailings. November 13.

18,016. C. D. Abel.—From H. Meeus. The utilisation of the gases resulting from fermentation and from lime-kilns for the production of alkaline bicarbonates and of pure carbon dioxide, applicable for treating saccharine matters, the production of liquid carbon dioxide, and other purposes. October 30.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

19,716. W. T. Griffin, J. Lewis, and G. H. Llewellyn. Improvements in kilns or ovens for firing or baking porcelain, earthenware, and other descriptions of pottery and clay goods; also for calcining, metal heating, and similar purposes. October 21.

19,804. J. H. Croskey and J. Locke. Improvements in and in the manufacture of wire glass. Complete Specification. October 22.

19,814. M. J. Owens and E. D. Libbey. Improvements in glass-blowing machines. Complete Specification. October 22.

19,845. M. J. Owens and E. D. Libbey. Improvements in glass-blowing machines. Complete Specification. October 22.

20,204. J. Lockhart. An improved fire-tile mainly designed for use in furnaces for calcining and roasting materials containing gold or silver. October 26.

20,367. G. L. Allen. Improved drying floor for bricks, tiles, pottery, and the like. October 29.

20,632. W. S. Bancroft and G. F. Priestley. Improvements in machinery for the manufacture of retorts, pipes, tiles, bricks, and other goods from clay or like material. November 1.

21,034. W. Christie. A new or improved saggar or case for firing clay goods. November 7.

21,630. C. Bruart and P. Lambot. New material for polishing glass. Complete Specification. November 14.

### Complete Specifications Accepted.

1895.

585. T. Ennson. Measuring and delivering molten glass or other material, and means therefor. November 13.

586. T. Ennson. Press for moulding glass. November 13.

587. T. Ennson. Process of manufacturing moulded glass. November 20.

6401. W. P. Thompson.—From J. N. Gregg and C. C. Stouffer Apparatus for the manufacture of wire glass. October 23.

7947. C. Bateson and C. Bateson. *See* Class I.

16,289. H. Muller-Hickler. Decorating glass. November 6.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

19,733. J. Tompkins, F. Pemberton, and J. Tompkins. Improvements in machines for grinding cement and the like. October 21.

19,831. W. Williams and H. Deffett and Co., Lim. A new or improved process for use in making cements. October 22.

20,119. T. Hyatt. Improvement in pavements. October 25.

20,151. A. G. Wright. Improvements in fireproof floors and ceilings. Complete Specification. October 25.

20,246. Count A. de Sainte-Marie and A. Hoffmann. Improvements in the treatment of wood. October 26.

20,250. W. T. Lord. Paving and other blocks, slabs, &c. October 28.

20,304. G. W. Parker. A process for treating gypsum rock to imitate chalcedony. October 28.

20,653. R. Grant. Improvements in the production and manufacture of cements from blast-furnace slags. November 1.

20,687. S. de la G. Williams. Improvements in kilns or ovens for burning lime, cements, and bricks, and for other like purposes. November 1.

20,770. W. Büsche. Improvements in brick-burning and other kilns. November 2.

20,892. J. A. Thomlinson. Improvements in fireproof walls or partitions. November 5.

21,293. F. W. Golby.—From F. Schmeisser. Improvements in the manufacture of cement or plaster compounds. Complete Specification. November 9.

21,294. E. Nelson. Improvements in the manufacture of damp-proof material. November 9.

21,295. O. Schwarz. A material suitable for use in building and the like, and means for manufacturing the same. November 9.

21,537. J. Holroyd. Improvements in or connected with the manufacture of terra cotta and like blocks for building purposes. November 13.

21,735. A. B. Grieg. Improvements in the construction of paving-blocks for roads, footpaths, and other ways. November 15.

### Complete Specifications Accepted.

1894.

21,734. E Weckwarth and M. Hoeft. Manufacture of cements for making mortars suitable for the production of artificial stone. November 13.

22,633. J. Leuba. An improved paving stone. October 23.

22,793. W. Orr. Improvements in concrete and composite buildings or structures. October 23.

23,123. W. P. Campbell Everden. An improved method of and means for mixing clays and other materials of a similar nature, more especially suitable for use in the manufacture of cement. November 6.

23,918. T. Potter. Construction of fire-proof floors and ceilings. October 23.

1895.

1092. C. Major. Fire-proof and ventilating floors. November 20.

15,517. C. W. Jefferson. Paving streets, roads, pathways, and the like, and manufacture of same. October 23.

## X.—METALLURGY, MINING, Etc.

### Applications.

19,265. J. G. Accles and J. Pinfold. Improvements relating to the working of aluminium and to apparatus therefor. October 14.

19,292. A. E. Tucker. Improvements in the coating of metals. October 15.

19,334. J. J. Maclean and M. W. W. Mackie. Improvements in apparatus for extracting gold or other metals from the sea and from other waters or solutions. October 15.

19,352. E. A. Uehling. Improvements in apparatus and method for casting and conveying metal from furnaces. Complete Specification. October 15.

19,681. H. L. Sulman. Improvements in the extraction of gold and silver from their solutions. October 19.

19,784. J. Jones. A twyer for the better distribution of blast in blast furnaces and cupolas. October 22.

19,899. A. E. Tucker. Improvements in the coating of metals. October 23.

20,226. W. C. Stiff and F. J. Clinch-Jones. An improvement or improvements in recovering tin from scrap or waste tin-plate, and from other tin-coated metals. October 26.

20,312. R. Maclaren, D. Hughes, and W. Davies. An improvement in apparatus or machinery for coating metal sheets with tin, lead, or other coating metal or alloy of metals. October 29.

20,440. R. I. Roman. Improvements in the manufacture of tubes of aluminium and its alloys. October 29.

20,472. A. F. Wileman. A machine and the construction of the same for the amalgamation of auriferous or compound ores by a dry process. October 30.

20,475. F. J. Chaplin and R. Chaplin. Improvements in the mode and means for annealing metals. October 30.

20,533. C. Vautin, H. L. Sulman, S. H. Johnson, and C. C. Hutchinson. Improvements in extracting metals from their ores and in apparatus therefor. October 31.

20,635. S. O. Cowper-Coles and C. R. G. Smythe. An improved process for the treatment of zinc ores. November 1.

20,792. W. H. Hyatt. Improvements in a method for extracting gold without the use of water, and improvements in apparati for effecting same. November 4.

20,953. G. Parkes. An improved process of tempering steel. November 6.

21,140. B. Cochrane and G. Love. Improved treatment of iron. November 8.

21,186. R. I. Roman. The manufacture of a new aluminium alloy. November 8.

21,575. H. Partin. A new alloy of aluminium. November 13.

21,644. S. O. Cowper-Coles, M. Ulcoq, W. M. Guthrie, and C. R. G. Smythe. Improvements in means for obtaining gold from its solutions. November 14.

21,699. J. Raine and B. W. Raine. A process for the utilisation of old steel rails or new rail crops without remelting. November 15.

21,750. I. A. Chavanne. An improved process relating to the casting of metals. November 15.

21,751. I. A. Chavanne. An improved process for treating iron and steel. November 15.

### Complete Specifications Accepted.

1894.

19,797. The Cowper-Coles Galvanising Syndicate, Lim., and S. O. Cowper-Coles. Manufacture or production of zinc-coated wire and other zinc-coated metallic articles. October 23.

21,820. A. H. Smith. Improvements in armour plates. November 20.

22,066. T. Hampton. Manufacture of compound armour plates. November 11.

23,557. J. Pfleger. Process for extracting gold and silver from ores. November 13.

24,837. C. Dreyfus. Utilisation of certain iron residues. October 30.

1895.

465. T. Hydes. Improvements in the manipulation and treatment of blast-furnace slag and other slag, and in the apparatus therefor. November 13.

882. J. J. Hood. *See* Class VII.

1523. E. Peipers. Production of chilled metal castings. November 30.

6431. A. Roger. A new process for the electrolytic preparation of aluminium. November 20.

7947. C. Bateson and C. Bateson. *See* Class I.

11,672. E. Fischer, E. Klein, and F. Mahlstedt. Method of extracting precious metals from their ores. October 23.

19,352. E. A. Uehling. Improvements in apparatus and method for casting and conveying metal from furnaces. Complete Specification. October 15.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

19,442. A. Hirsch. An improved method of and apparatus for welding by electricity, and for other purposes. October 16.

19,647. W. H. Willatt. Improvements in secondary batteries. October 19.

19,669. A. Schanschieff. Improvements in secondary battery plates. October 19.

19,670. A. Schanschieff. Improvements in secondary batteries. October 19.

19,745. J. Korner. Improvements in and in the manufacture of plates for electric accumulators or secondary batteries. October 21.

19,934. C. A. Burghardt and G. Rigg. Improvements in a process and apparatus for the electrolytic production of metallic zinc and metallic copper from zinc ore containing copper, and oxygen gas as a by-product. October 23.

20,131. P. Opitz and W. Petschel. An improved manufacture of secondary or storage battery plates. October 25.

20,214. E. S. Boynton. Improvements in tubular galvanic batteries. Complete Specification. October 26.

20,215. E. S. Boynton. Improvements in double-fluid galvanic batteries. Complete Specification. October 26.

20,216. E. S. Boynton. Improvements in galvanic batteries. Complete Specification. October 26.

20,306. J. Langelaan. Improvements in electric-power storage batteries or accumulators. Complete Specification. October 28.

20,131. J. J. Rooney. Improvements in secondary batteries. Complete Specification. October 29.

20,542. G. Bell and G. W. Bell. Improvements in or connected with apparatus for the electrolytic decomposition of brine. October 31.

20,572. C. Marschner. Improvements in and relating to the active material for secondary electric batteries. October 31.

20,821. W. Grimes. Improvements in or relating to electric batteries. November 4.

20,828. W. Rowbotham. Improvements in or relating to primary electric batteries. November 4.

20,843. C. P. Shrewsbury, F. L. Marshall, and J. L. Dobell. Improvements in electric batteries. November 5.

21,050. L. Marchlewski and M: Hertz. Improvement on the preparation of hydrosulphite of sodium by the electric current. November 7.

21,090. H. A. Bessemer. Improvements in or relating to welding or joining together metals by electricity. November 7.

21,283. A. S. Elmore.—From J. O. S. Elmore. Improvements in the electro-depositing of metals. November 9.

20,164A. S. O. Cowper-Coles, M. Ulcoq, W. M. Guthrie, and C. R. G. Smythe. Improvements in or connected with cathodes for use in the electrolytic deposit of metals. Filed November 14. Date claimed October 25, 1895.

21,759. T. W. Allan, A. Powell, and C. J. Tibbits. Improvements in electric storage batteries or accumulators November 15.

### Complete Specifications Accepted.

1894.

20,259. Electrolytic apparatus for decomposing metallic salts. October 30.

23,117. L. P. Hulin. An improved electrolytic process and apparatus for obtaining rich alloys of the metals of the alkalis or alkali earths and the production of halogen elements. October 30.

23,198. L. P. Hulin. Process for the treatment of certain metallic alloys for the manufacture of elements for voltaic batteries and caustic alkalis or their derivatives. November 20.

23,679. La Société des Cuivres de France. Process for the manufacture of metallic articles by electro-deposition. November 6.

25,074. R. O. Lorenz. Process and apparatus for the production of zinc and lead by electrolysis of the melted chlorides. November 13.

1895.

107. E. M. Levetus, H. Levetus, and W. Rowbotham. Primary batteries. November 20.

2816. F. King. Secondary batteries. November 20.

11,728A. W. Shaw. Voltaic batteries. October 30.

13,900. R. W. Gordon. Galvanic batteries. November 20.

17,288. W. A. Rosenbaum. Electrolytic decomposition of alkaline salts. October 23.

17,603. M. M. Bair. Electric batteries. October 30.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

19,890. A. J. Boult.—From T. J. Lovett. An improved manufacture of a lubricating compound. Complete Specification. October 22.

19,960. W. P. Thompson.—From A. des Cressonnières and E. des Cressonnières. Improvements in the mixing and kneading of soap and other like plastic substances, and in apparatus therefor. October 23.

20,003. E. J. T. Digby. An improved method of producing soft-soap. October 24.

20,107. H. T. C. Kraus. Improvement in the process of extracting oil from vegetable seed. Complete Specification. October 25.

20,433. H. E. Newton.—From J. H. Wingfield. *See* Class V.

20,621. J. Stalker. An improvement in the manufacture of soap for washing and blueing simultaneously. November 1.

20,795. E. Tate and W. Moss. The "magic cleanser." November 4.

21,557. P. C. D. Castle. A new or improved detergent or tanning substance. November 13.

### Complete Specifications Accepted.

1894.

20,158. M. Perls. Improvements in materials for and in the manufacture of soft-soap. September 25.

21,131. A. L. G. Dehne. Process for the separation of oils and fats from water. November 6.

24,669. J. McLaren. Cleansing powers of soap. November 6.

1895.

11,606. A. F. Beyer and A. G. Beyer. Power-presses for soap. November 6.

## XIII.—PAINTS, PIGMENTS, VARNISHES, RESINS, INDIA-RUBBER, Etc.

### Applications.

20,243. E. Hornung. A substitute for india-rubber, gutta-percha, and substances of a like nature, and process for manufacturing the same. Complete Specification. October 26.

21,085. J. McGillivray. An improved preservative coating for metals. November 7.

21,175. J. Noad. An improved method and means of producing lead oxide. November 8.

21,226. D. Z. Woods and W. P. Mackay. Improved composition for blacking and dressing leather. November 8.

21,379. C. F. Claus. *See* Class VII.

21,646. E. Garton. Improvements in and relating to the production of oxide of zinc. November 14.

21,717. W. Walters and W. T. Nichols. An improved patent-leather dressing. November 15.

### Complete Specification Accepted.

1894.

22,020. A. Tolhurst. A new or improved composition for the preservation of iron, steel, wood, and stone from rust, corrosion, and scaling, and for preventing the fouling of ship's bottoms. September 25.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### Applications.

20,123. M. Lewin. Improvements in tanning. Complete Specification. October 25.

21,557. P. C. D. Castle. *See* Class XII.

21,666. T. H. L. Bake and H. A. Leverett. Improvements in and connected with apparatus for tanning. November 14.

21,720. C. D. Abel.—From The Chemische Technisches and Hygienisches Institut Dr. Popp and Dr. Becker. Improvements in lyes or liquors for preparing hides for tanning. November 15.

### Complete Specifications Accepted.

1895.

16,493. R. Haddan.—From J. Scholl. Manufacture of marbled leather. November 13.

18,178. A. F. Diehl. Process and apparatus for the treatment of raw hides. November 13.

## XV.—AGRICULTURE AND MANURES, Etc.

### Applications.

20,303. R. Silcock. Improvements relating to the preparation or treatment of bones and mineral phosphates for fertilising purposes. October 28.

21,627. L. Tralls and E. Burmeister. Improvements in the treatment of manure, and in preservatives and disinfectants for manures. Complete Specification. November 14.

### Complete Specification Accepted.

1895.

8101. R. T. Savage and E. G. Walker. Treating animal blood for manurial purposes. November 20.

## XVI.—SUGARS, STARCHES, GUMS, Etc.

### Applications.

21,314. A. L. Tédesco. Process for manufacturing pure dextrose. Complete Specification. November 11.

21,654. W. H. Schwartz. Improvement in sugar. November 14.

### Complete Specifications Accepted.

1895.

16,340. L. Fuchs. Device for promoting the crystallisation of sugar out of sugar solutions or massecuite. October 30.

18,016. C. D. Abel.—From H. Meeus. *See* Class VII.

## XVII.—BREWING, WINES, SPIRITS, Etc.

### Applications.

19,335. E. Edwards.—From M. Pringsheim and H. Lezius. An improved process and apparatus for the separation of yeast from fermented wort. October 15.

19,674. H. Georgin. An improved process for the sterilisation of beer worts to render them unchangeable. October 19.

20,130. R. Free. Improvements in the preparation or treatment of beer. October 25.

20,176. W. T. Ramsden. Improvements in boiling beer and extracting the valuable properties of the hops, and apparatus connected therewith. October 26.

20,898. B. W. Valentin and W. D. Rock. Apparatus for drying brewers' grains and like material. November 5.

20,997. S. Kuhlmann. Improvements in brewing and apparatus therefor. Complete Specification. November 6.

### Complete Specifications Accepted.

1894.

17,848. C. J. Ollagnier. Improvements in apple, wine, and other presses. October 23.

24,672. G. Field. Improvements in or connected with mixing or blending apparatus for beer and other liquids. November 6.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, and DISINFECTANTS.

### Applications.

#### *A.—Chemistry of Foods.*

20,219. C. G. Moor. Humanised condensed milk. October 26.

20,798. R. L. Clarke. An improved method of malting wheat. Complete Specification. November 4.

20,799. R. L. Clarke. Improvements in the manufacture of wheat meal. Complete Specification. November 4.

21,103. D. Gray, jun. Improvements in preparing fat for use as a comestible. Complete Specification. November 7.

21,198. A. M. Clark.—From C. H. Boehringer and Sohn. An improved baking-powder. November 8.

#### *B.—Sanitary Chemistry.*

19,360. H. J. N. Bergé. Improvements in or relating to processes and apparatus for the purification of drinking-water. October 15.

19,952. G. MacDonald. Improvements in and connected with the manufacture of material for filtering water, sewage effluents, saccharine juices, alcoholic liquors, illuminating gas and other liquids and fluids, and for use in the manufacture of steel. October 23.

20,030. G. W. Smith. Improvements in the treatment and utilisation of gases, grease, and extracts from towns' sewage and other matters. October 24.

20,366. G. C. Purvis. New or improved method in sewage precipitation. Complete Specification. October 29.

21,142. D. Cameron and F. J. Commin. Improvements in the treatment of sewage and in apparatus therefor. November 8.

21,624. J. Simpson, J. W. Simpson, and R. J. H. Riley. Improvements relating to the treatment of the precipitate or sediment formed by the purification of the effluent water from bleachworks, dyeworks, printworks, paper-works, and the like. November 14.

#### *C.—Disinfectants.*

19,418. H. Hiscott. An improved disinfectant or composition for antiseptic, disinfecting, sanitary, and other purposes. Complete Specification. October 16.

19,814. E. W. Rowsell and C. Stansfeld. A crystal carbolic disinfectant and deodorant powder. October 22.

20,355. G. C. Kinloch, C. Heap, and J. H. Butterworth. Improvements in the production of compositions for treating sewage matters or other foul waters. October 29.

20,897. A. H. Barley. An improved preparation adapted for disinfecting and deodorising purposes for the toilet and for medicinal and other uses. November 5.

21,604. W. A. Morley and T. S. Henderson. A purifying deodoriser for the prevention of foul gases arising from sewerage or cesspools entering the air. November 14.

### Complete Specifications Accepted.

#### *A.—Chemistry of Foods.*

1894.

21,710. C. F. Hope. Manufacture of cheese. October 30.

24,706. E. Fischer, H. Zedler, and E. Klein. Improvements in preparing a substitute for coffee, and apparatus therefor. October 23.

1895.

16,145. W. P. Thompson.—From E. Hilberg. Process and apparatus for the treatment of milk, bouillon, or the like, to produce and entirely germ-free and transportable alimentary product. October 30.

#### *B.—Sanitary Chemistry.*

1895.

12,279. H. F. C. Ebeling. New or improved process and apparatus for purifying liquids. November 6.

#### *C.—Disinfectants.*

1895.

11,785. G. R. Morrison. An improved sheep dip and antiseptic dressing and preservative for hides and the like. October 30.

14,305. A. Pickles. Improved antiseptic and disinfecting compounds, applicable also for washing sheep and other animals, and for the like purposes. November 13.

18,223. J. L. Wade. An improved disinfectant compound which may be used for dipping sheep, also as an antiseptic for purifying, disinfecting, and general detergent purposes. November 20.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

19,471. G. W. A. FitzGeorge and H. J. Brown. Rapid paper-coating process. October 16.

20,360. F. Hancock and F. L. Fordham. A process for etching and staining xylonite. October 29.

20,652. J. Tait. Improvements in bleaching paper pulp. November 1.

20,726. J. Schofield. Improvements in waterproof roofing paper for houses, sheds, and the like. November 2.

21,079. J. C. Richardson. Improvements in or relating to the manufacture of celluloid or like. November 7.

21,318. L. Hutchinson. Pulp wood. November 11.

21,470. U. Marga. Improvements in or relating to cellulose compounds and articles manufactured therefrom. November 12.

### Complete Specification Accepted.

1894.

22,566. A. Grandjean. A new product obtained from paper or pulp, applicable for use as a filtering material and in the manufacture of celluloid, collodion, and explosives, and for other purposes. November 13.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, AND EXTRACTS.

### APPLICATIONS.

19,702. F. Hartmann. An improved process for manufacturing a solution of sulphurous acid for curative purposes. Complete Specification. October 19.

20,376. P. Auchinachie. Improvement in the distillation of aromatic waters, such as elder-flower water, rose water, and the like. October 29.

20,827. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture of pharmaceutical substances. November 4.

21,203. A. Eichengrün. New and useful bodies derived from iodoform. November 8.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

22,617. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of pharmaceutical compounds. September 25.

24,308. T. Chamings. Germ extract. November 20.

24,447. M. Otto. Apparatus for distillation. November 6.

24,901. O. Imray.—From The Farwerke vormals Meister, Lucius, and Brüning. Manufacture of new carbonic esters of acylamido-phenols and of their alkylised derivatives. October 30.

1895.

10,955. C. Fahlberg. Improvements in the manufacture of saccharine or compounds thereof, and in the production and treatment of materials for use therein. November 13.

17,322. J. Imray.—From La Société Chimique des Usines du Rhone Anct. Gilliard, P. Monnet, and Cartier. Manufacture of vanillin from protocatechuic aldehyde. October 30.

19,040. F. Valentiner. Process for the preparation of acetophenonphenetidid. November 20.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### APPLICATION.

19,711. J. Joly. Method of obtaining a colour-sensitive film or plate. October 21.

## XXII.—EXPLOSIVES, MATCHES, ETC.

### APPLICATIONS.

19,223. A. F. Hargreaves. Improvements in explosives. October 14.

19,667. E. Dickson. An improved gunpowder. Complete Specification. October 19.

20,234. A. Doutrelepont. New or improved explosive substances, and process of manufacturing the same. October 26.

20,307. A. Pain. Improvements in or relating to detonating fog signals for railways. October 28.

21,755. T. L. Willson. Improvements in the production of nitrogen compounds, and in apparatus employed therein. Filed November 15. Date applied for April 15, 1895, being date of application in United States.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

20,593. G. Schinko.—From A. Thimann. Improvements in or relating to lucifer matches and the like. November 6.

22,019. F. Greening, jun. Manufacture of nitro-cellulose or pyroxylin compounds. November 13.

25,058. J. Watson. Manufacture of igniferous fuses. November 6.

1895.

15,834. L. W. Buse. Manufacture of explosives. October 9.

16,861. H. Maxim. Manufacture of explosives. November 13.

18,575. J. I. Williams. An improvement in matches November 13.

## XXIII.—ANALYTICAL CHEMISTRY.

### APPLICATION.

20,051. E. Jahr. Process and apparatus for the analysis of butter and other fats. Complete Specification. October 24.

### COMPLETE SPECIFICATION ACCEPTED.

1894.

24,786. E. Herisse. Composition for the production of moulded articles. November 20.

## PATENT UNCLASSIFIABLE.

### COMPLETE SPECIFICATION ACCEPTED.

1895.

138. H. Albert. Manufacture of a carbonaceous absorbent. November 13.

Printed and Published by EYRE and SPOTTISWOODE, East Harding Street, London, E.C., for the Society of Chemical Industry.

# THE JOURNAL
OF THE
# Society of Chemical Industry:
## A MONTHLY RECORD
FOR ALL INTERESTED IN CHEMICAL MANUFACTURES.

No. 12.—Vol. XIV.] DECEMBER 31, 1895. [Non-Members 30/- per annum; Members 21/- per Set of extra or back numbers; Single Copies (Members only) 2/6.

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Notice is hereby given that, in accordance with the alterations in Rule 27 sanctioned at the Annual General Meeting in Edinburgh, all new members elected after January 1st, 1895, will be required to pay an entrance fee of one guinea. In accordance with the same rule the Life Composition Fee is now 20*l*., instead of 15*l*. as heretofore.

### COLLECTIVE INDEX.

A collective index, embracing the whole Journal from the Proceedings of the First Annual General Meeting, 1881, to the close of the current year, is now in preparation, and will be ready in 1896. It will contain both a subject-matter and authors' names portion and will be a volume of about 500 pages, uniform in size with the Journal.

The prices will be as follows:—

| | |
|---|---|
| To Members (see Rules 25 and 27) who make application with remittance, not later than June 30, 1896, on a form accompanying the November issue of the Journal | 5*s.* |
| To Members (see Rules 25 and 27) who make later application; Libraries, Corporations, and Exchanges on the Society's List, and Past Members (see Rule 30) | 10*s.* |
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Notice is hereby given, for the information of members and advertisers, that the advertisement columns of this Journal have been contracted for by Messrs. EYRE and SPOTTISWOODE, the Society's printers and publishers, to whom all communications respecting them should be addressed. The circulation of the Journal is now more than 3,000 per month.

Members are reminded that the subscription of 25*s.* for 1896, payable on January 1st, 1896, should be sent in good time to the Treasurer, in order to ensure continuity in the receipt of the Society's Journal. Any changes of address to appear in the new List of Members now in course of preparation, should reach the General Secretary not later than January 15th, 1896.

## LIST OF MEMBERS ELECTED 23rd DECEMBER 1895.

Appleby, Wm. R., University of Minnesota, Minneapolis, U.S.A., Professor of Metallurgy.

Baird, Wm. Raimond, 271, Broadway, New York, U.S.A., Patent Lawyer.

Bechi, Guido de, 43, rue de la Chaussée D'Antin, Paris, Director of "La Saturnine."

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Craig, Geo., l/o Lugar; 9, Hampden Terrace, Mount Florida, Glasgow.

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Stowe, W. T., l/o Somerset House; Inland Revenue, Wellington, Salop.

Taylor, H. E., l/o Greenwich; British White Lead Co., Ltd., Northfleet, Kent.

Watson, Chas. S., l/o Croydon; c/o Australian Gold Recovery Co., Charters Towers, Queensland.

Williams, T., l/o Birmingham; Marie Rose Mine, Johannesburg, S.A.R.

Wilson, Wm.; application for subscription, c/o Clark, Wilson, and Co., 11, Abchurch Lane, E.C.; Journals as before.

## Deaths.

V. L. Lovibond, Cannon Brewery, Fulham, S.W.

J. C. Major, The Rhylls, Compton, Wolverhampton. December 21st.

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SESSION 1895-96.

January 6th, 1896:—
Mr. Watson Smith. "Comparative Affinities in the Formation of Ammonium Salts."
Mr. J. W. Lovibond. "Colour Effect of Lime Salts on Hops in Brewing."
February 3rd, 1896.—Mr. Walter F. Reid. "Manufacture of Linoleum."

*Meeting held Monday, December 2nd, 1895.*

MR. B. E. R. NEWLANDS IN THE CHAIR.

## ALKALI MANUFACTURE BY THE HARGREAVES-BIRD SYSTEM OF ELECTROLYSIS.

BY JAMES HARGREAVES.

The decomposition of salt solutions by electrolysis is now a familiar subject of discussion, but its application has been arrested by the supposed impossibility of keeping the products separate, and of avoiding the production of secondary products, such as hypochlorites and chlorates, except by the use of mercury as the cathode.

The secondary products are valuable when in the place and condition desired; but otherwise they come under Lord Palmerston's definition of "dirt"—matter in the wrong place. The production of the undesired compounds also absorbs electrical energy which ought to be expended on producing the desired ones. To prevent this, porous diaphragms were used, but with only partial success. As the salt was converted into alkali, the current-duty became less and less, so that by the time any practical degree of purity was obtained, the desired electro-chemical duty became almost nil; but the undesired work of decomposing water was complete enough. It was therefore necessary to stop the reaction while a large proportion of the salt yet remained undecomposed. The presence of a large quantity of salt must be tolerated, or its removal effected by tedious and wasteful methods. Fortunately I had for my fellow-worker the late Mr. Thomas Bird, a man of unlimited energy, combined with a practical engineering training and high manipulative skill. With these were joined great fertility of resource, and a love of truth for its own sake, such as are seldom combined in the same person. His retiring disposition and hatred of display kept him from the public gaze. He died in harness while searching for scientific truth, his end hastened by the weight of the labours he had undertaken, and before completing his 40th year his battle for science was over. I hope it will not be taken as an intrusion that I place this record to the memory of a fallen comrade.

Our joint experiments began in 1890, after a careful examination of all accessible data. Preliminary trials were made to get some idea of the merits or demerits of the various systems which had till then been proposed. Amongst others was the system for the use of mercury cathodes, which at first sight looked very tempting; but on calculating the amount of mercury which must inevitably be carried off along with the hydrogen by gaseous diffusion, in consequence of its vapour tension at ordinary temperatures, it was evident that this loss must add to the cost of production. Our anticipations on this matter have been fully confirmed by others, who record a disappearance of mercury somewhat in excess of our own estimate of the loss to be expected. But this was by far the least serious part of the question: the results on the health of the workers and the neighbouring population were not likely to be tolerated for long by any sanitary authority after their effects had once been experienced. If the process cost nothing at all in money, it would still be too dearly purchased by the ruined health of those who came within the influence of the diffused mercury. After realising this, Mr. Bird emphatically declared that he would never have his name connected with anything likely to so seriously injure his fellow-creatures. In this I quite agreed with him; but he did not wait for any opinion of mine before declaring his own resolution.

I pass over the trials, failures, and disappointments. Finally we resorted to the use of a cathode of open texture placed in contact with a diaphragm, but without being submerged in liquid, the only liquid present being that which adhered by capillary attraction or which ran in a very thin stream upon the surface of the cathode and diaphragm. This afforded a gaseous boundary in close contact with the cathode, and facilitated the use of air or gases as auxiliary reagents.

The next difficulty was to produce a suitable diaphragm, and we at last produced one which yielded only 3 mols. of undecomposed salt to 10,000 mols. of alkali, with a current duty of 92 per cent. This, of course, was a laboratory result, and it might be too much to expect such results on a manufacturing scale: but it sufficed to show that some very positive opinions on the laws of electrolysis would have to be reconsidered. Our next step was the construction of larger cells, one of which I have now the honour to submit to your inspection. One side of the diaphragm being unsubmerged, and the cathode entirely so, ensures that there shall be no large mass of soda solution on the cathode side. The soda solution therefore cannot so readily pass by simple grahamic osmose to the anode compartment. The hydrostatic pressure in the anode compartment also resists the tendency to diffuse in that direction. The alkali is therefore kept intact when once obtained. The hydrostatic pressure assists in bearing the cathion towards the cathode, so that practically the grahamic and the electric osmose are both in the same direction. In the ordinary cell with porous partitions, grahamic osmose is continually going on in both directions with nothing to resist it, and so a part of the alkali is got and lost again repeatedly. Till the relative amounts of grahamic and electric osmose are quantitatively determined by experimental measurements, we can only guess how much is the share of each factor. For the present it must suffice to know that by lessening or suppressing the former we get results which were not anticipated, and indeed were distinctly declared to be impossible. It shows a strange negligence on the part of the orthodox to pay so little attention to the part played by simple or grahamic osmose; even when referred to at all it is regarded as a negligible quantity.

Lest my own memory might be at fault, I took up Dr. Lodge's report on electrolysis to the British Association in 1885.

In 50 pages of matter I find three lines devoted to this question of grahamic osmose. It is the non-appreciation of the part played by grahamic osmose which has given rise to so many assumptions on the migrations of the ions and the mathematical deductions from these assumed premises. The results of grahamic osmose happen in many cases to come out something like what these assumptions would preindicate, when actually it is only a chance coincidence. It is owing to this accidental coincidence being interpreted as the expression of an immutable law of electrolysis, that so much confidence has been entertained as to the absolute impossibility of obtaining any practical degree of purity by the interposition of diaphragms.

It must not, however, be assumed that any kind of a porous diaphragm will serve. This we have had occasion to learn by making and testing some thousands for durability, purity of product, current efficiency, resistance, &c. The diaphragms must not be porous at all in the ordinary sense of the term. With proper diaphragms a cell may be allowed to stand full of either brine or water for weeks, and not a drop filter out, but allow alkali to pass at once when the current is turned on. If a diaphragm leaks, it is at once assumed that it will yield an impure product. In the case of such leakage there is of course some undecomposed salt present in contact with the cathode. The process depends in fact upon the production of a diaphragm or proper texture. It would be easy to make diaphragms which would seem to prove the orthodox hypothesis completely, and just as easy to make others which as completely contradict it. An hypothesis so easily confirmed and contradicted does not supply much solid working ground for a technologist to build on. It may serve for academic students to dispute about, but the making or marring of fortunes depends on the good or bad judgment of the technologist, and he cannot afford to indulge in fancies, even if he would. To him the main use of hypothesis is as a guide to the effectual carrying out of his work. If it leads him astray in one detail he is justified in distrusting the rest.

Everything that had been taught us *ex cathedra* led us to expect that with such leakage a lower voltage would be needed, or a greater duty obtained for current used. The experimental fact is that with diaphragms of proper texture that is the case to only a very limited extent, and is no more than may be accounted for by the increased section due to porosity of the diaphragm itself, and is only slightly, if at all, due to the undecomposed salt present at the cathode. With the cathode unsubmerged there is no clinging of the hydrogen to it, and there is no hydrostatic pressure or interposition of liquid between the cathode and the surrounding gases. It is a fair deduction from Dalton's law that in such a case any hydrogen which may remain unoxidised (for some oxidation does occur under certain circumstances) would diffuse into the other surrounding gases almost as if passing into a vacuum, and the dynamic equivalent of this mechanical duty is at least partially recovered in the shape of lower voltage. I am aware that some of the views I am here setting forth are not orthodox, and I only suggest them as possible explanations of some of the results which the orthodox hypothesis does not preindicate. I should have preferred to avoid them altogether, and have only inserted them for the purpose of anticipating questions which might otherwise be asked. In the absence of certainties it is quite legitimate to frame temporary hypotheses, or, to speak more correctly, to make scientific guesses.

There are two fundamental laws of electrolysis which we may consider as fixed. The first is Faraday's law of direct correlation and equivalence between the current employed and the compounds electrolysed. The second is that of correlation and equivalence between the heat of combination and the E.M.F. of decomposition. To these may be added Ohm's law, which, however, relates to electric conduction rather than to electrolysis. Beyond these there is very little to be dogmatic about. But this need not prevent us from guessing at possible explanations of the causes of observed phenomena, so long as we do not set up our guesses as established facts, but continue our search with equal impartiality for confirmation or contradiction.

The results of my own experiments have led me to suppose that—(1st) Ionic migration is not bilateral but unilateral; (2nd) That the anion is merely a residual product remaining after the propulsion of the cathion from its contact with the anode; (3rd) That the cathode is merely the passive target against which the last cathion in the molecular chain is projected, and that the cathode has no propulsive action upon the anion; (4th) That it is not necessary that the electrolytic chain should hold the cathion in combination with the same class of anion through the whole length of the chain. For instance, electrolytic decomposition of chloride goes on quite as completely, though a portion of the chain consists of oxide, as when chloride alone is present, so long as only chloride is present on the surface of the anode. With a proper allowance for the action of grahamic osmose and diffusion; the hypothesis of unilateral migration supplies an explanation quite as complete as that supplied by the bilateral one, and also explains phenomena with which the bilateral hypothesis is in complete contradiction. I give these as my own scientific guesses, leaving them to be confirmed or contradicted by further experimental evidence.

For the present we must be content with experimental facts, and such deductions as can be legitimately drawn from them; and under all circumstances decline to assume a knowledge which we do not possess. I can speak more feelingly about this, because a large share of our time was lost at the beginning through accepting these guesses as established facts, and our change of views was due to encountering many phenomena of which the text books give no intimation. From a merely academic point of view, it is always important to have truth and not error; but it becomes still more serious when the technological searcher is put on wrong tracks. He has to retrace his steps and begin again after wasting time, strength, and means, where possibly there may be very little of any of them to spare.

The cell before you has an available diaphragm area of 5 sq. ft. The current employed is about 20 ampères per square foot of diaphragm, and requires an E.M.F. of 3 to 3·5 volts.

The diaphragms are placed on the two open sides of the cell, and when pressed tight in their place form a watertight chamber enclosing the two rough pieces of retort carbon. Two flanged plates serve to press the diaphragms against the edges of the cell for the purpose of forming the joint. To further support the diaphragm is a piece of strong copper cloth, which also serves as a cathode, and covers a cavity in the flanged plates. The positive conductor is connected to the carbon anodes, and the negative conductor to the flanged metallic plates, which are also in metallic connection with the cathode. The cavity between the two diaphragms is filled with concentrated brine; steam, together with carbonic acid, is passed into the cavities in the hollow plates. Moisture is condensed upon the cathode and diaphragm, and washes off from their surface any alkali with which it may come in contact. The carbonic acid also converts the newly formed soda into carbonate. The alkali in solution flows out through a perforation in the lower part of the flanged plates, and any excess of steam or gas escapes at the same orifice. As a ready means of obtaining carbonic acid, the exhaust gases from a gas engine are employed. Through the passage which carries the weakened brine the chlorine also escapes. These flow together into a chamber, where the liquid and the gas are allowed to separate. The brine flows to the well, where it is again saturated, and the chlorine to the bleaching-powder chamber, where it is absorbed by lime.

I give here the average record of 59 full days' working of 24 hours each, with 15 cells in series, of which this is one:—

| | |
|---|---|
| Average current per square foot | 18·7 ampères. |
| „ E.M.F. per cell | 3·4 volts. |
| „ current efficiency | 80·3 per cent. |
| „ mols. of NaCl to 100 mols. Na obtained as $Na_2CO_3$ | 7·7 |

The amount of salt is high, but I thought it best to put the facts as they stand recorded in our books. This average includes the worst results as well as the best; also the results of mistakes, accidents, and the testing of various qualities of diaphragms, and many contingencies that would not occur in regular working. With ordinary care the salt can be reduced to 3 mols. for 100 alkali, and less with a little more care. In many cases the impurities were less than 1 per cent., and in some a mere trace. But seeing that the above average is better than the average of the Leblanc process, I could well afford to let it stand. The bleach averaged 37·5 per cent.; in some cases 39 per cent.; in all cases tested after packing. This settles the question of the migration of any serious quantity of carbonic acid from the cathode to the anode cell, though no precautions whatever have been taken to prevent it. The chlorine was frequently examined during the run, and tested about

97·5 per cent., with very slight variations on either side. Since that run another cell has been tried with some modifications. The gas from this has kept pretty steadily about 98·5 per cent.

On estimating the aggregate value of the products from a given amount of electrical energy, we find that a greater aggregate market value is produced when making carbonate than when making caustic soda, and hence the greater part of our attention has been devoted to the carbonate experiments.

I preferred to give the foregoing figures, though less favourable than those which we now obtain, because they are the summing up of a long continuous run. In this work, as in every other, an apprenticeship must be served, and only long practice will enable the learner to grasp the numerous minute details which present themselves in the development of a manufacturing process.

I interpose this remark, because, although such an apprenticeship is known to be necessary in an old and established process, nearly everybody expects a new process to spring like Minerva from the brain of Jupiter, complete in every detail. To a society of practical technologists there is no need to enlarge upon the advantage of avoiding secondary products having no market value, such as alkali waste, calcium chloride, &c.; also of requiring no intermediate reagents, such as pyrites, manganese, nitre, &c. No furnaces are required, except for finishing soda-ash, or caustic, and in these the temperatures are comparatively low. The only unsaleable by-product is the ash from the fuel. The sanitary question has also been carefully considered. There is no escape of noxious gases or vapours whatever (except a possible escape of chlorine, which, within certain limits, may even be a positive advantage), and what is common to all large industrial operations—the products of combustion of fuel.

There is a very practicable and important application of this system to sanitary purposes, to which I would call the attention of the municipal authorities. Chlorine is incontestably the most practicable disinfectant for sewage; the difficulty is to obtain it in sufficient quantity at a price which is not excessive. When used in form of bleaching powder, the lime renders the sewage alkaline, which is not desirable. By its higher specific gravity, chlorine gas, when passed into a sewer, keeps in contact with the absorbing surface of the liquid sewage, so that within moderate limits no special provision need be made for getting the gas into solution before passing it into deep sewers. By the use of this system it is quite easy to decompose salt for the purpose of producing chlorine on the spot where it is wanted. It will be evident that a simple apparatus, such as the one before you, may readily be erected and worked at at any place where power and salt are available, and chlorine and alkali can be ground out as desired. There is then no cost for carriage of the more costly materials. Not only is the salt carried more cheaply, for the weight of the salt is much less than its aggregate products, but the cost of packing and packages is also avoided. Amongst other applications, I mention paper making, linen and calico bleaching, gold extracting, &c. Some of these industries are established in out-of-the-way places, where the carriage of chemicals is costly; while their equivalent in the form of salt is easily carried. Since the trials, the results of which I have given, further experiments have been continued, giving decidedly better average results, and there is no reason why still further improvements may not continue to be made. In the progress from the laboratory to the manufactory, the enlargement of the scale of operations often brings new difficulties which did not show themselves on the smaller scale. In this case, however, such difficulties have not shown themselves. The first cell had a working area of 0·2 sq. ft.; the next size, one of which is before you, had 5 sq. ft., or 25 times as large; a third has 16 sq. ft., or 80 times as large as the original one, and bears out all the results obtained from the first small one, so that it is safe to infer that an increase of three or four times greater surface will cause no practical difference in working results, but will reduce the number of working parts and the cost of attendance.

The soda-ash resembles Leblanc ash in texture, its only difference being its greater purity. The samples before you are obtained by direct boiling down of the solution as it flows from the cells. The purity of each sample is expressed in molecules of Na, as chloride and alkali. The variations in composition are due to variations in quality of diaphragms.

Previous workers do not seem to have considered the composition or the texture of the diaphragm as having any important influence on the results of electrolysis. A porous diaphragm was just a porous diaphragm and nothing more. After this, I think the scientific world will begin to recognise the fact that the part played by the diaphragm may be made something more than that of a mere mechanical screen for keeping the products of decomposition apart.

The data from our experiments show that, with ample allowance for contingencies, 2,000 electrical horse-power will decompose per day 17 tons 10 cwt. of sodium chloride, and produce 26 tons 5 cwt. of 37 per cent. bleaching powder (allowing $7\frac{1}{2}$ per cent. of the chlorine to be unavailable), and 15 tons 15 cwt. of 58 per cent. soda ash, at a cost all round of about 2*l.* 12*s.* per ton, packed at works, including in the cost all necessary plant, labour, materials, maintenance, communications with railways, rates and taxes, working capital, &c. &c.

The following well-founded data, which give ample allowance for contingencies, will suffice to show this:—

| | |
|---|---|
| Chlorine per ampère-hour ... | 1·31 grms. |
| Electric duty for 1 I.H.P. ... | 600·0 watts |
| Current duty................ | 0·8 |
| l in kilo. of bleach ......... | 350·0 grms. |
| E.M.F. required............. | 3·4 volts |

$$\frac{350 \times 3{\cdot}4}{1{\cdot}31 \times 600 \times 0{\cdot}8} = \frac{1{,}190}{628{\cdot}8} = 1{\cdot}89 \text{ I.H.P.}$$

or, not to be too exacting, say 2 I.H.P. hours. I can find plenty of engineers who will guarantee to produce the above power for very much less than 1 kilo. of coal.

It is one of the weaknesses of human nature to wish to get all the credit possible for anything we do, and I frankly confess that I am not entirely free from the weakness myself; but the same frankness compels me to admit that all the science, skill, and patience spent in actually accomplishing this work is a mere trifle compared to what has been devoted to proving that it cannot be done. It is difficult to explain, by ordinary rules, why so much trouble should be taken to acquire negative knowledge. Technologists do not usually spend their time in getting to know how things cannot be done. I suspect most of us are pretty well stocked with that sort of knowledge already. Anyhow, I have a lot of it which I would gladly exchange for some of the other sort.

Technologists have much greater opportunities, and also correlatively greater responsibilities, than they had 30 or even 20 years ago. Thanks to the laborious and disinterested researches of a noble army of scientific investigators, the amount of energy required to produce a given reaction is an ascertained or an ascertainable quantity. It is the business of the technologist to effect his reactions with the smallest expenditure that the nature of the subject will allow. The problems awaiting solution are so many, and the gaps between present working results and scientific potentialities so wide, that we never need despair of having worlds enough to conquer. We shall never arrive at perfection, but there is ample room to approach it. We must humbly accept the fact that so-called impossibilities lie, not in the nature of things, but in our own ignorance We may not know how, but we must consider that—within the limits of energy-equivalence — the "how" exists, whether we know it or not. It is our business to learn "how," and when we have taught ourselves how, it is again our duty to teach others how. Before teaching others, we must accept nature as our schoolmistress. If we misinterpret her lessons and her laws, it is not she, but our own dull wits that are to blame. Let us all bear in mind the wise saying of Leonardo da Vinci, "La sperienza non falla mai, ma sol fallono i vostri giudizii." An experiment never fails; it is only our judgments that fail

### Discussion.

Sir Henry Roscoe said that the subject of this paper was one of such importance and difficulty that he hardly felt in a position at that moment to express an opinion on its general merits, nor to put the process in comparison with others, in one of which he was concerned, viz., the process known as the Castner-Kellner process, which, however, he might say he believed to be superior to all diaphragm methods. Whilst they were all glad to have heard Mr. Hargreaves' paper, he must say that some of the remarks which had fallen from him were of such a nature as to require an immediate reply. It was with special reference to that part of the paper, and to that only, that he now proposed to speak. It had been stated in the paper, and in other communications which the author had published, that the use of mercury as employed in the Castner process was much to be deprecated. He would not say a word in reply to remarks which had been made in other places, as these might be dealt with in another way, but in reply to what was stated in the paper he would lay before the meeting a few facts bearing on that particular point. In the first place he regretted that Mr. Hargreaves had not visited the works of the Castner Company at Oldbury. Had he done so the officials there would have been glad to have shown him the process, and Mr. Hargreaves might then have spoken with the authority of one acquainted with all the details of its working. By such a visit and inspection of the process, working on a scale of 30 cells, he would have learnt that the hydrogen was not evolved from the surface of the sodium amalgam, but from the iron grid which lay over the alloy of sodium and mercury; and thus the idea that any mercury vapour could be carried away by the hydrogen gas was obviously erroneous. Mr. Hargreaves wished also to make them believe that mercurial poisoning was certain to occur by the use of mercury by this process. If he had taken the trouble to go to Oldbury and see what was being done there, he would have learnt that in the two and a half years during which this process had been carried on, there had not been a single trace of mercurial poisoning, either amongst the men directly concerned with the process or the others, and he would have found on consulting the registers of the workmen's attendances that not a single man during the last 18 months had stayed away from his work through illness, and that if illness had occurred the authorities would have at once become aware of it and of its nature from the doctor's certificate required in every instance. In comparing, as Mr. Hargeaves had thought it fair to do, a process in which the mercury is always covered by salt solution or caustic solution with other processes in which—such as in the old process of silvering mirrors—dry mercury is used, or with the working in quicksilver mines, Mr. Hargreaves had altogether forgotten that the processes were entirely dissimilar, and that the argument in the one case was not in any degree applicable in the other. Now, as to the source of loss of mercury. It was well known to users of mercury, whether on the large or the small scale, that there was a constant loss of the metal from one cause or another. Mr. Hargreaves assumed that it was all vaporised. On the principle that an ounce of fact was worth a pound of theory—a principle which was certainly true in this case if not in others—however, he would like to tell the Section exactly what happened at Oldbury. It was found by the chemists there that in the last run of the process, namely, during a space of 11 weeks, the quantity of mercury issued was 2,782·85 lb. When the mercury was collected together again it was found that there was a decrease of 7·27 lb., corresponding to a loss of 2 per cent. per annum on the quantity used. He need scarcely remind any chemist who had worked with mercury that it was impossible to prevent the spilling of this metal, and that it was extremely difficult to gather it up again. There was no doubt at all that the small loss referred to was entirely due to handling, and not due to evaporation, as assumed by Mr. Hargreaves, and that with more perfect arrangements the loss would be less. To bear out this statement it was only necessary to mention that at Oldbury the working floor was from four to five feet above the drainage floor, made to catch the spilt mercury and drainage from the tanks. In falling this distance the mercury became so pulverised and scattered that its collection was extremely difficult. However, the whole of the dirt, water, and mercury was passed into a gutter, whence it was led into a catchpit, the dirt taken out, and the mercury separated by distillation. Of the 7·27 lb. which were missing, 3·3 lb. were recovered in that way; thus, the actual loss in working was only 1 per cent., or 4 lb. out of a total of about 2,800 lb., and he thought that members would agree with him in regarding such a loss under such circumstances as merely mechanical, and that the idea that mercurial poisoning was likely to take place was a mere chimera. Another sensational report with regard to this process was that the men were working in a frightful atmosphere of chlorine and mercury. He could only say, however, that his friend Mr. Carpenter, the Chief Inspector under the Alkali Acts, and his old pupil, Mr. Jackson, who were present when the plant was run off, remarked on the entire absence of chlorine; and that many who had visited the works had even doubted if the apparatus was actually running because of the absence of chlorine odour. He need only add that statements of the kind made by Mr. Hargreaves ought not to be put forward by any responsible person without proper investigation, and he much regretted that Mr. Hargreaves should have lent himself to the publication of statements calculated to damage, in the eyes of unskilled persons, an important new industry, with the details of which he had not thought it worth his while to make himself acquainted. In conclusion he might say he looked forward with great hope to the future of electrolytic chemistry. He believed, with the author, that we were only on the verge of great applications of electricity, not only to scientific investigation, but to chemical manufactures, and whether the one or the other of the several processes now before the public turned out to be the most successful, they were indebted to those gentlemen who had spent their time and knowledge in endeavouring to perfect what he believed would prove to be a great benefit to the chemical trade of this country, as well as to science in general.

Mr. D. Howard wished to add one word on this side-issue of an important question. There was no need for any great apprehension with regard to the use of mercury under proper conditions and with due precautions. He could himself speak to prolonged experiments on the health of workmen. The longest extended for a period of 50 years, by which time the patient was 75 years of age, and showed no signs of salivation.

Dr. F. Hurter said that he, having been to Oldbury, could confirm all that Sir Henry Roscoe had said about the Castner process. Anyone who had studied Castner's specification must know that the hydrogen was not given off from the surface of the mercury. There was considerable difference between the Castner and the Hargreaves processes. They knew the strength of the caustic solution produced by the former, but had been told nothing about the strength of that produced by the latter. He would not criticise the Hargreaves cell. Eight years had brought many and great changes in electrolytic methods—among them those introduced by Mr. Hargreaves himself. No one who knew Mr. Hargreaves could do otherwise than acknowledge him a genius; and the cell he had devised was as ingenious as any he (the speaker) had seen. Whether it was the best or not, was, of course, another question. He saw nothing to alter in the statement he had made in 1887—that it took a current of 1,000 ampères three years, working day and night, to produce one ton of hydrogen when using a single cell—since it was absolutely correct. It had been made simply to show the small amount of work which an ampère could do. As chemist to the United Alkali Company it was his duty to report on the various processes brought out from time to time. In doing so with respect to the electrolytical processes, he could not base his judgment on his own practical experience, nor on that of others, for none existed. He was therefore obliged to depend entirely on theoretical considerations. One such theory which was fairly well established was that of the migration of the ions—a fact as absolutely certain as was gravitation. Such a phenomenon must play its part in any cell. It had been established by Hittorf, and later by Kohlrausch, that the velocity of migration of different ions was not equal, and that the results obtained by electrolysis were, to some extent, affected by this inequality. In the paper referred to, he had endeavoured to bring these results to bear upon the current efficiency, by which he meant the number of ampères of any given current which did that particular chemical work which was desired, and no other. The theory was applied to imaginary cells filled with certain solutions and containing imaginary diaphragms, and simply served to indicate what might be expected in practice. The essence of the theory was this—that if a current passed through a solution containing only one electrolyte, and, if that electrolyte did not change its composition, the current efficiency would always be 100 per cent. For instance, if a solution of copper sulphate were electrolysed between two copper plates, copper simply passed from one plate to the other without changing in composition the electrolyte, and the current efficiency would be 100 per cent. But if they had an electrolyte like common salt under treatment, they got, after some time, not only common salt, but sodium hydrate in solution; and in proportion to the presence of the latter, secondary reactions took place, and chlorates, &c., were formed. All these salts were electrolytes themselves, and the question arose—what would happen as regards the distribution of the current? Would it all travel across the sodium chloride, or would some cross the sodium hydrate and the rest cross the other salts? He had arrived at the conclusion that under the circumstances of these cells, all the electrolytes in the solution took part in the conduction of the current. But to what extent? If one had two ordinary wires, one of small and one of large section, and passed a current through, it would divide itself between the wires in proportion to their relative conductivities. Experience with electrolytes showed that between caustic soda and chloride of sodium exactly the same thing took place. Caustic soda was an excellent conductor, and the result was that as it increased in the cell a proportionately larger current passed across it, and less across the common salt. That could not be proved absolutely by measurements of resistance alone. It would only be proved by observing the migration of the ions that caustic soda had conducted the current, say, by the appearance of oxygen on the anode. By measuring that, they knew how much current had crossed the caustic soda, and they found that the current had divided itself among the electrolytes in proportion to their conductivity. He would now show what results the theory brought out in connection with the Hargreaves cell.

He had already shown in the paper referred to how the current efficiency might be calculated if the composition of the electrolyte were given. For the purpose of applying the theory to the Hargreaves cell, he would reverse the formulæ, and calculate from a given current efficiency the composition of the solution corresponding thereto. For this purpose he would use the following formulæ, in which E meant the current efficiency, and $x$ the number of gramme-molecules of caustic soda or carbonate of soda which might be obtained per litre. The conductivities of the various solutions he would take from Kohlrausch's researches. They expressed the conductivities as compared with mercury when multiplied by $10^8$ at 18° C.

The temperature in the Hargreaves cell was more than 18°; that would affect the absolute values of the conductivities, but not their relative value.

Kohlrausch gave the following conductivities:—

| — | Gramme-Molecules. | — |
|---|---|---|
| | Per Litre. | |
| NaHO | 5·0 | 3,259 |
| NaCl | 5·0 | 1,991 |
| $Na_2CO_3$ | 3·5 | 794 |

By means of these numbers and the principles just explained, the following formulæ for the composition of the solutions were constructed:—

$$\text{For carbonate, } x = \frac{1{,}990\ (1 - E)}{398 - 171\ E}$$

$$\text{For caustic, } x = \frac{1{,}990\ (1 - E)}{398 + 254\ E}$$

These formulæ furnished the following table for the composition of the solutions:—

| Carbonate. | | Caustic. | |
|---|---|---|---|
| E. | Grms. $Na_2O$ per Litre. | E. | Grms. $Na_2O$ per Litre. |
| Per Cent. | | Per Cent. | |
| 90 | 25·3 | 90 | 11·2 |
| 80 | 48·0 | 80 | 20·7 |
| 70 | 74·0 | 70 | 31·0 |
| 60 | 83·0 | 60 | 45·2 |
| 50 | 99·0 | 50 | 58·8 |

These numbers showed that the theory indicated that better results were obtained when making carbonate than when making caustic, and showed the strength of the solution obtainable. It could not, however, be expected that these results should be anything but approximations to the truth.

Other considerations affected the matter, but this was the general principle of the theory. He had seen the Hargreaves process at work, and these were the results then being got. The caustic soda solution contained 37·3 grms. per litre. The following day the Chairman of the Pennsylvania Salt Company was there and brought away a sample containing 32·7 grms. $Na_2O$ per litre. It would be seen how well these figures agreed with his theory. With carbonate solution the cell gave 66 grms. $Na_2O$ on one day and 56·7 grms. $Na_2O$ the next day. One point appeared to require explanation, namely, why was the carbonate solution so pure? The amount of salt which, according to Mr. Hargreaves, could go through the diaphragm was very small indeed. He could not at the moment recollect the factor for the transmission by diffusion of common salt through solutions, but he thought it was about 1 grm. in a day of 24 hours, with a difference of concentration of 1 per cent. spread over a distance of 1 centimetre. If that were all that passed through an open solution, what would pass through a diaphragm the pores of which were filled up with phosphate of lime? One could not get the solution stronger on the cathode side of the diaphragm because it was permeable for the caustic soda; and if it were richer on the cathode side it would rapidly pass by osmosis to the anode side, owing to osmotic pressure, which acted in the contrary direction to the current. Whether right or wrong, he made an endeavour to assist chemists in calculating the results to be obtained by electrolytical processes, and, like Mr. Hargreaves himself, was doing his best to advance our knowledge of this most important subject.

Mr. J. Swinburne was glad to welcome yet another process for the electrolysis of salt. It was a common mistake of inventors to imagine that every predecessor had failed in this method of working. There were many possible processes, and they varied in details and cost only. But as the cost of the pure electrolytic part of a soda work was but a small proportion of the whole, it followed that the difference between a good process and a bad one could not be very great. It was therefore a pity for any inventor in bringing forward a new process to criticise others; they should rather direct their attention to overcoming the inertia of people towards new processes in general, and study to effect improvements in working which would render a new method more useful and important. He agreed with Dr. Hurter that it was quite out of place at the present time to criticise a process which was already ten years old. Electrolysis was making tremendous strides, not only in this country, but in Germany. He quite agreed with Sir Henry Roscoe's remarks respecting the use of mercury, and considered that its dangers were overestimated even in other processes. He had had some experience of its use in the manufacture of incandescent lamps, in which case it was exposed to the air; but he never heard of a case of illness from it.

Mr. A. Philip asked the author to state, unless the figures were already given in the paper, the actual cost of the diaphragms. However efficient they might be, their cost would necessarily form an important item in the cost of the process.

Mr. Bertram Blount though it might be well if a word were said on the purely chemical side of the question. When a given chemical reaction took place, it was generally desirable to remove the products from the sphere of the reaction with all speed; and it seemed to him that in this case also the whole importance of the process turned upon the possibility of getting the products quickly away from the neighbourhood of the cathode and anode, and allowing free play for the current to react on the remaining molecules of sodium chloride. Another question as important, but not previously touched upon during the discussion, was the voltage necessary in this and similar processes. It seemed to him scarcely relevant to quote figures of 10 years back—though no doubt valid enough at the time—as to the voltage necessary to decompose an electrolyte. He believed that he was not speaking without warrant when he said that the critical voltage for the decomposition of common salt was barely over two volts; and the results quoted by Mr. Hargreaves were obtained with a voltage of 3·4.

Mr. Hargreaves: We have since been working with a voltage of 3.

Mr. Blount, continuing, remarked that that was in the production of sodium carbonate, which was not quite the same thing. That required a total of expenditure of energy smaller than with caustic soda as the ultimate product, and so the efficiency was less marked. Various other questions arose, but he would only touch on one, viz., the life of the anode. He would be glad to know the time this endured under ordinary conditions; also, if possible, the cost of a given unit of plant and the output of that plant. The last matter was of much moment, having regard to the fact that a considerable fraction of the total cost of an electrolytic process was frequently made up of the interest and depreciation charges on the plant.

Mr. C. F. Cross considered that this question had now reached a stage in which the struggle for existence between the various processes was carried on on purely practical lines. All accepted the fundamental equations, and were agreed as to a high electro-chemical efficiency being attainable. It was a question now of the evolution of the cell to attain that end. In regard to the Hargreaves cell, he had found that the extreme variations of efficiency in ordinary work were between 80 and 90 per cent. His partner, Mr. Bevan, had carried out an exhaustive trial, and the figures showed that the efficiency being from 82 to 95 per cent., the composition of the carbonate of soda produced varied between 54·6 and 57·6 per cent. $Na_2CO_3$. There were now before the technical public three electrolytic processes deserving, in his opinion, special mention: one, the "Le Sueur," was successfully running at Rumford Falls, U.S.A.; the Castner process, which had been spoken about by Sir Henry Roscoe; and the last claimant in order of time, the Hargreaves cell. It would be interesting if Dr. Hurter would make a careful dissection of these various processes from the point of view of the control of the actual factors of the electrolysis. No one had given more attention to these still obscure questions of theory in their bearings on the industrial problems. Most important was the theory of "migration." It was a great pity that there should be so much confusion on this point. It required mathematical treatment, and its consideration should not be mixed up with questions of the practical working of the cell. It was impossible to refuse their testimony to the value of the Hargreaves cell, and he looked forward to its taking a high rank amongst practical electrolytical processes.

Dr. R. Messel inquired what surface would be covered by plant per ton of caustic soda produced. This was a most important consideration, affecting the expense of maintaining a perhaps costly plant. Some years ago he had investigated a process which appeared to be advantageous, and found that in order to produce 30 tons a day of finished material they would have to cover at least six acres with plant, a fact which rendered the process quite impracticable.

Mr. J. Hargreaves, in reply, said that he had worked at the subject of electrolysis since 1875. At that time they had no economical motor to work with, and the dynamo was only just coming into use. He therefore devoted himself to the consideration of the thermo-dynamic factor, and eventually succeeded by means of a special motor in reducing fuel consumption to an amount of liquid fuel equal to $\frac{3}{4}$ lb. of coal per h.p.-hour. With respect to the use of mercury, he could only say that it was good enough for them to give up after working for a considerable time; and they did not take that course lightly, but because they felt convinced that if once its use extended to a manufacturing scale it would sooner or later be stopped for public reasons; that the sanitary authorities would exercise their common sense in the public interest and hamper the industry with conditions which would make it unworkable. As to the question of loss of mercury, he had simply quoted the figures given by the Castner Company to the alkali inspectors. That loss amounted to about 16 oz. per ton; whereas he estimated his own loss, working at 50° F., at 11 oz. The company had since reported its loss at 2 per cent., which, taking the quantity of alkali produced, came to 6 oz. per ton. Loss could be minimised by keeping down temperature, and no doubt they used refrigerating machinery for that purpose. There had been no change in the laws of electrolysis; these laws being more fixed than the laws of the Medes and Persians. Dr. Hurter had truly stated that one would have to work three years to make a ton of hydrogen in one cell from one ampère; but he hoped that statement would not convey the impression of the absolute hopelessness of electrolysis as a manufacturing process. He gave Dr. Hurter credit for the correctness of his calculations. If they were making carbonate and did not pass steam against the diaphragm they would get an accumulation of solid carbonate on the cathode which would eventually break the diaphragm. The steam was added in sufficient quantity to break up this solid mass and carry it off. The diaphragm before the meeting had worked for 57 days. Some went longer. The materials for making it would cost about $1\frac{1}{2}$*d.* The cost ran to about 1*s.* to 1*s.* 6*d.* per ton of products. There was no question about producing alkali; that was easy enough. The problem they had to solve was to obtain a practically pure product with a reasonable amount of current.

Mr. Carpenter disclaimed any knowledge of the report attributed by Mr. Hargreaves to the Chief Inspector of Alkali Works, and thought Mr. Hargreaves must have intended to refer to his predecessor.

Mr. Hargreaves explained that that was so. It appeared in the last annual report.

The President (Mr. T. Tyrer) referred to the valuable work done both by Mr. Hargreaves and Dr. Hurter in the advancement of chemical technology, and expressed the belief that the differences between this or that process made for the good of chemical industry, for out of them an ideal process would arise. In this connection he would like to refer to the last clause of a paper by Mr. Mond, read before the New York Section (this Journal, 1895, 946). It was evidently Mr. Mond's opinion that we must not expect too much from electro-chemistry.

He would take this opportunity of testifying to the hearty welcome and the friendly feeling he and the foreign secretary had met with in America. It was a great mistake to suppose that intelligent and business-like Americans were other than kindred spirits. Responsible Americans, men who had something to lose, had the greatest respect for their British fellow-workers. Personally he had to acknowledge that the greatest possible courtesy and kindness had been extended to him by the New York Section during his recent visit and in his opinion it resulted from two causes: Firstly, the excellence of the Society's Journal as a necessity to chemical technologists. Secondly, the kindly way in which American chemists had been received in England generally, and particularly at the Annual Meetings.

The Chairman said that he had had an opportunity of going through Mr. Hargreaves' figures as to the cost of his process, and found that the whole cost of the electrolysis was equivalent to about $6\frac{1}{2}$ per cent. of the total cost of the process. In other words, it equalled 2*s.* per ton on the raw material employed, or 3*s.* 4*d.* on the finished products; and the total cost of power would be 1*s.* 7*d.* per ton on the materials carried. A good deal had been said lately of the iniquities of a certain aluminium company in destroying a waterfall in order to get motive power for its work. But as waterfalls were generally remote from railways it was evident that there would not be much inducement to use one for the purpose of saving expense of motive power in the Hargreaves process.

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# THE ANALYSIS OF CHROME IRON ORE, FERRO-CHROMIUM, AND CHROME STEEL.

BY DR. S. RIDEAL AND S. ROSENBLUM.

ALTHOUGH various processes have been devised for the estimation of chromium in these compounds, most of them are open to the objection that they take a long time to execute. The introduction into commerce of sodium peroxide has given analysts a new oxidising agent which is suitable for the fusion of compounds which are difficult to oxidise, and Hempel in 1893 (Zeitsch. Inorg. Chem. 3, p. 193), proposed its use for the decomposition of chrome ores.

J. Spüller and Kalman (Chem. Zeit. 1893, pp. 881, 1207, 1360, 1412), and J. Clark (J. Chem. Soc. 53, p. 1079), subsequently made the process a quantitative one. Saniter (Iron and Steel Institute, August 1895), also described a process for the analysis of chromium compounds in which this reagent is employed.

In Dr. J. Clark's method (Jour. Chem. Soc. 53, p. 1079), "The finely-powdered ferro-chromium is mixed with about six times its weight of sodium peroxide and heated in a platinum crucible at a low temperature until the mass becomes pasty but not fluid. If the ferro-chromium is in a sufficiently fine state of division, the whole of the chromium is rendered soluble in one fusion." In order to test the efficiency of this process, a ferro-chromium of about 65 per cent. of Cr was treated exactly as above described, and we obtained the following results:—I. 18·18; II. 25·90 chromium per cent.

In the second experiment heating had been continued until the mass had just become fluid. In both cases undecomposed ferro-chromium could be distinctly seen after solution of the melt. It is quite evident from these experiments that the amount of dissolved chromium is in direct proportion to the duration of heating. Clark succeeded in obtaining very accordant results by his method, but the above results of our experiments confirm the statement of Saniter that the decomposition by this process was far from complete.

Saniter has altered Clark's method, in so far that he continues the heating until three minutes after the mass is fluid, giving the nickel capsule a continuous circular motion, to prevent the chrome ore from settling to the bottom. A complete decomposition of the chrome ore is said to be effected in this way, even if the ore be only "moderately finely ground."

"The melt is then dissolved in cold water (boiling water being used only for rinsing out the nickel capsule), the solution and the wash-water are put into a beaker and an excess of sulphuric acid is added. As soon as the solution clears it is diluted to about 100 c.c., and boiled to decompose any peroxide of hydrogen. After cooling, the chromium is estimated by titration in the usual manner."

The advice to boil the acidulated solution naturally anticipates that some sodium peroxide, undecomposed, is present in the solution. If this be the fact, as we have found that it really is, then it is quite evident that any peroxide of hydrogen, which has been formed in the solution after the addition of sulphuric acid, must of necessity, if enough of it be present, reduce the chromate in the solution.

We do not presume to suggest that Mr. Saniter was not aware of this reaction. If, however, he succeeded in obtaining by his method very accordant results, this can be due only to the remarkable chance that in all the determinations made by him the whole of the sodium peroxide was decomposed during the fusion.

In the numerous analyses of chrome-ore, ferro-chromium and chrome steel, which we have had occasion to make, we have found that an excess of undecomposed sodium peroxide is almost in all cases present in the aqueous solution of the melt, and that in these few cases, where it has erroneously not been decomposed before the addition of sulphuric acid, no chromate or only a part of it was found on titration.

Working on known solutions of potassium bichromate, to which 1 grm. of sodium peroxide and then sulphuric acid were added, the chromate was found to be totally reduced by the hydrogen peroxide formed.

When sodium peroxide is added to an acidulated solution of a chromate, the whole suddenly assumes the beautiful dark blue colour of chromium peroxide, $Cr_2O_7$. This rapidly changes to lighter shades of the same colour, until the solution becomes colourless, assuming after some minutes the characteristic green of the chromium salts. This last change is more rapid if the colourless liquid be slightly heated.

We are not aware that this colourless stage in the reduction of chromate by hydrogen peroxide has been noticed before. Owing to its fugitive character we were not able to make a further investigation of it.

To decompose the excess of sodium peroxide Spüller and Kalman (Chem. Zeit. 1893, p. 861 *et seq.*) have recommended passing a current of carbon dioxide through the warm aqueous solution of the melt for one hour and then boiling the solution for 15 minutes in order to free it from the carbon dioxide.

Dr. Clark (Journ. Chem. Soc., 53, p. 1079) has, however, found that boiling is in itself sufficient to decompose sodium peroxide when in solution.

A complete decomposition of the $Na_2O_2$ being of extreme importance for the further course of the determination, we considered it necessary to prove, by means of the following experiments, that no free sodium peroxide remains in the solution after it has been boiled for a certain time.

To a known solution of potassium bichromate, 1 grm. of sodium peroxide was added; the solution was then boiled for 10 minutes, being stirred from time to time to allow of a more rapid escape of oxygen. Sulphuric acid was then added, and after cooling, the solution was titrated with double iron salt and bichromate.

| $K_2Cr_2O_7$ added. | $K_2Cr_2O_7$ found. |
|---|---|
| Gr. | Gr. |
| I. 0·1000 | 0·1002 |
| II. 0·2000 | 0·2000 |

It follows from these experiments:

(1.) That when sodium peroxide is added to a neutral or alkaline solution of a chromate, the state of oxidation of the chromium is unaffected.

(2.) That boiling for 10 minutes is sufficient to decompose a comparatively large excess of sodium peroxide.

In our attempt to analyse chrome ores according to Saniter's method, the solution of the melt was of course boiled, in every case, to decompose the excess of sodium peroxide.

The result of four determinations of a chrome ore which had been found (by Clark's magnesia method) to contain 30·42 per cent. of Cr were as follows: — I. 29·51; II. 28·65; III. 29·47; IV. 29·83 per cent.

A small portion of undecomposed chrome ore was always visible after the melt had been dissolved. The undecomposed residues of each fusion were subjected to a second fusion and yielded:—I. 0·86; II. 1·75; III. 0·91; IV. 0·55 per cent. Adding this to the percentage of chromium obtained in the first fusion, the total amount of chromium will be:—I. 30·37; II. 30·40; III. 30·38; IV. 30·38 per cent.

The same sample was fused with sodium peroxide for 10 minutes; about 1 grm. of sodium peroxide was then added and the heating continued for another five minutes. The decomposition was complete, 30·39 per cent. Cr being found in the solution on titration.

A new portion of the same sample was reduced to a very fine powder. A complete decomposition was effected in five minutes:—I. 30·45; II. 30·46 per cent.

An additional reason for very fine grinding is the fact that chrome ores vary considerably in their percentage of chromium, and that the higher that percentage the less easily do they yield to decomposition.

The following experiments will show how the process should be conducted :—

An ore, containing 38·58 per cent. of chromium, was reduced to a very fine powder and 0·5 grm. of it were intimately mixed in a nickel crucible with six times its weight of sodium peroxide. The crucible was held by means of tongs in a Bunsen flame, and after the mass had become fluid it was heated for five minutes. The melt was then allowed to cool until a crust was formed on its surface. 1 grm. of sodium peroxide was then added and the heating continued for another five minutes. The ore was found to be completely decomposed :—I. 38·58 ; II. 38·63 per cent.

A nickel crucible, though considerably attacked, will last for a long time provided it is not exposed to a very high temperature. We have tried platinum, silver, and porcelain crucibles, but with unsatisfactory results.

We have found that a considerable amount of nickel from the crucible is dissolved by the sulphuric acid. It causes much inconvenience on titration, as it forms a brown precipitate of nickel ferricyanide, which tends to mask the final point of the titration.

We therefore attach much importance to the filtration of the aqueous solution of the melt, as it ensures that the solution is free from both nickel and iron oxides.

Saniter also applied his method to the decomposition of ferro-chromium, but found that however finely the alloy was pounded the decomposition remained incomplete. He therefore added barium peroxide, in order to keep the particles of ferro-chromium separate. Barium peroxide has been proposed for this purpose by Donath in 1887 (Dingl. 263, p. 245) and subsequently in combination with sodium carbonate by Kinnicutt and Patterson (Journ. Anal. Chem. 3, p. 132).

Mr. Saniter recommends that 0·5 grm. of a ferro-chromium reduced to a powder, which will pass through a sieve with 10,000 meshes to the square inch, be mixed with 4 grm. of sodium peroxide and 0·75 grm. of barium peroxide and then be treated exactly after the method for the decomposition of chrome ore.

With us this method with a ferro-chromium containing 29·40 per cent. of chromium gave I. 26·04 ; II. 27·81 per cent., and in both cases a small portion of ferro-chromium remained undecomposed. The same experiment repeated with another portion of the same sample reduced to an impalpable powder, gave 29·35 per cent.

A ferro-chromium containing 65·84 per cent. gave, by Saniter's method, 58·93 per cent., and when reduced to an impalpable powder gave 65·21 per cent.

Saniter goes on to say that sulphuric acid could not be used in dissolving the melt "owing to the presence of the barium peroxide, and on attempting to use hydrochloric acid it was found that a considerable quantity of chromium was reduced by it. It therefore became necessary to apply Stead's modification of Galbraith's method in order to reoxidise the partially reduced chromium." It is difficult to understand the meaning of the phrase "owing to the presence of barium peroxide." After some difficulty we have, however, come to the conclusion that for "peroxide" in the phrase "owing to the presence of barium peroxide" one should read "chromate." In this case the adoption of hydrochloric acid as a solvent is quite comprehensible. We are also inclined to think that the reduction of chromium, which was noted by Mr. Saniter, was due to hydrogen peroxide formed by the action of hydrochloric acid upon sodium peroxide left undecomposed. The reduction of chromium could hardly be attributed to the hydrochloric acid, inasmuch as the whole method of Mr. Stead (this Journal, 12, p. 712) is based on the fact that hydrochloric acid of a certain strength does not reduce chromates. It also appeared to us that some of the ferro-chromium, which remained undecomposed after the fusion, was dissolved by chlorine evolved from the hydrochloric acid by permanganate formed from manganese in the ferro-chromium ; and indeed we noticed that the undecomposed residue was lessened by this treatment.

A special determination was undertaken in order to ascertain the actual amount of ferro-chromium decomposed by the sodium and barium peroxides alone, and it was found that this amount did not exceed 42·69 per cent. in a ferro-chromium containing 65·84 per cent.

Having thus obtained somewhat unsatisfactory results with Saniter's method, we attempted to effect a complete decomposition of the ferro-chromium by a direct fusion with sodium peroxide alone.

The manner of procedure was as follows :—

About 0·5 grm. of a very finely-powdered ferro-chromium were mixed with 3 grm. of sodium peroxide and heated very gently, until the mass began to melt and then to glow by itself. The heating was then continued for 10 minutes, and after the mass was partially cooled 1 grm. of sodium peroxide was added and the heating continued for another five minutes.

The crucible, when still moderately warm, was placed in a suitable porcelain basin, which was then half filled with hot water and covered with a clock-glass. The melt easily dissolved in the hot water, the solution obtained being of a deep purple colour, due to sodium ferrate, which is abundantly formed during the fusion. The solution also contained sodium manganate, resulting from the oxidation of the manganese which is present in ferro-chromium.

To decompose both these salts a small quantity of sodium peroxide was added, on which the solution immediately lost its purple colour. The solution was then boiled for 10 minutes to decompose the excess of sodium peroxide and the insoluble residue of iron, nickel, and manganese oxide was filtered off. An excess of sulphuric acid was then added to the solution and after cooling it was titrated in the usual manner.

We give below the results of five determinations of a sample containing 29·40 per cent. of chromium : — I. 29·38 ; II. 29·35 ; III. 29·42 ; IV. 29·43 ; V. 29·42 per cent.

Another set of determinations of a ferro-chromium containing 65·84 per cent. gave the following results :—I. 65·84 ; II. 65·84 ; III. 65·80 ; IV. 65·88 ; V. 65·85 per cent.

A very small quantity of sodium peroxide (0·3—0·6) was found to be sufficient to decompose the sodium ferrate and manganate formed. The reaction in both cases is analogous, sodium ferrate being reduced to iron oxide and sodium manganate to manganese peroxide. These are two of the few cases in which sodium peroxide acts as a powerful reducing agent. The property of sodium peroxide to reduce manganese salts to manganese peroxide can be easily utilised for a quantitative determination of manganese in its solutions, as well as for its separation from other metallic oxides which are not reduced by sodium peroxide, and thus afford a means of determining the manganese in such compounds.

We find that Dr. Clark (Journ. Chem. Soc. 53, p. 1079) has already studied this reaction.

*The Determination of Chromium in Chrome Steel.*—A very detailed method has been worked out by J. Spüller and S. Kalman (this Journal, 12, pp. 867, 950) for the analysis of chrome ores and ferro-chromium, and the same method, with some suitable alterations, has been applied by them for the analysis of chrome steel. Their method is too lengthy to give here in detail. We will only state, in general terms, that, as regards the analysis of chrome steel, it consists in dissolving the chrome steel in sulphuric acid, evaporating the solution to dryness, and fusing the residue with a mixture of 4 parts sodium peroxide and 8 parts caustic soda. We have frequently had occasion to convince ourselves of the exactness of this method, which, however, is very laborious, and occupies a great deal of time. We have applied it with advantage in the case of high-percentage chrome steels, of which no more than 0·5 grm. is used for analysis, as the volume of sulphates obtained is then not too large to be conveniently fused. Thus, we have used this method for the analysis of a chrome steel containing (by Stead's method) as much as 2·101 per cent. of chromium, with the slight alteration that the sulphates were fused with sodium peroxide only.

The further treatment of the fusion was exactly the same as in the case of ferro-chromium. The results were as follows:—I. 2·099; II. 2·100 per cent.

In order to avoid a fusion several attempts were made by us to effect a direct oxidation by sodium peroxide of the chrome in a solution of chrome steel; but no results of any real value could be obtained.

We therefore regard Stead's modification of Galbraith's method (this Journal, 12, p. 712) as the best and shortest method yet devised for the determination of chromium in chrome steels. It is, of course, considerably simplified if the insoluble residue of the chrome steel be fused with sodium peroxide, as Mr. Saniter recommends.

We have also found that the fusion with sodium peroxide can be very advantageously employed for the decomposition of chromium phosphate as obtained in a method suggested by Dr. Clark (this Journal, p. 340), and also in the modification of it, the so-called hypo-acetic method of Mr. Stead (Iron and Steel Inst., 1893, I. p. 160).

A sample of chrome steel containing (by Stead's permanganate method) 0·915 per cent. of chromium gave after the hypo-acetic method, in which the chromium phosphate was fused with sodium peroxide:—I. 0·923; II. 0·924 per cent.

Another sample, containing 0·673 per cent., gave after the same method:—I. 0·674; II. 0·678 per cent.

We are therefore able to recommend this method as being exceedingly exact, though requiring a little more time than Stead's permanganate method.

Our experiments appear to show that sodium peroxide, if certain conditions be observed in its use, is a very valuable agent for the analysis of chrome ore, ferro-chromium, and chrome steel, as it removes the two main defects of former methods, viz., the necessity of repeated fusion to effect complete decomposition and the inconvenient slowness of these processes.

The conditions which should be observed may be summarized as follows:—

(1.) Great care should be taken to reduce the chrome ore or the ferro-chromium to an almost impalpable powder. This can be done without much difficulty if the ore or the alloy be crushed in a steel mortar until a powder is obtained which will pass through a linen bag. This powder is then ground in an agate mortar to the required degree of fineness, a little water being added to facilitate the grinding.

(2.) The water solution of the melt, before acidulation, must be freed from an excess of sodium peroxide. Whenever sodium ferrate or sodium manganate is formed during the fusion it must be decomposed in the water solution of the melt.

(3.) As the result of the analysis depends to a large extent upon the titration, and especially upon a clear perception of its final point, it is important that the solution in which the chrome is to be determined should be as free as possible from other metallic salts, as for instance, iron, manganese, and nickel salts. We have also observed that the ferricyanide solution which is used as an indicator is most satisfactory when it contains no more than 1 per cent. of ferricyanide.

The samples of ferro-chromium were kindly placed at our disposal by the Secretary of the Iron and Steel Institute, and for those of chrome steel we are indebted to the courtesy of Mr. Walter Macfarlane, of the Glengarnock Iron and Steel Company.

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SESSION 1895-96.

January 8th, 1896.—Mr. J. T. Conroy. "Some Experiments relating to the Manufacture of Cyanides."

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*Meeting held Wednesday, December 4th, 1895.*

THE PRESIDENT OF THE SOCIETY IN THE CHAIR.

The PRESIDENT expressed his thanks to the members of the Section for their hearty reception, and addressed them at some length, giving the impressions gained during his recent visit to the United States, and reviewing the condition of chemical and technical education generally in America.

He had been perusing the report on secondary education, and was somewhat disturbed to find the tendency to commit this important link in our educational system to local authorities, greatly accentuated. Of all matters, to his mind, this was not theirs, nor, judging by the proceedings of most local authorities, were they fitted to control it.

Prof. Austen, President of the New York Section of the American Chemical Society, said a little while ago "that investigation in technical chemistry was as difficult and quite as slow as investigation in pure science." Mr. Ludwig Mond, commenting thereon in a speech, said: "No doubt investigation in technical chemistry has its own difficulties. Certainly they are just as great as in any scientific investigation, but there is this immense difference—that investigation in science bears fruit in centuries to come. Few who devote their lives to pure science see the result of their labours or its practical value, but future generations derive the benefits, which are for all time. Every discovery of new truths is an increase of knowledge. Technical matters come and go, making room for improved methods; these improvements being the result of wider knowledge and closer application of scientific principle."

Education or training in "principles" must not remain the inadequate and perfunctory thing it at present too often is. In the report referred to a remark occurs (page 103) that "witnesses have frequently complained that technical instruction has been hindered or even made useless by a defective early training." This is particularly true of what is called "education in technical chemistry." Unhappily the word is understood in different senses; for instance, speaking of the Department of Science and Art, the report says (page 28, sec. 16): "In defining technical instruction, the department has kept in view the varying needs of different localities, and has been liberal rather than strict in its interpretations; for example, the following are a few among the subjects which it has sanctioned:—The principles of banking and financial science, book-keeping, the principles of commerce, singing and musical notation, instrumental and orchestral music, political economy, steam-ship, the science and art of teaching, veterinary science."

Again, the same report, on pages 135 and 136, sec. 40, in describing what secondary education comprehends, says: "All education is development and discipline of faculty by the communication of knowledge, and whether the faculty be the eye, or the hand, or the reason, or the imagination, and whether the knowledge be of nature, of art, of science or literature,—if the knowledge be so communicated as to evoke and exercise and discipline faculty, the process is rightly termed education. Secondary education may be described as a modification of this general idea. After quoting Plato's distinction between the arts and the crafts, the report says: "Every profession, even that of winning scholarships, is a craft, and all crafts are arts." But if secondary education be so conceived, it is evident that under it technical instruction is comprehended; technical instruction is secondary, *i.e.*, it comes after the education which has awakened the mind by teaching the rudiments or arts as the alphabet of all knowledge, and the better the whole of this alphabet has been mastered, the better and easier will be the later learning. And secondary instruction is technical—that is, it teaches the boy so to apply the principles he is learning, and so to learn the principles by applying them, or so to use the instrument he has been made to know, as to perform or produce something: interpret the literature of a science, make a picture or a book, practice a plastic or manual art, convince a jury, persuade a senate, translate or annotate an author, dye wool and weave cloth, design or construct a machine, navigate a ship, or command an army. Secondary education therefore, as inclusive of technical improvement, may be described as education conducted with the view of the special life that has to be lived with the express purpose of forming the person to live in it.

On page 285, sec. 77, the report further says: "Under the term technical, we include all such special preparation for mercantile business or for particular branches of the public service as it may be found possible to make." He was exceedingly sorry that these definitions had received some sort of official approval.

Among the subjects in which he had more poignant regret than any other was that fact of the limitation of his own early opportunity of acquiring a deep knowledge of the principles of chemical and physical science. Students as a rule only began to understand when they went into the work of life. He sincerely trusted, with the advantages of such institutions as those which existed in the localities of the Society's sections, young men would spend very much longer time in them than hitherto. In his opinion a chemist could not be turned out under five years. The sooner guardians, students, and professors accepted this the better.

In this connection he could scarcely do better than recommend a perusal of the discussion on technical education in chemistry which appeared in the Society's Journal in May 1889, and to which discussion the Liverpool Section had made by no means the least important contribution.

## THE VOLATILISATION OF SALTS DURING EVAPORATION.

BY G. H. BAILEY, D.SC., PH.D.

It is well known that many solid substances can be volatilised by steam, and the process of steam distillation is largely used in the preparation of organic compounds. It is further acknowledged that boric acid is carried off by steam although the normal boiling-point of boric acid must be very high. Similar observations have been made by Drown and Eldridge in the case of tin salts, and I have found that mercuric chloride, which vaporises under normal conditions at 307° C., is nevertheless carried over by steam in tolerable quantity. Yet Nernst asserts that there is no loss by volatilisation when the boiling-point of the substance dissolved lies about 130° C. above that of the solvent. Stas, in his researches on atomic weights, with that foresight which characterised all his work, contemplated the possibility of loss by volatilisation, and went even so far as to boil silver chloride and water and then test the condensed steam for the presence of silver. He found that no precipitate or coloration occurred when sulphuretted hydrogen was added to the liquid. And it is not surprising that, with a substance like silver chloride, such a result should have been attained. Had Stas, however, turned his attention to any of the alkaline chlorides, I think that the fact of volatilisation would not have escaped him.

It must be well known to manufacturers, especially to those concerned with the evaporation of common salt or salts of the alkalis, that somehow or other these bodies have the faculty of getting away from the liquor and depositing themselves in flues or over surfaces of walls in the neighbourhood of the boiling-pan. Whether anyone would be able to assert that such deposit is formed under circumstances which preclude such influences as mechanical spiriting during boiling or "creeping" of the salt is more than I can say. I have, however, found that, with the whole of the alkaline chlorides, viz., those of lithium, sodium, potassium, rubidium, cæsium, volatilisation takes place, even when the evaporation is so conducted that it is quite impossible to call in any of these mechanical agencies to assist.

A series of experiments was first performed by evaporating solutions of the alkaline chlorides in water-baths, in such a way that no visible ebullition took place at any time. After a quantity of water had been evaporated off, the amount of salt in the residue was determined by estimating the chloride with every possible care. A constant loss was found, varying between 2 or 3 mgrms. per litre of water evaporated in the case of lithium chloride, to about 12 mgrms. in the case of cæsium chloride, for normal solutions. The loss was apparently *proportionate* to the molecule weight, as calculated from the formulæ of these chlorides as ordinarily written. The method of experiment was, however, open to the objection that the estimations had to be made on so large a quantity of salt, and the differences measured were so small, that, even with extreme care, the results were likely to be affected by errors, and even the conclusion that volatilisation had taken place could hardly be said to have been sufficiently established. That volatilisation does actually occur is easily demonstrated by placing a sheet of filter-paper some inches above a basin, in which, say, potassium chloride solution is evaporating. After some little time dip the filter-paper in pure water and add a drop or two of nitrate of silver and nitric acid; a distinct turbidity will be observed.

In order to establish this conclusively and to determine, with some approach to accuracy, the amount of chlorides volatilised, I decided to conduct the evaporation so as to present as free a surface as possible, whilst at the same time condensing the steam given off and estimating the chlorides actually occurring in the condensate. A Meyer water bath, with the inverted funnel hood, answered this purpose admirably. About 80 per cent. of the steam was condensed, and assuming that the whole of the salts were entrapped in this, the amount of salts carried over by the steam, per litre of water evaporated, as shown in the following table. The strength of the solutions is stated in multiples, or sub-multiples, of the normal solution, *i.e.*, that containing the gramme-molecule per litre.

| —— | Strength of Solution. | Chloride in Condensate in Mgrms. |
|---|---|---|
| Lithium chloride ................ | 0·1 | 0·25 |
| " " ................ | 0·9 | 2·45 |
| Cæsium chloride................ | 0·21 | 2·40 |
| " " ................ | 1·70 | 18·86 |
| " " ................ | 3·20 | 43·50 |

The previous series of experiments had indicated that the volatility increased with the molecular weight, and in these experiments I therefore employed only the highest and lowest member of the series of alkaline chlorides.

It is clearly manifest that not only is cæsium chloride volatilised to a greater extent than lithium chloride, but it is further evident that the concentration of the solution is an important factor; indeed, it seems as though the amount of loss is proportional to the concentration. But, after all, this is only a loss of something like $\frac{1}{100}$ per cent. of the salt, and competition in the alkali trade is surely not quite so finely drawn that losses of $\frac{1}{100}$ per cent. are to be bothered about. It is, however, to be remembered that my earliest efforts have been rather in the direction of convincing myself that volatilisation does really occur, and that even under adverse conditions and with every facility for arriving at results, which are too low rather than too high, moreover, the solutions I used were usually very dilute.

But it is not this point of view that induced me to bring my observations before the Liverpool Section, but, rather than your section has always shown a very philosophical interest in the principles involved in chemical operations.

I shall therefore be glad, not only of any quotation of instances within your knowledge in which evidence seems to be presented of volatilisation occurring in such a way, but also of any light that may be thrown thereby on the nature of evaporation.

In considering such a matter, one turns naturally to the observations that have been made on the vapour pressures of solutions and a very complete series is to be found in a paper by Tammann (Wied. Ann. **24**, 523) embracing the whole of the alkaline chlorides and many other salts. It is found that, as a general rule, if salts are dissolved in water, the vapour tension of the solution is smaller than that of pure water, and this is ascribed to the restraining effect of the particles of salt, though what the precise significance of this expression is, is a mystery. Wüllner found this depression of vapour tension to be, for a given salt, proportional to the mass of the salt dissolved, and this is roughly true for such bodies as we have under consideration.

Tammann's results show, however, that the depression increases somewhat more rapidly than the concentration, about 2 per cent.

The depression of vapour tension at about 100° C. for normal solutions may be calculated from Tammann's tables, and we obtain—

| | | |
|---|---|---|
| for $LiCl$ | a depression of | 2·74 mm. |
| $NaCl$ | „ | 2·73 „ |
| $KCl$ | „ | 2·50 „ |
| $RbCl$ | „ | 2·66 „ |
| $CsCl$ | „ | 2·62 „ |

Bunsen has further found by exposing beads of these salts to the heat of a Bunsen burner, that the volatility is in direct proportion to the molecular weight.

As a first approximation therefore, it seems probable that there is an intimate relation between the vapour tension and the salts and the vapour pressures shown by solutions of the salts, and if we regard the phenomena of evaporation as allied to those of the distillation of miscible liquids we have the expression—

$$\frac{m}{m_1} = \frac{WP}{W_1P_1}$$

where $m$ and $m_1$ are the masses of the salt and the water in the distillate $W$ and $W_1$, the masses in the solution and $P$ and $P_1$, the vapour tensions of the salt and the water in the solution at 100° C. or thereabouts.

By the application of such a formula, the vapour tension of cæsium chloride at 100° C. would be about 0·06 mm. of mercury.

So far as the experiments with mercuric chloride have gone, the vapour tension of this body (boiling point 307° C.) is approximately 2·3 mm., when evaporated in ethereal solution. How far the result is affected by pressures in the surface film, which, according to Stefan (Wied. Ann. **29**, 655), amount, in the case of water, to over 20,000 atmospheres, or by osmotic pressure, which, for an aqueous solution of potassium chloride of normal strength, amounts to about 39 atmospheres, I do not propose to discuss until further series of experiments are completed. Moreover, Ramsay has recently shown grounds for assuming that liquid water is not composed of simple molecules, but of aggregates of about 3 molecules. In any case I hope it will be remembered that the object of this paper has been rather to point out that molecular weight and concentration affect vapour pressures of solutions relatively in a similar manner to that in which they affect the amount of salt volatilised.

# Manchester Section.

Rooms of the Chemical Club, Victoria Hotel.

*Chairman:* George E. Davis.
*Vice-Chairman:* Peter Hart.
*Committee:*

**G. H. Bailey.**
**R. Forbes Carpenter.**
**R. S. Dale.**
**C. Dreyfus.**
**H. Grimshaw.**
**J. M. Irving.**
M. J. Langdon.
**I. Levinstein.**
**W. H. Perkin, jun.**
**Sir H. E. Roscoe.**
E. Schunck.
W. Thomson.

*Hon. Local Secretary:*
**J. Carter Bell,**
**Bank House, The Cliff, Higher Broughton, Manchester.**

SESSION 1895–96.

Friday January 3rd, 1896:—
Dr. B. W. Gerland. "On some New Methods of Testing Gas."
Mr. Wilfred Irwin. "On the Influence of Temperature on the Illuminating Constituents of Coal Gas."

## *Meeting held Friday, December 6th, 1895.*

THE PRESIDENT OF THE SOCIETY IN THE CHAIR.

The Chairman, Mr. George Davis, introduced the President of the Society, remarking that his visits to Sections would do a great deal of good, by affording opportunities for learning the views of members.

The President, enlarging upon remarks made in other Sections, observed with regret the disposition to house scientific educational institutions in almost palatial buildings. What were most required, in his opinion, were complete equipments for science teaching and the best men as teachers, adequately remunerated so as to give undivided personal attention to the students. The more he thought over the subject he was confirmed in the opinion expressed by the majority of those who contributed to the discussion on Technical Education, reported in the Journal for May 1889. He was of opinion the instruction in the principles of science was not pointed enough, and he was more strongly of opinion that students did not remain long enough to get that grasp of principles by which alone progress could be made. Mr. Grimshaw said there in 1889, that he believed "the want of familiarity of the professors with the works was more startling than the ignorance of the manufacturer as to chemical theory." That simply confirmed the position he (the President) urged: "Educate your masters" and exact obedience from the workman. He strongly recommended a perusal of the discussion referred to, in view of the report of the Commission on Secondary Education. He did not wish to make any invidious remarks, but it was a fact that the "pass men," or rather "youngsters," from technical schools had failed to work satisfactorily. They imagined they were "chemists," and were not as a rule amenable to discipline like trained men, whose knowledge was discipline, or like intelligent workmen, who did as they were told. Again he emphasised it, in the broad sense: "Educate your masters." After some account of his impressions of men and things chemical in the States, the President thanked the Section for its courtesy and attention.

Dr. Lewkowitsch then read a paper on "Analysis of Fats," which will appear in a succeeding issue.

# Newcastle Section.

*Chairman:* G. T. France.
*Vice-Chairman:* Alf. Allhusen.

*Committee:*
P. P. Bedson.
T. W. Hogg.
T. W. Lovibond.
N. H. Martin.
W. Martyn.
John Morrison.
John Pattinson.
W. W. Proctor.
W. L. Rennoldson.
W. A. Rowell.
T. W. Stuart.
John Watson.

*Hon. Local Secretary and Treasurer:*
Saville Shaw, Durham College of Science, Newcastle-on-Tyne.

*Meeting held at the Durham College of Science, Newcastle-on-Tyne, Thursday, November 21st, 1895.*

MR. GEO. T. FRANCE IN THE CHAIR.

## NOTE ON THE ESTIMATION OF PHOSPHORUS IN IRON AND IRON ORES CONTAINING TITANIUM.

BY JOHN PATTINSON, F.I.C., AND DR. H. S. PATTINSON, F.I.C.

(*This Journal*, 1895, *page* 443.)

### Discussion.

Mr. T. W. Hogg said that he had made some experiments with pig-iron in order to ascertain how the presence of titanium in solution would affect the phosphorus determination under his own conditions of working. These conditions are such that the separation of the phospho-molybdate is rarely influenced by the presence of other substances. To the solution of 3·26 grms. of iron or steel 6 to 7 grms. of ammonium chloride are added, and the volume of molybdic acid solution used contains 3 grms. of molybdenum trioxide. The precipitation of the phospho-molybdate is quite complete in half an hour at a temperature of 60° C., or at 75° C. 10 minutes is sufficient. Ordinarily it is preferable to allow the solution to stand at the lower temperature for half an hour, and in the first set of experiments given below, the precipitate was filtered off at the end of this time with the results shown in Table I.

The effect of the titanic acid was quite unmistakable immediately after adding the molybdic acid solution. After filtering off the precipitates, the filtrates in all the experiments where titanic acid was present turned turbid, and in time deposited a further quantity of phospho-molybdate. The experiments were therefore repeated, but instead of filtering off after half an hour's standing, they were allowed to remain for four hours, when the precipitation seemed quite complete, and as will be seen from Table II., the results obtained are similar to the results which might have been arrived at in the absence of titanic acid.

*First Set of Experiments.*

| No. of Experiment. | Phospho-Molybdate obtained. | Equal to P. | $TiO_2$ present. |
|---|---|---|---|
| | Grms. | Per Cent. | Grms. |
| 1 | 0·090 | 0·045 | None |
| 2 | 0·080 | 0·040 | 0·005 |
| 3 | 0·060 | 0·030 | 0·010 |
| 4 | 0·044 | 0·022 | 0·015 |
| 5 | 0·040 | 0·020 | 0·020 |

Under the usual conditions wherein the precipitation is complete in 30 minutes.

3·26 grms. of pig-iron taken, and the volumes of solutions, temperatures, and salts present identical in each case, with the exception of titanic acid.

These were all filtered off at the end of 30 minutes from the time of adding the molybdic acid solution.

*Second Set of Experiments.*

| No. of Experiment. | Phospho-Molybdate obtained. | Equal to P. | $TiO_2$ present. |
|---|---|---|---|
| | Grms. | Per Cent. | Grms. |
| 1 | 0·090 | 0·045 | None |
| 2 | 0·089 | 0·044 | 0·005 |
| 3 | 0·094 | 0·047 | 0·010 |
| 4 | 0·088 | 0·044 | 0·015 |
| 5 | 0·086 | 0·043 | 0·020 |
| 6 | 0·090 | 0·045 | 0·020 |

These were all allowed to stand for four hours before filtering.

He (Mr. Hogg) would like to ask Messrs. Pattinson how long their solutions were allowed to stand before filtering, and whether after filtration any subsequent turbidity appeared in the filtrates.

The effect of titanic acid in solution in retarding the separation of the phospho-molybdate is most decided, even under the most advantageous conditions for counteracting its influence, and it may well be imagined that in certain cases it would prevent it altogether. Chemists will undoubtedly feel grateful to Messrs. Pattinson for having drawn attention to one more serious source of error in the determination of phosphorus by this method.

Mr. H. S. Pattinson, in reply to Mr. Hogg, said that under the conditions in which they had effected the precipitation of ammonium phospho-molybdate, after filtering off the precipitates, no further precipitation had occurred in the filtrates, such as Mr. Hogg had noticed. Perhaps the presence of the large quantity of ammonium chloride or the large excess of ammonium molybdate that Mr. Hogg used induced the gradual precipitation of the whole of the phosphoric acid present. The amount of ammonium molybdate that Mr. Hogg had used was more than twice as much as they would use. They had had mainly in view to point out how the presence of titanic acid in solution might cause an error in the estimation of phosphorus as it is usually carried out by the molybdate method in this country, and Mr. Hogg's experiments confirmed in a very satisfactory way the results of their own experiments, which showed that titanic acid in solution hindered to a very marked degree the formation of the precipitate of ammonium phospho-molybdate.

## A NOTE ON COLORIMETRY.

BY T. W. HOGG.

Notwithstanding the many forms of apparatus which have been devised for conducting the carbon colour-testing process with greater ease and certainty, the ordinary Eggertz tubes are still so largely used that the modification of them which I present to your notice to-night may recommend itself on account of the facility with which they can be used both for examining liquids endways, as well as for use in the ordinary way.

The necessity for the examination of certain liquids in greater depth than can be comfortably done in the ordinary Eggertz tubes, is in no case better shown than in the carbon colour-testing process. The depth of liquid looked through in the Eggertz tubes is so small that the operator has not much difficulty in rapidly adjusting the liquids in colour intensity to his satisfaction, whereas an observation of a greater depth of the liquids, adjusted in this way, would often show a considerable difference between them. As the Eggertz tubes do not allow of this being readily done, I have substituted a form somewhat greater in width, and the bottoms are made as perfectly flat as possible, so that the disturbing effect of the concentric rings seen in the round-ended tubes is reduced to a minimum. The tubes are graduated in millimetres, and as the tubes are made in pairs, of which each tube is exactly similar, the mm. graduations are taken as measures of volume. I had at first some difficulty in obtaining tubes perfectly flat at the end, and for many years have had to make them myself; the specimen tubes, however, which I have here, have been made by Messrs. Mawson and Swan, and, as will be seen, they leave very little to be desired.

Perhaps some apology is needed for bringing before your notice such a well-worn subject as colorimetry. I am certain, however, that those who have much colour-testing work to do, feel the need of something a little better than the Eggertz tubes, and do not want to be bothered with an apparently complicated piece of apparatus; and a somewhat lengthy experience enables me to state that these modified tubes, and a small mirror for reflecting skylight vertically up through them, will enable the operator to accomplish anything in the way of colorimetry much more quickly and with quite as much certainty as he could by any other method.

Without going into unnecessary detail, perhaps it may be of interest to give three typical examples showing how the results required may be best attained by means of these modified tubes. The first and simplest case, viz., that of determining the combined carbon in mild steels below 0·20 per cent., is conducted in the following manner:—The standard (0·20 grm.), containing 0·20 per cent. carbon, together with the several steels to be examined, are dissolved in 4 c.c. $HNO_3$, 1·2 sp. gr. After the usual heating in boiling water the tubes are cooled, and the standard is mixed with water, introduced into one of the graduated tubes, which should have a small rubber ring placed round it to prevent confusion, and then made up to the 200-mm. mark. The tube containing the steel to be examined is now taken and an unmeasured quantity of water added, and then this mixture is poured into the other graduated tube. The two tubes are then held together in the left hand, and, looking down through them upon the mirror, the standard liquid is poured out little by little into a reservoir tube until the two columns are equal in colour intensity, and when this is reached, the percentage of carbon is read straight from the tube, if the operator so wishes it, to the third place of decimals; there is not any calculation to be made, and it is surprising what a large number of mild steels can be compared in this way in half an hour. Neglecting intermediate steels, which can be almost as rapidly done by making up the standard, which is purposely selected a little higher, to some small multiple of the percentage; high carbon steels could be also done quite as certainly if it was not for the circumstance that as the colour intensity increases, there is an increasing want of sensitiveness to see slight differences, so that it becomes necessary to work to that intensity of colour which the operator finds most suitable to himself. In higher carbons therefore than 0·50 per cent. it expedites the operation if the standard is exactly this amount, or should it happen to be greater, say 0·57 per cent., after diluting to twice this number of millimetres, viz., 114, the 14 are poured out and the standard remaining is therefore always kept at 0·50 per cent. The higher carbon steel solution is now made up to the 200-mm. graduation, and, after the usual mixing, the portion of it equal to the 0·50 is found by carefully pouring out. By operating in this manner, the calculation necessary is simplified to the extent of *always* having to divide the portion of the 200-mm. equivalent to 0·50 per cent. into 100.

The third example has reference to the colorimetric method of determining chromium in chrome steel I described before this Society in 1891 (this Journal, Vol. X.). In this method advantage is taken of the fact that the tinctorial value of chromium in the form of a solution of the sulphate is so intense compared with that of iron under the same condition that the percentage of chromium may readily be found by comparing solutions in sulphuric acid of the chrome steel with a suitable standard, preferably of higher value than the steel being examined; however, as the calculation necessary for the correction due to the colour value of the iron itself is a somewhat troublesome one, the following formula for finding the correction to be made to any graduation when the standard is highest may be useful.

The solution of the chrome steel standard is made up to the 100-mm. graduation; the colour value of a similar quantity of pure iron is then ascertained in terms of this standard; let this value $= a$, then the correction to be applied for any observed graduation, $x$, equal to the steel under examination, is—

$$\frac{a}{100 - a}\,(100 - x)$$

*i.e.*,

$$\frac{(100 - x)\,a}{100 - a}$$

Of course these calculations are only required for preparing the table showing the equivalent of chromium represented by each mm. on the graduated tube, and afterwards the percentage of chromium is simply read from this. It is best to use a standard of about 3 per cent. chromium, and for such steels as approach this the correction may be neglected.

# DEPOSITS FOUND IN OLD WORKINGS AT DELAVAL BENWELL (NORTHUMBERLAND) AND TANFIELD LEA (DURHAM) COLLIERIES.

BY SAVILE SHAW.

### *Abstract.*

The author describes two deposits found in the above collieries by Mr. C. J. Murton and Mr. Norman Nisbet respectively. The workings in which they occur have been untouched for at least a century, and possibly date from a very much earlier period. For a long time these workings have been waterlogged, and have only recently been drained. The earlier workers left large pillars of coal to support the roof, and the deposits are found in the spaces left between the pillars, being surrounded in the case of the Benwell deposit by the underclay, which has "crept" up, whilst the Tanfield Lea deposit is found as a layer on the floor of the old workings.

From the appearances presented by both substances it is quite evident that they have been slowly deposited from still water, layers of hydrated ferric oxide intermingling with the white portions of the substance in each case.

Physically the two deposits are identical, though they differ somewhat in chemical composition. Freshly gathered they consist of pure white masses of the consistence of soft cheese, possessing a slight opalescence, drying readily in the air, shrinking considerably, and leaving opaque, white, very friable masses, breaking with conchoidal fracture, and strongly adherent to the tongue. The specific gravity was found to be 1·7. Before the blowpipe both substances are infusible, soluble in a borax bead, and leave pure blue infusible masses when heated after moistening with cobalt chloride. On heating they lose water, and at a red heat white fumes of sulphur trioxide are evolved.

The composition of the two air-dried deposits is as follows:—

| --- | Benwell. | Tanfield Lea. |
|---|---|---|
| | Per Cent. | Per Cent. |
| Silica | 12·12 | 8·9 |
| Alumina | 37·93 | 39·96 |
| Lime | 1·9 | 0·29 |
| Sulphuric anhydride | 5·3 | 11·61 |
| Water | 42·44 | 39·23 |
| | 99·69 | 99·99 |
| Loss at 100° C. | 27·0 | 21·4 |

The silica in both cases is wholly in combination, and the lime is not present as sulphate, as the substances are uniformly absolutely amorphous, and yield no calcium sulphate after prolonged digestion with water. The Benwell deposit absorbs a small amount of carbon dioxide on exposure to the air, pointing to the probability of the calcium being present as hydrated silicate. Water also does not dissolve out any aluminium sulphate, which must therefore be considered as present in part as insoluble basic sulphate, the remainder being in combination with the silica.

The author suggests that the following formulæ, which agree well with the results of the analyses given above, may be taken as representing the constitution of the two substances—

Benwell:—

$$\underbrace{[Al_2(SO_4)_3.2Al_2O_3.9H_2O]}_{\text{Aluminite.}}\underbrace{7[2Al_2O_3.SiO_2.9H_2O]2[CaO.SiO_2.18H_2O]}_{\text{Collyrite.}}$$

Tanfield Lea:—

$$[Al_2(SO_4)_3.2Al_2O_3.9H_2O]3[2Al_2O_3.SiO_2.12H_2O]$$

The mode of formation of the deposits can only be a matter of conjecture, but it seems probable, in the author's opinion, that water containing free sulphuric acid arising from the decomposition of pyrites has by long contact with the underclay dissolved a part of it, forming aluminium sulphate and disintegrating the silica. Subsequent decomposition would then give rise to the formation of basic sulphate and finely-divided alumina, which, combining with the silica, would form the collyrite portion of the deposits.

# Nottingham Section.

UNIVERSITY COLLEGE, NOTTINGHAM.

*Chairman:* F. J. R. Carulla.
*Vice-Chairman:* J. M. C. Paton.
*Committee:*

L. Archbutt.
F. Clowes.
J. B. Coleman.
H. Forth.
W. G. Johnston.
J. F. Kempson.
T. Mason.
J. O'Sullivan.
C. Taylor.
G. J. Ward.
R. Lloyd Whiteley.

*Treasurer:* S. J. Pentecost.

*Hon. Local Secretary:*
J. T. Wood, 29, Musters Road, West Bridgeford, Nottingham.

*Meeting held Wednesday, December 11th, 1895.*

THE PRESIDENT OF THE SOCIETY IN THE CHAIR.

Mr. F. J. R. Carulla, Chairman of the Section, said it was a great pleasure that his first public duty after opening the session should be to welcome the President of the Society in one of his visits to the sections. That such a proceeding must be beneficial was as certain as that a cemented wall was stronger than one built of loose stones; and a weak section might well profit, not only from the stimulus and encouragement thus afforded, but also from advice given by the President by his experience of the working of a stronger section.

## THE COMPOSITION OF THE LIMITING EXPLOSIVE MIXTURES OF COMBUSTIBLE GASES WITH AIR.

BY F. CLOWES, D.SC.

A series of experiments was made with mixtures in varying proportions of each combustible gas with air. A flame was brought into contact with each mixture, sometimes above and sometimes below, and it was noted whether the mixture burnt back independently of the external air. For each combustible gas there was thus obtained a lower percentage, below which the mixture would not burn independently, and a higher percentage, above which the gas burnt independently only when it was supplied with more air.

The limiting percentages was as follows:—For methane 5 and 13; for hydrogen, 5 and 72; for carbon monoxide 13 and 75; for ethylene, 4 and 22; for water-gas, 9 and 55; for coal-gas, 5 and 28.

It was also proved that many mixtures which were outside but close to the above limits, and which could not be fired from above, could be fired from below.

Hence it is inferred:—

1. That the limiting explosive mixtures for different combustible gases vary widely.

2. That methane shows the narrowest limits, hydrogen the widest limits.

3. That the risks of a mixture being fired explosively increases with the different gases in the following order:—Methane, ethylene, coal-gas, water-gas, carbon monoxide, hydrogen.

4. That the risk of explosion is greater when the mixture is kindled from below than when it is kindled from above.

### Discussion.

Prof. William Robinson wrote as follows:—Any experimental evidence which adds to our stock of knowledge as to the behaviour of explosive gaseous mixtures cannot fail to be of interest.

Probably the quantity of mixture dealt with may affect the results, so I have compared the figures recently obtained by Mr. Glover at the Yorkshire College, Leeds, and those obtained by other experimenters, with the results given in the paper, and I find they agree closely. The temperature and pressure of the mixture, as well as the method of firing it, will considerably affect the results, so that we cannot expect the explosive proportions obtained by various experimenters, working under different conditions, to be entirely concordant.

For instance, at any given temperature a large flame will ignite a larger mass of particles than a small flame, and so give the explosion a better start. If applied at the bottom layers of a gaseous mixture, as proved in the paper, the heated and burning gases rise and propagate the flame throughout the mixture more readily than when applied at the top.

Again, an electric spark gives the highest temperature, although exposing only a small surface, and electric-spark ignition is therefore applicable to mixtures under pressure; but an intermittent spark will not so readily fire a very dilute mixture below atmospheric pressure, because only comparatively few particles of combustible gas lie in the path of the spark. The nature and temperature of the containing vessels is also a factor which plays some part in the combustion.

If in a non-conductor, the heat will be retained in the gas and encourage the combustion, whereas a good conductor must take away some of the heat, however small, into the skin of the enclosure. In gas-engine practice, the cylinder walls play an important part in the combustion of the charge. A cylinder at a fairly high temperature gives more complete combustion than when kept quite cool by the water jacket. In the case of oil engines the petroleum vapour is sometimes fired automatically, without any ignition gear, simply by compression against the hot walls of the combustion chamber. In modern gas engines the surface of the combustion chamber exposed to the charge is reduced as much as possible to prevent loss of heat. Such action cannot appreciably affect the experiments carried out by the author in a glass vessel, and on a small scale, although it will undoubtedly come into play in experiments carried out on a large scale in iron cylinders.

It would also appear that excess of air, containing as it does the inert gases nitrogen and argon, retards the progress of combustion more than the burnt products from previous combustions.

Prof. F. Clowes stated—in reply to a suggestion by Mr. Archbutt that the *size* of the flame applied for kindling the mixture was a matter which influenced the result—that this was not of much importance in the firing of a *gaseous* mixture. The size of the flame largely influenced the kindling of inflammable dust disseminated throughout the air, a large flame being usually necessary for this purpose. The flame used in the experiments referred to in the paper, was of ample size to easily kindle even a sluggish gaseous mixture. The temperature of the mixture undoubtedly affected the ease of kindling.

Mr. Kempson and Mr. Ward asked whether the kindling of firedamp in colliery air was not affected by certain special conditions.

Prof. F. Clowes, in reply, referred to the remarkable lowering of the lower explosive proportion of firedamp (methane) when fine coal-dust was present with it in the air. It had been shown that air containing only 1 per cent. of firedamp could be kindled and caused to burn explosively when fine coal-dust in sufficient quantity was disseminated through it. This pointed to the necessity of using far more delicate methods of "gas-testing" in "dusty" mines than those commonly employed, which detected only 3 per cent. of firedamp. The hydrogen flame-test advocated was found to be by far the most delicate and accurate method for detecting and measuring minute proportions of combustible gas and vapour in the air. Many mixtures which would not fire under ordinary pressure would easily fire when they were placed under pressure increased to a sufficient extent.

In reply to an inquiry by Mr. J. T. Wood as to what were the explosive limits for benzoline and other combustible vapours when these were mixed with air, benzoline vapour was dealt with in Mr. Boverton Redwood's paper, which appeared in abstract in the Society's Journal, 1894, 1182. He hoped himself to determine the explosive limits for certain other combustible vapours.

The President asked Mr. Archbutt, as chemist to the Midland Railway, whether he had any experience of the explosiveness of ether under conditions similar to those mentioned by Dr. Clowes. He might say incidentally that in some respects gasoline, though a far more dangerous liquid, was more favoured than ether in respect of carriage by railway. He had recently been making some experiments on the pressure in commercial containers tested by certain inflammable liquids, and observed with surprise the comparatively small degree of pressure.

Mr. Archbutt observed that this was probably due to the solution of the residual air in the liquid.

In discussing this paper at the Chemical Society, Mr. B. H. Brough considered that it would be a valuable addition to Prof. Clowes' investigations if the action of other methods of firing had been tried. For it had to be remembered that colliery explosions were sometimes due to inflammation by sparks such as were produced by picks. Some interesting experiments had recently been made in the Moravian Ostrau coalfield in Austria with an apparatus for testing the liability of gaseous mixtures to inflammation in that way. A wheel was mounted on a vertical axis inside a casing, which was hermetically sealed and provided with a large removable cover. Definite proportions of gas were introduced and mixed with the air by revolving the wheel. An iron bar sliding through the casing was brought against the revolving wheel, and in case of an explosion the cover, which was secured by a chain, was blown off without further damage.

The President thanked the members for their cordial welcome. He also made some observations upon the need for personal supervision of students in these times by the professors of chemistry in their schools and colleges. In those American institutions he had visited the professors were in nearly all cases interested in or consultants to works, and a very direct result of this was the technical direction given to the students' work. Whether this was a good or bad thing was not for him to determine, but one thing was certain, that unless the principles of the science of chemistry and chemical physics were clearly imparted and demonstrated to, and equally thoroughly understood by, the students, disappointment, unfitness, and failure in competition with others would result. He described some technical laboratories he had seen, and particularly referred to that of the Bethlehem Iron Works in the Lehigh Valley, in Pennsylvania, U.S.A., where 2,444 analyses were made in a week, among which were:—Carbon (by combustion), 60; carbon by colour test, 976; manganese (Williams' method), 192; manganese (Solvay's method), 339; phosphorus, 210; silicon, 289; copper, 96; nickel, 40; silica in ores, &c., 36; iron in ores, 48; mixtures, 28.

The rapidity of the methods employed did not appear to vitiate the results, which Mr. A. L. Colby, the director of the laboratory, stated were made by 18 persons, including the lad who collected samples, and any labour required in drilling, crushing, and preparing the samples for analysis. Carbon was estimated in 12 minutes, manganese in 10, and phosphorus and silicon in half an hour each.

Proof of the Accuracy of Rapid Methods.

| Carbon. | | Manganese. | | Phosphorus. | | Silicon. | |
|---|---|---|---|---|---|---|---|
| Grav. | Colour. | William's. | Deshay's | Grav. | Vol. | HCl. | $HNO_3$ and $H_2SO_4$ (Drown's Method) |
| 1·038 | 1·03 | 0·18 | 0·19 | 0·091 | 0·092 | 1·69 | 1·70 |
| 1·039 | 1·01 | 0·53 | 0·55 | 0·095 | 0·091 | 1·45 | 1·42 |
| 0·558 | 0·56 | 0·29 | 0·30 | 0·077 | 0·076 | 1·39 | 1·40 |
| 0·235 | 0·23 | 0·58 | 0·59 | 0·028 | 0·028 | 2·57 | 2·58 |
| 0·771 | 0·77 | 0·78 | 0·78 | 0·113 | 0 114 | 2·96 | 2·93 |
| 0·997 | 0·99 | 0·90 | 0·90 | 0·060 | 0·059 | 3·58 | 3·54 |
| 0·211 | 0·21 | 0·86 | 0·85 | 0·912 | 0·915 | 2·19 | 2·18 |
| 1·044 | 1·02 | 1·22 | 1·22 | 0·041 | 0·040 | 2·74 | 2·70 |
| 1·010 | 1·00 | 1·30 | 1·30 | 6·603 | 0·599 | 2·99 | 3·03 |
| 0·719 | 0·73 | 1·37 | 1·36 | 0·423 | 0·421 | 4·57 | 4·55 |
| 0·664 | 0·64 | 1·32 | 1·34 | 0·102 | 0·101 | 3·97 | 4·00 |
| 0·527 | 0·53 | 1·01 | 1·03 | 0·281 | 0·280 | 0·57 | 0·55 |

After some extended remarks upon the importance of the phase through which education seems to be passing, he expressed grave fears that there was and would be considerable waste of force, time, and money, in the overlapping of institutions, referring more particularly to the Birmingham Technical Schools about to be opened.

# Yorkshire Section.

*Chairman:* C. F. Tetley.
*Vice-Chairman:* J. J. Hummel.
*Committee:*
H. E. Aykroyd.
J. E. Bedford.
F. W. Branson.
T. Fairley.
N. Farrant.
A. Hess.
W. Leach.
W. McD. Mackey.
A. G. Perkin.
C. Rawson.
Geo. Ward.
Thorp Whitaker.
*Hon. Local Secretary and Treasurer:*
H. R. Procter, Yorkshire College, Leeds.

SESSION 1895–96.

January 27th:—
Messrs. F. W. Richardson, F.C.S., and H. E. Aykroyd. "On Sulphides, Sulphites, Thiosulphates, and Sulphates, their Estimation in Presence of each other."
By the same Authors. "On Cachou de Laval."
Mr. W. McD. Mackey will exhibit Improved Apparatus for determining the Spontaneous Inflammability of Oils.

*Meeting held at the Yorkshire College, Leeds, on Monday, December 2nd, 1895.*

MR. J. E. BEDFORD IN THE CHAIR.

## NOTE ON THE SALINE EARTH USED IN CURING HIDES IN INDIA.

BY H. R. PROCTER, F.I.C., AND WALTER TOWSE.

A large number of the hides of the small native cattle of India are imported into this country in a dried or dry-salted condition. These which are simply dried are usually called "arsenic kips," and at one time an alkaline solution of arsenious acids was employed in their preparation as an antiseptic, and to prevent the attacks of insects; but now seems to have gone out of use, none of the so-called arsenic kips examined by the writers having shown any traces of arsenic.

Dry-salted, or as they are commonly called "plaster cures," such as those of Dacca and Mehapore, are thickly coated with a white material, which in the first instance is simply the insoluble portion of a saline earth used in the cure; though in many cases it is applied in larger quantities than necessary, with the simple object of giving weight. The salting is thus described by Mr. W. G. Evans, who some years since had considerable experience as a tanner at Cawnpore.

"The salt used by the natives is a salt-earth; and is so called by them. It is found extensively in the districts of Cawnpore, Agra, Delhi, Lucknow, Patna, &c., and has no doubt, something to do with the localisation of the hide-curing and kindred industries in these places. The mode of procedure used is pretty much as follows: 'The salt-earth is mixed into a very thin paste, and this is lightly brushed on to the flesh side one day, and the hide allowed to remain over night under cover. Next day for best hides, the same solution is again spread on the flesh side of the outstretched hide, and rubbed into it with a porous brick, and then for legitimate salting, the hide is allowed to dry under cover. If for export, the saltings may be three or four, and the hides are treated out in the open, subject to the intense heat of the sun; which accounts for the number of hides which go back in the soaks in England and elsewhere.'

"We had a clause in our agreement with hide-factors, that any hides which did not come down to natural suppleness in two days in clean water were to be returned. Of arsenic curing I know nothing, and it is not so much in vogue as formerly. There is quite a trade in Cawnpore, Lucknow, Allahabad, &c., in treating old and inferior hides with new for export, and great efforts are made by native holders to get their stocks down before the rains commence, as they say, and rightly I think, that hides are not worth so much after the rains by 30 per cent. The peculiar latent moisture of the rains affects them very detrimentally."

Under certain circumstances this mode of cure gives rise to extensive iron-staining of the skins, and analyses were undertaken of the material scraped off Dacca and Mehapore kips with a view to elucidating the causes of this injury, and the results seemed sufficiently interesting to form the foundation of a note for the Society of Chemical Industry. The following are the results of the analyses referred to, which were made upon the residue after the rather considerable quantity of fibrous organic-matter, which had been scraped off with the cure, had been destroyed by ignition, together no doubt with traces of ammoniacal salts.

| — — | Dacca. Entire Cure. | Mehapore. Entire Cure. |
|---|---|---|
| Sand and silica | 20·55 | 27·38 |
| $Fe_2O_3$ | 2·77 | 1·86 |
| $Al_2O_3$ | 2·48 | 2·74 |
| $Mn_3O_4$ | 0·60 | 0·40 |
| CaO | 2·60 | 3·70 |
| MgO | 3·38 | 3·69 |
| $Na_2O$ | 28·97 | 26·80 |
| $SO_3$ | 38·90 | 33·75 |
| Cl | 0·22 | 0·18 |
| $H_3PO_4$ and $CO_2$ | Traces | Traces |
|  | 100·47 | 100·50 |

The soluble matter salts of the Dacca cure were also analysed separately with the following result:—

|  |  |
|---|---|
| Ca | 0·50 |
| Mg | 0·36 |
| Na | 21·50 |
| $SO_4$ | 45·50 |
| Cl | 0·22 |
| Insoluble | 32·12 |
|  | 100·20 |

thus consisting exclusively of sulphates, with the exception of a trace of chloride. The cures, after ignition, were both neutral to phenolphthalein, but before ignition the Dacca was distinctly alkaline, and both showed considerably larger traces of carbonates before than after.

The most striking feature of these analyses is the absence of more than the smallest traces of chlorides. The cures are thus practically free from common salt, and owe their antiseptic power to the sodium sulphate which they contain, and which indeed forms their principal constituent. Nitrates appear to be entirely absent.

The iron staining of hides which has been mentioned appears to result only when the hides in cure are exposed for a lengthened period to a moist atmosphere, and probably the carbonic acid present also plays its part, the iron passing into solution as hydric carbonate.

The analyses show a striking resemblance to those of the soda deposits of Wyoming, given by Dr. Attfield in a recent paper published in this Journal, 1895, p. 4, except that their percentage of sodium carbonate is smaller, which is quite intelligible in the light of Mr. Brunner's abstract on the "Probable origin of natural deposits of sodium carbonate" (this Journal, 1893, 116), which supports the view that the sodium carbonate is derived from sodium sulphate by the reducing and carbonating action of low organisms.

### DISCUSSION.

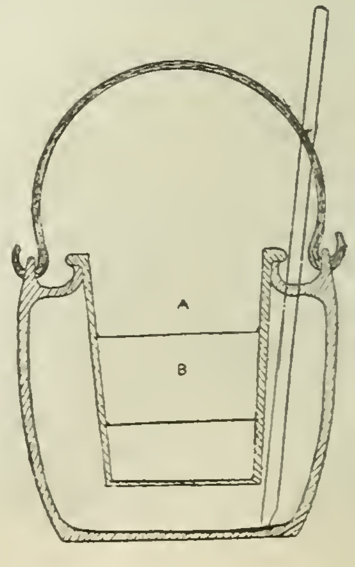
The CHAIRMAN asked whether it was commonly known that sodium sulphate possessed antiseptic properties. He would have thought that borax would have been used.

Mr. H. R. PROCTER replied that sodium sulphate possessed considerable antiseptic power, though not a true "disinfectant"; and that it had been used in Austria and some parts of Germany for preserving hides in place of common salt. Borax was only a weak antiseptic unless used in considerable quantity, and was too costly for salting hides.

## NOTE ON A METHOD OF SUBLIMING ALIZARINE.

BY A. G. PERKIN, F.R.S.E.

CRYSTALS of alizarine, obtained either by crystallisation from solvents or sublimation in the ordinary way between watch glasses, are of small size, and possess no particular beauty. During one of the London exhibitions a continental firm showed crystals of this substance, which, so far as I am aware of, were larger in size than any before exhibited, but beyond the fact that these were produced by sublimation, no details were given of their method of preparation. It is well known that very large crystals of anthra-quinone can be obtained by heating this substance above its melting point in large, closed, iron vessels, and though this method might be also applicable with alizarine, its more expensive nature and the fact that a great portion of it is destroyed during this operation, is sufficient to forbid its use.



It being necessary at one time to prepare a similar sample of alizarine to that above referred to, after numerous experiments the following method was devised, and as this, with or without modification, has been found useful for the sublimation of other substances, it appeared to me that an account of the same might be serviceable to others.

Into the inner vessel of a large glue pot (about 18 ins. diameter) a layer of powdered, dried, alizarine paste was introduced, and about 2 ins. above this there was erected a tray or circular disc of filter paper of the same diameter as the pot. This latter, which was preferably of the grey kind, was pierced with numerous small holes, and was supported by tripods, formed by bending the wire arms of pipeclay triangles to right angles. About the same height above this first tray, a second, and similar one, was erected, and the mouth of the whole vessel was closed by means of an iron disc resting upon filter-paper. The outer jacket being now nearly filled with paraffin wax, and a thermometer introduced, the apparatus was heated to 280° C. for 18 hours, and then allowed to cool.

Examination of the contents showed that whereas the top tray A contained but fine flocculent crystals, in the second tray B there was present some quantity of crystals of comparatively large size and considerable beauty. These were best removed by means of forceps from the small quantity of flocculent matter also present.

Some inconvenience was apt to be caused owing to the natural brittleness of the paper trays after the operation, but with a little practice it was found possible to remove these without fracture. To overcome the difficulty, asbestos paper suggested itself, but singularly enough the quality and the quantity of the crystals deteriorated when this was used.

### Discussion.

In reply to a question by Mr. C. Rawson, the author said that he secured a sufficiently constant temperature in his apparatus by using a Fletcher burner of such a size that with the gas full on the thermometer did not rise above 280°. In reply to Mr. H. R. Procter he said that he did not think that sublimation *in vacuô* would increase the yield of crystals, as the loss was probably more due to condensation than to oxidation. Slow sublimation was necessary for the formation of good crystals. In reply to Prof. A. Smithells he remarked that it seemed to be of importance to deposit the crystals at a temperature just below their melting point. He exhibited a beautiful specimen of crystallised alizarine, and said that the size of the crystals seemed to be in some measure proportional to the size of the apparatus used.

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## ON THE CAUSE OF THE CHANGE IN COLOUR OF SOAPS CONTAINING INDIGO EXTRACT.

BY JAMES PROUDE AND W. H. WOOD, F.I.C., F.C.S.

Indigo extract is commonly added to soaps, especially soft soaps, to give them a green tint, "this tint being natural to hemp-seed oil, and, therefore, artificially imitated in other cases" (Alder Wright, "Oils, Fats, Waxes, &c.," p. 459). One of us having found that the green tint is not permanent, but that both soft and hard soaps* so treated gradually lose the colour from the surface inwards, we have made experiments to determine the cause of the change.

It was found that soft soap tinted with neutral extract of indigo lost its colour equally well in light and in darkness. Exposed in a tube open at both ends, the colour disappeared at the same rate from each surface. The colour, therefore, did not subside, but was destroyed by the action of the air. No substance could be extracted by ether from the untinted soap which would discharge the blue colour of the indigo-extract solution.

Passing on to the oils employed in making the soap, viz., cotton-seed, linseed, and olive, each was found capable of discharging the blue colour of the extract by shaking with it, and distilled water used for washing the cotton-seed oil, and then filtered through a dry filter, had the same effect.

Substituting powdered commercial indigo for the extract solution, each of the oils named dissolved some of the colour on warming on a water-bath, forming blue and yellow-green solutions. On exposure to air the indigo was gradually bleached, and more quickly on warming. The fatty acids from the soap acted in the same way as the oils.

Solutions of the indigo in phenol and turpentine were tried for comparison. The phenol solution was unchanged on exposure to air and warming and shaking with water, while the turpentine solution was gradually decolorised. Turpentine is known to oxidise by contact with air, and this no doubt causes oxidation of the indigo. Probably soaps and oils act similarly, the colour being destroyed by oxidation, and not by reduction.

Pure indigotin gave a greenish-purple solution at 115° C. in cotton-seed oil. The colour was discharged even when sealed up in a tube after bubbling dry hydrogen through it for 15 minutes.

Further proof that oxygen was concerned in the change was shown by heating similar solutions to the above with oxygen and air respectively, the pure oxygen bleaching the indigo more quickly than the air.

We conclude, therefore, that soaps containing indigo extract, and oils containing indigo, destroy the indigo extract and indigo respectively by oxidation, and that the substance in the soap or oil which causes the oxidation is either a natural constituent of the soap or oil, or is formed by exposure to air before, or during, the action on the colour.

### Discussion.

In answer to a question by the Chairman, Mr. W. H. Wood said that the colour of indigo dissolved in olive oil disappeared in about 10 days, in cotton-seed oil in about a fortnight, and in a somewhat longer time with linseed oil.

Prof. Smithells inquired if the authors had tested directly for hydrogen peroxide. Some of the circumstances described seemed to suggest the presence of this substance, which is believed to be formed during many processes of slow oxidation.

Mr. C. Rawson pointed out that weak solutions, even of pure indigo sulphate in distilled water, lose their colour rapidly when exposed to light and air. Green soaps artificially coloured rapidly became of a yellow or brownish-yellow colour when heated to 100°—110° C., whereas green olive-oil soap merely become somewhat paler in tint. He thought that it was hardly surprising that solutions of indigo in oils were gradually decolorised, as the solubility of indigo in oils was so very small.

The Chairman thought that the disappearance of the colour might be due to the combination of the indigo with free fatty acid in the oil.

Mr. W. H. Wood replied that the samples of cotton-seed oil used were practically free from free fatty acids.

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## ON THE SOLUBILITY OF INDIGO IN OILS.

BY JAMES PROUDE AND W. H. WOOD, F.I.C., F.C.S.

The solubility of indigo in oils shown incidentally in the previous paper does not seem to have been much investigated. Watts' Dictionary (original edition) says "fixed oils heated above 100° C. dissolve small quantities, and deposit it again on cooling" (Vol. 3, p. 253).

We have found that cotton-seed oil commences to dissolve commercial indigo at 45° C., the colour of solution at 94°

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* Some foreign soaps with this fugitive green tint are to be found in the market as *olive-oil soaps*, though in some cases as much as 75 per cent. of the oil they contain has not been derived from olive oil.

being purple while hot, and dark yellow-green when cold. Pure indigotin was not acted on below 84° C.; colour purplish at 94°, and yellow-green when cold.

Raw linseed oil begins to act on the indigotin at about 90°; at 94° colour is opaque purple, becoming dark yellow-green when cold.

Olive oil begins to act on indigotin at 20° C.; at 94° the solution is blue, and greenish-blue when cold.

Indigo-red in commercial indigo probably influences solubility of indigo-blue in oils, as it does in cold alcohol, colour being darker than with indigotin.

Filtered solutions exposed to air lost their colour, which was not restored on warming. The indigo had, therefore, been destroyed by the action of the oil, and oxygen was shown to quicken the change.

Rough attempts at determination of solubility at about 115° C. showed that 0·0305 to 0·0328 per cent. of indigotin were dissolved by different samples of cotton-seed oil.

Indigo, therefore, dissolves in oils—cotton-seed, linseed, and olive—below 100° C., and from such solutions the indigo does not separate on cooling, but is destroyed by oxidation.

### Discussion.

The Chairman said that it would be very desirable to find some substitute for indigo for colouring soaps, and suggested that blue-orchil, which is very permanent in presence of alkalis, might be tried.

Mr. W. H. Wood said that solid colouring matters, such as ultramarine or powdered indigo, could not be used, as they separated out by subsidence before the soap set. He added that chlorophyl was now frequently used, and appeared to be the most satisfactory colour at present to be obtained.

# Scottish Section.

*Chairman:* John Clark.
*Vice-Chairman:* J. B. Readman.
*Committee:*

G. Beilby.
R. Cox.
J. Gray.
D. Harris.
G. G. Henderson.
W. I. Macadam.
J. S. Macarthur.
A. Macdonald.
R. C. Menzies.
E. Ostlere.
T. L. Patterson.
Sir R. Pullar.
H. Rose.
P. Rottenburg.
E. C. C. Stanford.
D. R. Steuart.

*Hon. Secretary and Treasurer:*
J. Stanley Muir, Chemical Laboratory, The University, Glasgow.

*Meeting held in the Philosophical Institution, Edinburgh, on Tuesday, December 3rd, 1895.*

DR. JOHN CLARK IN THE CHAIR.

## DESTRUCTIVE DISTILLATION.

BY R. TERVET, F.C.S.

The following brief note may be considered as the outcome of experiments suggested by Dr. Mills' paper, read before this Section (this Journal, Vol. IV., page 325). The experiments were made on coal and shale, and were undertaken to ascertain whether the hydrocarbons existing in purified coal-gas always possessed the same properties and composition, and, if possible, to give some qualitative and quantitative expression to their value; or whether they varied with the varying quality of the coal or temperature employed.

From the very earliest stages at which true resolution takes place in the destructive distillation of coal, gas is a constituent of the distillate. To facilitate the investigation of this point, a regular plan was adopted to give arrangement to the fractions of the gaseous distillate. These fractions were examined with care, and their character noted.

Had this been more closely studied on the line indicated, many of the perplexing opinions anent the nature of these hydrocarbons would have been avoided in accounting for the part they play in the composition of coal-gas.

Both high and low temperature distillates are extremely complex in composition. It is well known that the purified paraffin product from shale is derived from a very mixed distillate. But it would appear that, no matter to what extent shale may vary in quality, or the crude distillate in the relative proportions of its components, there is a "definite character" stamped on the properties of the several constituents by which distillates from widely different shales may be compared. Thus, the distillates from two or more shales may be very different as regards the relative proportion of liquids and solids, but, by the ordinary methods of fractionating and liquation, these are further separated, and the resulting record arranged according to per cent., specific gravity, melting-point, and bromine absorption, &c.

If this criterion be accepted as a method of investigating a liquid distillate, it is rendered probable that if applied to a gaseous one, the information it will afford would not be less trustworthy. Besides, the stability of the products resulting from high temperatures, and their extreme dilatability, make examination comparatively easy.

The purpose of this notice is to draw attention to what appears to be the definite character of the process, so far as it relates to the manufacture of coal-gas. To illustrate this point, I have chosen a tabulated list of commercial analyses of coal, cannel, shale, and other illuminating-gas-producing substances, embracing nearly every variety used for this purpose. They are 182 in number, and the results range thus:—

Table No. I.

Summary of Analyses of Gas Coals made by G. F. Cusiter, F.R.S.S.A., Engineer, Dalkeith Gas Works.*

| No. | Durability 5° Flame = D. | Condensation by Bromide = B. | Illuminating Power in Candles. | D − 30. | $\frac{D-30}{B}$. |
|---|---|---|---|---|---|
| 4 | 84·07 | 24·35 | 42·81 | 54·07 | 2·22 |
| 5 | 77·02 | 20·51 | 39·23 | 47·02 | 2·29 |
| 8 | 70·87 | 17·94 | 37·59 | 40·87 | 2·27 |
| 9 | 68·11 | 16·85 | 35·13 | 38·11 | 2·26 |
| 4 | 67·12 | 17·00 | 34·69 | 37·12 | 2·18 |
| 6 | 66·38 | 16·06 | 33·89 | 36·38 | 2·26 |
| 8 | 65·36 | 15·69 | 32·85 | 35·36 | 2·25 |
| 1 | 64·83 | 16·00 | 32·86 | 34·83 | 2·17 |
| 7 | 63·01 | 14·49 | 32·35 | 33·01 | 2·27 |
| 5 | 61·59 | 13·88 | 31·64 | 31·59 | 2·27 |
| 8 | 60·50 | 13·14 | 30·77 | 30·50 | 2·32 |
| 4 | 59·28 | 12·20 | 29·37 | 29·28 | 2·40 |
| 8 | 58·65 | 11·90 | 28·43 | 28·65 | 2·40 |
| 4 | 57·38 | 11·63 | 27·72 | 27·38 | 2·35 |
| 5 | 56·65 | 11·48 | 27·43 | 26·65 | 2·32 |
| 3 | 55·29 | 11·30 | 26·77 | 25·29 | 2·24 |
| 11 | 54·44 | 10·24 | 26·07 | 24·44 | 2·38 |
| 8 | 53·48 | 10·02 | 25·02 | 23·48 | 2·34 |
| 5 | 52·59 | 9·94 | 24·96 | 22·59 | 2·27 |
| 8 | 51·53 | 9·44 | 23·74 | 21·53 | 2·17 |
| 5 | 50·25 | 8·96 | 22·80 | 20·25 | 2·26 |
| 9 | 49·53 | 8·05 | 20·66 | 19·53 | 2·42 |
| 8 | 48·55 | 7·44 | 20·76 | 18·55 | 2·49 |
| 4 | 47·69 | 7·30 | 19·31 | 17·69 | 2·57 |
| 1 | 46·16 | 7·20 | 19·60 | 16·16 | 2·24 |
| 6 | 45·36 | 6·16 | 17·10 | 15·36 | 2·49 |
| 2 | 44·58 | 5·50 | 16·18 | 14·53 | 2·65 |
| 1 | 44·33 | 5·00 | 16·75 | 14·33 | 2·86 |
| 8 | 43·62 | 5·51 | 15·40 | 13·62 | 2·43 |
| 3 | 42·83 | 5·47 | 15·58 | 12·83 | 2·34 |
| 9 | 41·32 | 4·74 | 14·29 | 11·32 | 2·38 |
| 1 | 40·65 | 4·20 | 13·75 | 10·65 | 2·53 |
| 3 | 38·88 | 4·26 | 13·16 | 8·88 | 2·11 |

$$\text{Average of } \frac{D-30}{B} = 2{\cdot}34.$$

These analyses were made many years ago by Mr. G. F. Cusiter, engineer of the Dalkeith Gas Works, and were arranged in the order of their durability by Mr. William

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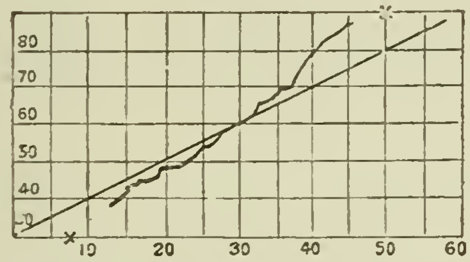
* Proceedings, West of Scotland Association of Gas Managers.

Young, the durability test being the time expressed in minutes required to burn 1 cb. ft. with a jet flame 5 in. long.

They embody three important determinations, viz., condensation of the unsaturated hydrocarbons by bromine, the durability, and the illuminating power. The determination of the first two we may for the present regard as absolute, while the third may be taken as comparative to a standard. Yet they constitute three equations, which, if Mills' theory be correct, must be consistent and compatible with each other so far as we can expect commercial analyses to be.

To distinguish between theory and observation, I have delineated the illuminating power in terms of durability by a curve, No. 1, where the abscissa is the illuminating power and the ordinates durability. It is found to take an erratic course, leaving the impression that there exists no definite relationship between the two quantities. Indeed, it will be seen that from about 30 candles the curve takes a course of contrary flexture, which makes it somewhat troublesome to deal with.

No. 1.



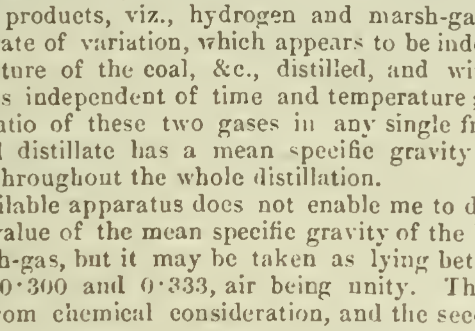
Being guided by experiment in the manufacture of coal-gas on a small scale, I am led to believe that the ultimate resolution products, viz., hydrogen and marsh-gas, have a constant rate of variation, which appears to be independent of the nature of the coal, &c., distilled, and within very wide limits independent of time and temperature; further, that the ratio of these two gases in any single fraction of the mixed distillate has a mean specific gravity which is constant throughout the whole distillation.

My available apparatus does not enable me to decide the accurate value of the mean specific gravity of the hydrogen and marsh-gas, but it may be taken as lying between the limits of 0·300 and 0·333, air being unity. The first is derived from chemical consideration, and the second from physical.

From a number of determinations I adopted 0·30 as a first approximation to the mean specific gravity of these residual gases. Regarding 0·30 for the present as an empirical constant affecting the properties of illuminating gases, I proceeded to deduct this quantity from the durability of the individual gases as tabulated by Mr. W. Young, which gave me a new number approaching as near as possible to the observed illuminating power.

I have drawn the course of this approximate curve, *i.e.*, straight line, over the observed illuminating power, and designated it absolute illuminating power; the reason to be shown presently. It will be seen that the point of greatest departure from the observed is at the upper extremity, where the illuminating power passes the range of reliable photometry; while, at the other extremity, the greater efficiency of the burner, and the marked assistance of the saturated hydrocarbons coming into play, increase the illuminating power beyond that due to the unsaturated hydrocarbons alone. Further, it will be seen that this line intersects the observed illuminating power at a point of 30 candles. Photometric determinations are, however, of little value in an investigation of this character, and I have only made use of them as a connection leading to the other determinations.

No. 2.



The disorder of observed illuminating power, as exhibited on both sides of the absolute, must certainly arise from the variable efficiency with which gases of different richness can be burnt.

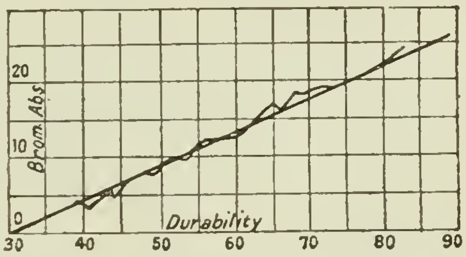
The most important point, however, is the appearance of a constant derived from the following equation:—

$$\frac{D-30}{B} = C,$$

where D = durability, 30 empirical constant, and B bromine absorption. The application of this rule leaves no doubt with respect to the certainty of the results of Mr. Cusiter's analyses, and it furnishes a general and complete solution to the problem of "definite character" in the process of destructive distillation as proposed by Mills.

Treating each individual gas in this manner, we obtain a line at right angles to the durability and parallel with the empirical constant 0·30, while the line derived from D – 30 occupies the position it should do, viz., that of absolute illuminating power. This will be easily traced out by comparing diagrams Nos. 2 and 3, and their relation to No. 1.

No. 3.



With regard to the curve of experiments and $\frac{D-30}{B}$ (No. 3), we could wish that this had been a little more regular, but the irregularity is certainly due to the presence of CO, and possibly to the hydrocarbons of the $C_nH_{2n+2}$ series, which are so much heavier than hydrogen and marsh-gas. It will therefore be understood that the whole burden of these heavy gases is thrown on the empirical constant, which tends to vitiate its true value. Besides, the same empirical constant is applied alike to gases derived from coal, cannel, shale, the oxygen equivalent of which varies to a very considerable degree.

I need express no regret that the investigation of this relationship, founded on commercial analyses, does not possess all the rigour we could wish; neither does it touch the quantity of accompanying phenomena in destructive distillation; but I think the demonstration given is sufficient to show that, in whatever manner we may have the final expression of the law of "definite character" as applied to the whole distillate, we may, by the aid of such reciprocal formula, be able to investigate the properties of the gaseous fraction.

There are two other factors made use of by the gas manufacturer, viz., "carbon density" and "carbon efficiency." Whatever value may be attached to these numbers in their general application to coal-gas, there is one point which cannot be ignored—that is, the residual illuminating power of the unabsorbable gases, and in this connection it may be noted that the mean of the *observed illuminating power* in relation to durability and bromine absorption, is a line through the 2 *x* on diagrams Nos. 1 and 2. At 7·5 candles there should be no bromine absorption. Mr. L. T. Wright has determined the illuminating value of the unabsorbable hydrocarbons, and average is 6·51 candles (Jour. Gas Lighting, page 194, February 3, 1885).

From the preceding observations, it is evident that there is another physical element belonging to coal-gas, which must be closely related to the quantities we have just considered, viz., the specific gravity of the gas. Unfortunately, with the data before us, the accuracy with which the problem can be approached is vitiated, not only by the variable proportions of CO, but also by the fact that in gases of high bromine absorption the hydrocarbons are not actually in the gaseous state. This latter not only affects the specific gravity, but also the illuminating power. Hence the wide disparity between observed and absolute illuminating power, as shown on the diagram. Without making these restrictions, the problem would be too complicated to admit of solution, and would require to be determined by experiment for each individual gas. But it is evident that if the equation of specific gravity is to preserve the same uniformity as D – 30, we need only know the mean specific gravity of the hydrocarbons (absorbed by bromine) as they exist in the gas.

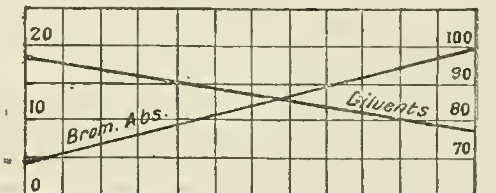
Taking the specific gravity determinations as they occur in the analytical reports of gas coals, they do not exhibit any embarrassing discrepancies when compared with the other contemporaneous determinations we have just examined. The following table (No. 2) contains 19 determinations of specific gravity and illuminating power, made by Mr. G. R. Hislop, engineer of the Paisley Gas Works. I notice in all Mr. Hislop's analytical reports on gas coals, that the specific gravity of the gas obtained is given. Parallel with these determinations, I have summarised some of Mr. Cusiter's analyses, as also sundry others. The classification is made as far as possible comparable by taking advantage of the illuminating power in both cases. Thus we have by Mr. Hislop's, specific gravity and illuminating power; and by Mr. Cusiter's, illuminating power and bromine absorption. As the agreement between these two illuminating observations is not perfect, it may suffice to see how far the general formula of probability can be made to establish the possibility of tracing a relationship through all the four quantities.

For this purpose I have traced the bromine absorption and diluents in terms of the specific gravity by the curves (Diagram No. 4). It is remarkable that the point of intersection between the two components occurs as it did on the former curve of illuminating power, viz., 30 candles, or a calculated specific gravity of 0·582, instead of 0·593, as obtained by Mr. Hislop. The law of this curve is: where $y$ = bromine absorption, and $x$, specific gravity—

$$y = 52{\cdot}631\,x - 17{\cdot}48$$

$$x = 0{\cdot}019\,(y + 17{\cdot}48)$$

No. 4.



The differences between the observed and calculated specific gravity are not great, and all preserve a fair uniformity, showing the agreement and regularity of Mr. Hislop's determinations.

We cannot for certain say that the relationship remains constant beyond the limits of comparison—that is, on the upper and lower reaches of the curve. The presumption is that there will be an alteration in the lower end, owing to the more attenuated condition of the hydrocarbon vapours, and on the upper end the deviation will be magnified in a contrary direction, from the greater saturation of the gas.

A greater number of observations are required to enable us to judge how far any definite equation approaches the truth.

I have chosen this method of treating the subject in preference to an extended account of my own experiments, which were, I thought, on too small a scale to be worth the notice of those practically interested in destructive distillation. However, the experiments were as far as possible correct, the observations accurate, and the inferences, if of value, should be capable of general application. This will explain my borrowing so largely on the practical results of Mr. Cusiter and Mr. Hislop.

The more exact determinative knowledge of destructive distillation has been introduced by Dr. Mills in his "Cumulative Resolution," and also in the paper just referred to. By the aid of three circumstantial co-efficients, and an empirical formula for coal and shale, he is able to trace the distribution of the original molecule for high and low temperatures. The agreement which subsists between theory and experiment indicates that the resolution is not influenced by mere accidental causes, but rather shows how the definite character of the process can be made intelligible by the definite character of the result. At first sight it may appear that a determinate distillate could not be obtained from coal or shale, for if the co-efficient of temperature varied, it would admit the whole to vary, but this by no means excludes a determinate distillate or definite character.

Table No. 2.

| No. | Mr. G. R. Hislop. | | Mr. G. F. Cusiter. | | Calculated. | |
|---|---|---|---|---|---|---|
| | Specific Gravity of Gas. | Illuminating Power. | Illuminating Power. | Bromine Absorption. | Specific Gravity of Gas. | Difference. |
| 5 | .. | .. | 39·23 | 20·51 | 0·722 | .. |
| 8 | .. | .. | 37·59 | 17·94 | 0·673 | .. |
| 9 | .. | .. | 35·13 | 16·85 | 0·652 | .. |
| 4 | .. | .. | 34·69 | 17·00 | 0·655 | .. |
| 15 | .. | .. | 33·26 | 15·85 | 0·633 | .. |
| 6 | 0·620 | 32·22 | 32·05 | 14·23 | 0·603 | 0·017 |
| 1 | 0·593 | 30·00 | 30·77 | 13·14 | 0·582 | 0·011 |
| 2 | 0·580 | 29·14 | 29·37 | 12·20 | 0·564 | 0·016 |
| 5 | 0·581 | 28·25 | 28·43 | 11·19 | 0·558 | 0·023 |
| 2 | 0·571 | 27·20 | 27·18 | 11·41 | 0·549 | 0·022 |
| 1 | 0·540 | 25·55 | 25·42 | 10·30 | 0·528 | 0·012 |
| 1 | 0·536 | 23·13 | 23·37 | 9·23 | 0·507 | 0·029 |
| 1 | 0·518 | 22·32 | 22·80 | 8·96 | 0·502 | 0·015 |
| 17 | .. | .. | 20·50 | 7·55 | 0·476 | .. |
| 6 | .. | .. | 17·10 | 5·83 | 0·445 | .. |
| 8 | .. | .. | 15·50 | 4·51 | 0·418 | .. |

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## THE IODINE NUMBER OF FATS AND OILS.

BY H. SCHWEITZER AND E. LUNGWITZ.

In further pursuance of the study of the reaction taking place during the determination of the iodine absorption value of oils and fats by Huebl's method, we have carried out a number of experiments, the results of which appear to us to be of great interest.

In our last paper on this subject (this Journal, 1895, 130) we ascertained that in Huebl's process both absorption ("addition") and substitution of iodine take place, and we described at length a new method which enabled us to determine this, viz., the titration with potassium iodate and iodide.

This method is based on the reaction—

$$5HI + HIO_3 = 6I + 6H_2O,$$

and by means of it presence of free mineral acid had been already qualitatively detected with great exactness. We were, however, the first to recommend this reaction for the quantitative determination of free mineral acid in the presence of salts of the heavy metals. When free organic acids are in solution, the above reaction proceeds only very slowly, and it does not take place at all if water-insoluble organic acids are present.

We note that F. Gantter (Chem. Zeit. 1893, R. 111) states that fatty acids of the acetic series absorb iodine, and he concludes that the iodine-absorption numbers possess only relative value.

Again, F. Gantter (Zeits. f. anal. Chem. 1893, 178—181) and Fahrion (Chem. Zeit. 1892, 1472) question whether the iodine absorbed in Huebl's process is solely taken up to form additive compounds. C. Liebermann and H. Sachse (Berl. Ber. 1891, 4112) express the same opinion and, in consequence of all these observations, Holde (Chem. Zeit. 1893, 54, 980) advocates to use the term iodine absorption instead of iodine number.

Furthermore, Hehner (Chem. Zeit. 1895, 261) concludes from the results of the gravimetric determination of the bromine absorption of oils, that the high iodine number of such oils as castor oil and boiled linseed oil is caused by the formation of acid in Huebl's process.

In our publication above referred to we pointed out that the conditions should be found under which the true iodine-addition figure for oils, fats, &c., could be ascertained. The results thus obtained would be of great importance, because they would help to throw light upon the composition of these natural products. In the following lines we report the efforts we have made in this direction :—

### I. *Influence of Solutions of Iodine in Different Organic Solvents on Oils and Fats.*

In previous experiments we had observed that when tetrachloride of carbon was employed as solvent, according to Gantter, no substitution took place, in contradistinction to the other solvents examined. It was, therefore, our first object to study the influence of the solvents in the Huebl test, and the use of methylic for ethylic alcohol naturally suggested itself as the first step.

(*a.*) *Methylic and Ethylic Alcohols.*—W. Fahrion (Chem. Zeit. 1893, 61, 1100) recommended the use of methylic alcohol, claiming that the solution of iodine prepared with this menstruum was more stable and could be used immediately after preparation.

In order to convince ourselves of the existence of any difference we have started comparative experiments, using the proportions given by Huebl, substituting, however, in the one series methylic for ethylic alcohol.

The solution in methylic alcohol was prepared by dissolving 15·0 grms. $HgCl_2$ in 250 c.c. and 12·5 grms. I in 250 c.c., thus giving 500 c.c. of solution.

1. *Results with Methylic Alcohol.*

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found in HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grm. | | | |
| 1 | Lard oil ........... | 0·2155 | 76·8 | 19·6 | 37·6 |
| 2 | Oleic acid......... .. | 0·3020 | 83·33 | 20·27 | 42·79 |
| 3 | Maize oil .......... | 0·2906 | 125·72 | 24·87 | 75·98 |
| 4 | „ .......... | 0·3837 | 123·23 | 23·04 | 77·15 |
| 5 | Fish oil............ | 0·2192 | 173·99 | 36·4 | 101·19 |
| 6 | Linseed oil, raw.... | 0·2673 | 221·1 | 42·1 | 136·9 |
| 7 | „ „ .... | 0·4598 | 176·8 | 34·5 | 107·8 |

2. *Results with Ethylic Alcohol.*

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found in HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| 1*a* | Lard oil ........... | 0·2514 | 76·6 | 6·3 | 64·0 |
| 2*a* | Oleic acid.......... | 0·3378 | 83·00 | 11·0 | 61·0 |
| 3*a* | Maize oil .......... | 0·2108 | 126·1 | 11·92 | 102·26 |
| 4*a* | „ .......... | 0·3868 | 124·06 | 10·13 | 103·80 |
| 5*a* | Fish oil............ | 0·2167 | 165·2 | 15·5 | 135·2 |
| 6*a* | Linseed oil, raw.... | 0·2287 | 192·4 | 17·1 | 158·2 |
| 7*a* | „ „ .... | 0·4637 | 174·0 | 14·1 | 145·8 |

All these experiments were carried out simultaneously, under absolutely the same conditions. From the results we see that the values obtained for total absorption (Huebl's number) are practically the same for both solvents, that, however, the ratio between addition and substitution, and therefore the true iodine addition number are quite different. The figure called by us "true iodine addition number" is found by multiplying the substitution number expressed in terms of iodine found as HI, by 2, and subtracting this amount from the total absorption. The reason for this is apparent, since each molecule of HI formed owes its origin to two atoms of iodine, one of which substitutes hydrogen in the molecule of the fat, whereas the other combines with the liberated hydrogen to form hydriodic acid.

In the methylic alcohol solution substitution takes place to a great extent, and the true iodine number therefore works out very low when compared with that obtained in the ethylic alcohol solution. Considering the fact that the figures for the total absorption are almost identical in both cases, the results obtained are very striking. We tried to find the cause of this remarkable behaviour, and started a series of experiments, in which we determined the iodine number with methylic alcohol as solvent, but without using $HgCl_2$.

The conditions of reaction in these tests differed somewhat from those prevailing in the Huebl process. We dissolved the oils in 10 c.c. of chloroform, but our iodine solution contained double the quantity of iodine indicated by Huebl. In spite of the fact that the measuring off of such concentrated iodine solutions is not as exact as that of dilute solutions, we were forced to use such concentrated solution because in consequence of the presence of methylic alcohol the solubility of fats in chloroform decreased.

For each test we took 10 c.c. of iodine solution, the quantity of iodine present therein being perfectly sufficient for complete absorption, owing to the greater concentration of the liquid, and owing to the fact that in the absence of $HgCl_2$ the absorption of iodine is much lessened.

We dissolved 5 grms. of iodine in 100 c.c. of methylic alcohol, and used 10 c.c. of this solution for each test, allowing the mixture to stand for 20 hours.

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil ....... | 0·505 | 7·86 | 3·98 | −0·10 |
| 2 | Olive oil ........... | 0·2333 | 73·4 | 36·9 | −0·40 |
| 3 | Lard oil ........... | 0·2741 | 65·43 | 32·71 | +0·01 |
| 4 | Arachis oil......... | 0·1622 | 81·8 | 40·77 | +0·26 |
| 5 | „ „ ......... | 0·3533 | 57·1 | 28·2 | +0·70 |
| 6 | Colza oil........... | 0·2219 | 76·7 | 37·5 | +1·7 |
| 7 | „ ........... | 0·3758 | 56·6 | 27·2 | +2·2 |
| 8 | Linseed oil, raw ... | 0·1745 | 105·6 | 51·7 | +2·2 |
| 9 | „ „ ... | 0·3040 | 71·0 | 32·8 | +5·4 |
| 10 | Linseed oil blown 5 hours. | 0·1219 | 129·4 | 64·5 | +0·4 |

We then experimented with a solution of iodine in ethylic alcohol under exactly the same conditions.

Five grms. of iodine were dissolved in 100 c.c. of ethylic alcohol. The weighed oil was dissolved in 10 c.c. of chloroform and treated with 10 c.c. of the iodine solution. Each test was allowed to stand for about 20 hours.

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil ....... | 0·5155 | 8·06 | 3·11 | 1·84 |
| 2 | Olive oil ........... | 0·2308 | 72·7 | 34·68 | 3·34 |
| 3 | Lard oil ........... | 0·2741 | 63·4 | 30·52 | 2·36 |
| 4 | Linseed oil......... | 0·2628 | 82·1 | 38·2 | 5·7 |
| 5 | ,, ......... | 0·2424 | 83·9 | 36·1 | 11·7 |

From the results of these two series of experiments carried out under strictly the same conditions of time, apparatus, and reagents, we conclude that the iodine dissolved in methylic alcohol effects substitution only of iodine, whereas the solution of iodine in ethylic alcohol causes mainly substitution, but, at the same time, addition to a very small extent.

These figures, in connection with those obtained in the presence of $HgCl_2$ with methylic and ethylic alcohols (p. 3) prove, that the "substituting tendencies" of the two alcohols are greatly lessened by the influence of the metallic salt which causes addition to a large extent.

(*b.*) *Chloroform.*—We then determined the action of solutions of iodine in pure chloroform on fats and oils. We prepared a solution of 6·25 grms. of iodine in 250 c.c. of chloroform, and used for each determination 25 c.c.; the action was allowed to go on for 20 hours.

On account of the disagreeable effect on the system experienced when pipetting off chloroformic solutions we filled the pipettes by means of the suction pump, the ends of the pipettes being drawn out to capillary tubes. The following results were obtained:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution Expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil....... | 0·2615 | 6·9 | 3·06 | 0·78 |
| 2 | Olive oil ........... | 0·1845 | 61·3 | 23·3 | 14·7 |
| 3 | ,, ........... | 0·1565 | 65·0 | 26·2 | 12·6 |
| 4 | Maize oil ........... | 0·1807 | 76·5 | 26·6 | 23·3 |
| 5 | Linseed oil ........ | 0·1625 | 100·0 | 23·4 | 53·2 |
| 6 | Tallow............. | 0·2094 | 35·4 | 16·2 | 3·0 |
| 7 | ,, ............. | 0·2833 | 29·7 | 12·3 | 5·1 |
| 8 | Paraffin oil......... | 0·2636 | 5·3 | 2·65 | 0·00 |

From these figures it appears that iodine when acting on fats and oils in chloroformic solution effects both addition and substitution. It is further shown that iodine does not interact with chloroform because the solutions, although frequently examined, were always found to be absolutely neutral. It is therefore evident from the results obtained in all the tests described that it is impossible to effect exclusively addition of iodine by employing either methylic or ethylic alcohol or chloroform with or without the use of $HgCl_2$.

(*c.*) *Common Ether* (*Sulphuric Ether*).—For the following series of experiments we used a solution of 6·25 grms. of iodine in 250 c.c. of ether. The measuring off of this solution was done as described above in the case of chloroform. The ether employed was Squibb's strong ether for anæsthetics.

The results are the following:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution Expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil ....... | 0·3790 | 8·4 | 3·2 | 2·0 |
| 2 | Lard oil ........... | 0·2180 | 43·7 | 17·9 | 7·9 |
| 3 | Compounded lard.. | 0·2115 | 40·2 | 16·6 | 7·0 |
| 4 | Tallow............. | 0·3013 | 27·6 | 10·6 | 6·4 |
| 5 | Maize oil........... | 0·1940 | 55·3 | 22·3 | 10·7 |
| 6 | Linseed oil ........ | 0·1818 | 62·3 | 25·8 | 10·7 |

These figures show that the ethereal solution also causes substitution and addition, but favours addition of iodine more strongly than ethylic alcohol.

When ascertaining the titre of the ethereal solution of iodine, we always noticed the presence of a small amount of free acid. However, we did not ascertain whether the acid was due to some action of iodine on the ether or to the presence of acid or peroxide of hydrogen in the ether used.

(*d.*) *Bisulphide of Carbon.*—The commercial bisulphide of carbon was purified according to the directions of Lidot (Comptes Rendus 69, 1303). It was violently shaken with mercury, the liquid poured off from the mercury and distilled off. To retain traces of water in the distilling flask we added a little anhydrous phosphoric acid. The distillate had an ethereal, not at all unpleasant, smell.

We dissolved 12·5 grms. of iodine in 500 c.c. of bisulphide of carbon, and used for every test 25 c.c. of the solution, allowing as before 20 hours for the completion of the reaction.

We obtained the following results:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution Expressed in amount of I found as H I. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil ....... | 0·4016 | 6·9 | .. | 6·9 |
| 2 | Lard oil ........... | 0·2257 | 39·5 | .. | 39·5 |
| 3 | Compounded lard.. | 0·2187 | 34·3 | .. | 34·3 |
| 4 | Tallow............. | 0·3924 | 15·0 | .. | 15·0 |
| 5 | Maize oil...... .... | 0·1880 | 54·3 | .. | 54·3 |
| 6 | Linseed oil......... | 0·1720 | 74·5 | .. | 74·5 |

The conclusions drawn from this series of experiments are as follows:—

(1.) Iodine does not act on bisulphide of carbon, as evidenced by the solution not undergoing any change in strength.

(2.) When a solution of iodine in carbon bisulphide is allowed to act on fats and oils, purely addition of iodine takes place.

(*e.*) *Tetrachloride of Carbon.*—Iodine was introduced into tetrachloride of carbon, and after standing for several days with repeated stirring, the saturated solution was poured off.

For every test we used 25 c.c. of this solution, and allowed the test to stand for 20 hours. The following results were obtained:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Cocoanut oil ....... | 0·1246 | 4·8 | .. | 4·8 |
| 2 | Maize oil........... | 0 1180 | 64·4 | .. | 64·4 |
| 3 | Cotton-seed oil ..... | 0·1365 | 52·0 | .. | 52·0 |

We learn from these figures that tetrachloride of carbon does not interact with iodine, and that exclusively addition of iodine takes place when this iodine solution is allowed to act on fats and oils.

Besides using these more common organic solvents, we experimented with solutions of iodine in benzene, toluene, nitrobenzene, aniline, amylic alcohol, methyl, ethyl, and amyl acetates.

The results of these experiments were not studied with the same care as before. On the whole, there always took place both addition and substitution to a varying degree, so that the employment of any of these solvents for our purpose, viz., "to purely effect addition, and that up to the amount demanded by theory," offered no advantage whatever.

### *II.—Influence of Metallic Salts in the Solution of Iodine.*

The study of the influence of the various organic solvents had taught us the fact that bisulphide of carbon and tetrachloride of carbon caused exclusively addition of iodine. In the course of these experiments we learnt, moreover, that the "substituting tendencies" of solvents, especially of methylic and ethylic alcohols, were diminished, and pure addition increased by the presence of bichloride of mercury. We therefore proceeded to investigate the influence of metallic salts in order to find out whether a change in the quantities or the nature of the metallic salt would solely produce addition and prevent substitution entirely.

(*a.*) *Bichloride of Mercury.*—We determined the iodine absorption with the following solutions:—

(1.) 5 grms. of iodine dissolved in 100 c.c. of ethylic alcohol.
3 grms. of $HgCl_2$ dissolved in 100 c.c. of ethylic alcohol.
(2.) 5 grms. of iodine dissolved in 100 c.c. of ethylic alcohol.
9 grms. of $HgCl_2$ dissolved in 100 c.c. of ethylic alcohol.
(3.) 200 c.c. of ethylic alcohol were saturated with $HgCl_2$, and in this solution 5 grms. of iodine were dissolved (100 parts of alcohol dissolve 33 parts of $HgCl_2$).
(4.) Huebl's solution.

We used for these tests the lard oil which had served in all preceding experiments.

The following results were obtained:—

| Iodine $HgCl_2$ Solution. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of Iodine found as HI. | Iodine Addition. |
|---|---|---|---|---|
| | Grms. | | | |
| 1 | 0·1936 | 75·5 | 12·42 | 50·66 |
| 1 | 0·4080 | 76·4 | 10·8 | 54·8 |
| 2 | 0·2007 | 73·8 | 9·48 | 54·84 |
| 2 | 0·4130 | 75·5 | 10·4 | 54·7 |
| 3 | 0·2505 | 74·4 | 16·4 | 41·6 |
| 3 | 0·3265 | 73·6 | 15·3 | 40·0 |
| 4 | 0·2500 | 78·36 | 10·22 | 57·92 |
| 4 | 0·3770 | 77·47 | 9·83 | 57·81 |

Although these figures tend to show that an excess of $HgCl_2$ in the iodine solution effects strong substitution, we yet doubt whether we should be justified in coming to such a conclusion. For we observed that in solution No. 3, iodine interacts very strongly with ethylic alcohol, and that after 2 days' standing this solution lost as much iodine as the Huebl solution does after months. It is therefore rather difficult to decide how much of the high substitution is to be attributed to this reaction.

We therefore abstain from giving a definite opinion on the influence of variable quantities of $HgCl_2$. At any rate, our experiments showed that nothing could be gained for our purposes by the employment of varying quantities of $HgCl_2$, because the Huebl solution in the above series gave the highest true iodine addition number.

Here we wish to add that when carrying out the experiments mentioned under 3 we met with some difficulties. The first addition of iodide of potash produces a voluminous precipitate, which is only redissolved by a large excess of potassium iodide, and the solution assumes a colour similar to that of a weak solution of iodine in potassium iodide. This colour and the excess of potassium iodide render the titration rather inexact.

On the other hand, the chloroformic solution of the fat absorbs the iodine from solution No. 3 very quickly, and the end of the titration is so sharp and distinct that we first entertained hopes of being able to determine the iodine number by direct titration of the chloroformic solution of a fat with solution No. 3. However, since the titre of such a saturated solution changes very quickly, and (therefore) must be ascertained before each test, little advantage could be gained by such procedure. At any rate, it may sometimes be of value to ascertain approximately the total iodine absorption, and in such a case it could be done by direct titration with a solution saturated with $HgCl_2$ in the manner described above.

Thus we were led to try a method for the direct titration, and remembering the previously-ascertained fact that pure methylic alcohol and iodine do not interact, we substituted methylic alcohol for ethylic alcohol in solution No. 3. We found, however, that the excess of $HgCl_2$ causes the iodine to act on methylic alcohol, and we consequently abandoned all further trials in this direction.

(*b.*) *Bibromide of Mercury.*—We then substituted $HgBr_2$ for $HgCl_2$ in the Huebl solution. 12·5 grms. of iodine were dissolved in 250 c.c. of ethylic alcohol, and 22·5 of $HgBr_2$ in 250 c.c. of ethylic alcohol. The solutions were then mixed; we obtained the following results:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Linseed oil, raw ... | 0·2364 | 185·3 | 72·3 | 40·7 |
| 2 | " " ... | 0·4124 | 182·5 | 63·3 | 55·9 |
| 3 | Linseed oil blown at 100° C. for 5 hours. | 0·1451 | 184·03 | 60·7 | 62·63 |
| 4 | Linseed oil blown at 100° C. for 5 hours. | 0·3100 | 168·1 | 53·8 | 60·5 |
| 5 | Linseed oil blown at 100° C. for 15 hours. | 0·1645 | 175·4 | 61·5 | 52·4 |
| 6 | Linseed oil blown at 100° C. for 15 hours. | 0·2654 | 166·87 | 53·6 | 59·67 |
| 7 | Linseed oil blown at 100° C. for 20 hours. | 0·1958 | 165·0 | 55·2 | 54·6 |
| 8 | Linseed oil blown at 100° C. for 20 hours. | 0·2947 | 153·1 | 47·7 | 57·7 |
| 9 | Linseed oil blown at 100° C. for 20 hours and then 5 hours with oxygen. | 0·3248 | 142·1 | 45·3 | 51·5 |
| 10 | Fish oil............ | 0·1665 | 173·3 | 49·9 | 73·5 |

We then substituted methylic alcohol for ethylic alcohol, and prepared the following solutions:—12·5 grms. of iodine dissolved in 250 c.c. of methylic alcohol; and 22·5 grms. of $HgBr_2$ dissolved in 250 c.c. of methylic alcohol.

We obtained the following results:—

| No. | Oil. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|
| | | Grms. | | | |
| 1 | Linseed oil blown at 100° C. for 15 hours. | 0·2464 | 173·64 | 54·5 | 64·64 |
| 2 | Linseed oil blown at 100° C. for 15 hours. | 0·1666 | 179·2 | 56·6 | 66·0 |
| 3 | Linseed oil blown at 100° C. for 20 hours. | 0·1498 | 171·9 | 57·9 | 56·1 |
| 4 | Linseed oil blown at 100° C. for 20 hours. | 0·3225 | 153·3 | 45·0 | 63·3 |
| 5 | Linseed oil blown at 100° C. for 20 hours and 5 hours with oxygen. | 0·3528 | 147·0 | 46·9 | 53·2 |
| 6 | Linseed oil blown at 100° C. for 20 hours and 5 hours with oxygen. | 0·1762 | 158·3 | 48·9 | 60·5 |
| 7 | Fish oil............ | 0·1644 | 181·2 | 45·4 | 90·4 |
| 8 | " ............ | 0·3100 | 164·0 | 43·1 | 77·8 |

From these figures we learn that practically the same degree of substitution is obtained by using $HgBr_2$ either in methylic or ethylic alcohol solution. Furthermore, we see that $HgBr_2$ under the same conditions effects substitution to a greater extent than $HgCl_2$.

We therefore abandoned further experiments with $HgBr_2$. Nor did we try the action of bromine in alcoholic solutions without metallic salts, as we had done before in the case of iodine.

(*c.*) *Various Metallic Salts.*—We give in tabulated form the results obtained with some other chlorides and bromides.

For all these tests we employed a lard oil, the Huebl iodine number of which was 78·4. The solutions of metallic salts and of iodine in ethylic alcohol were used after 12 hours' standing. The reaction was allowed to take place during about 20 hours. On account of the presence of water of crystallisation in some of the metallic salts, we used 25 c.c. of absolute alcohol to prevent dilution. The following solutions were used :—

1. 2·5 grms. of $ZnCl_2$ in 100 c.c. of 95 per cent. ethylic alcohol.
   5·0 grms. of iodine in 100 c.c. of 95 per cent. ethylic alcohol.
2. 3·5 grms. of $MnCl_2 + 4H_2O$, 25 c.c. of absolute alcohol, 75 c.c. of 95 per cent. alcohol.
   5·0 grms. of iodine, 100 c.c. of alcohol.
3. 5·2 grms. of $MnBr_2 + 4H_2O$, 100 c.c. of alcohol.
   5·0 grms. of iodine, 100 c.c. of alcohol.
4. 5·5 grms. of $CoCl_2 + 6H_2O$, 25 c.c. absolute alcohol, 75 c.c. alcohol, 95 per cent.
   5·0 grms. of iodine, 100 c.c. of alcohol.
5. 5·5 grms. of $NiCl_2 + 6H_2O$, 100 c.c. of alcohol.
   5·0 grms. of iodine, ,,
6. 5·0 grms. of $CdCl_2 + 2H_2O$, ,,
   5·0 grms. of iodine, ,,

The results obtained are as follows :—

| Metallic Salt Solution. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of Iodine found as HI. | True Iodine Addition. |
|---|---|---|---|---|
| | Grms. | | | |
| $ZnCl_2$ | 0·1785 | 70·4 | 21·9 | 27·6 |
| ,, | 0·3442 | 60·7 | 19·9 | 20·9 |
| $MnCl_2$ | 0·1784 | 74·6 | 3·0 | 68·6 |
| ,, | 0·345 | 66·5 | 2·6 | 61·3 |
| $MnBr_2$ | 0·1760 | 56·6 | 1·7 | 53·2 |
| ,, | 0·3325 | 50·1 | 2·2 | 45·7 |
| $CoCl_2$ | 0·1845 | 72·8 | 2·7 | 69·4 |
| ,, | 0·348 | 65·5 | 2·1 | 61·3 |
| $NiCl_2$ | 0·1893 | 74·1 | 2·6 | 68·9 |
| ,, | 0·3502 | 65·9 | 2·6 | 60·7 |
| $CdCl_2$ | 0·1891 | 71·8 | 12·4 | 47·0 |
| ,, | 0·3589 | 67·0 | 12·0 | 43·0 |

From this table it is apparent that $MnCl_2$, $MnBr_2$, $CoCl_2$, and $NiCl_2$ cause practically no addition, and that $CoCl_2$ gives the highest true iodine addition figure. We therefore tried to reduce the small substitution shown by $CoCl_2$ in the following experiments, retaining the above conditions, but making the following variations :—

1. We ascertained the iodine number at a higher temperature by heating for 30 minutes at 122° F., as described by us in this Journal, 1894, 616.
2. We saturated absolute alcohol with $CoCl_2$, and added 100 c.c. of this solution to 100 c.c. of alcohol, in which 5 grms. of iodine had been previously dissolved.

| No. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|
| | Grms. | | | |
| 1 | 0·1826 | 68·04 | 2·7 | 62·64 |
| 1 | 0·3825 | 56·3 | 2·6 | 51·1 |
| 2 | 0·1811 | 75·3 | 1·1 | 73·1 |
| 2 | 0·3567 | 66·3 | 1·4 | 63·5 |

It is thus seen that a larger amount of $CoCl_2$ in the solution tends to reduce the substitution and gives a greater value for the true iodine addition.

### *III. Method for the Determination of the Correct Iodine Addition Number.*

The substitution of alcohol-soluble metallic salts for $HgCl_2$ in the Huebl solution teaches us the remarkable fact that $CoCl_2$, $NiCl_2$, $MnBr_2$, $MnCl_2$ does not cause substitution of iodine to any considerable extent, and this observation, taken together with the behaviour of bisulphide of carbon and tetrachloride of carbon, suggested a great variety of experiments to obtain solely addition of iodine, and this to the theoretically highest amount.

In these experiments we had to contend against manifold obstacles, which were constantly leading to new variations and combinations. The nature of the difficulties will become apparent from the fact that the metallic salts are only very slightly soluble in those solvents which were most desirable for our purposes, and that, on the other hand, the solutions of a fat in chloroform or absolute alcohol do not intermix with the iodine metallic salt solutions. Thus, for example, 100 parts of bisulphide of carbon dissolve only 0·14 part of $HgBr_2$ at 15° C.; and further, only absolute alcohol and sulphuric ether mix in all proportions with bisulphide of carbon, which at the same time is a solvent for $HgCl_2$.

However, all these experiments resulted in obtaining figures showing small substitution numbers and true addition numbers below the theoretically possible limit, and although they logically led us to reach our final object, we do not consider any of them of sufficient interest to report at length.

Our final experiments were carried out by dissolving iodine in bisulphide of carbon and allowing these solutions to act at a higher temperature and under pressure on oils and fats in the presence of bichloride of mercury.

We had great difficulties in getting tightly-fitting glass-stoppered bottles, and even stoppers ground to order did not prevent the escape of $CS_2$ vapours at elevated temperatures. Plaster of Paris, silicate of soda, paraffin wax, linseed meal, &c., which are usually employed for tightening, could not be used on account of the action of the reagents on these substances. At last we found the means to accomplish our purpose by moistening the stopper with a concentrated solution of iodide of potassium. When introducing the $HgCl_2$ into the bottle, we left a few crystals in the neck of the bottle, and thus, on closing the bottle with the stopper treated as above, we precipitated some $HgI_2$. By giving the stopper a turn or two, we rubbed the $HgI_2$ crystals uniformly round the neck of the bottle. In this manner we were able to close our bottles perfectly tight.

Our tests were carried out by placing a weighed quantity of an oil into the bottle, adding 25 c.c. of $CS_2$ and 0·6 to 0·7 grm. of finely-pulverised $HgCl_2$. The bottle was then closed and warmed in a water-bath to a certain temperature. Blank tests were always carried out together with these determinations, and in all these blank tests we found a certain amount of free mineral acid, which was very likely produced by the moisture introduced through our method of tightening the bottles. This amount of free mineral acid was very small, and did not increase in the actual tests, which shows that under these conditions only true iodine addition had taken place :—

| Oil. | Time of Heating. | Temperature of Water-Bath. | Weight of Oil. | Total Iodine Absorption. | Substitution expressed in Amount of I found as HI. | True Iodine Addition. |
|---|---|---|---|---|---|---|
| | | °C. | Grms. | | | |
| Lard oil, Huebl iodine number 78·4. | 30 minutes | 50 | 0·1439 | 73·0 | .. | 73·0 |
| | 30 ,, | 50 | 0·1316 | 72·8 | .. | 72·8 |
| | 60 ,, | 60 | 0·1537 | 80·6 | .. | 80·6 |
| | 60 ,, | 60 | 0·1360 | 79·4 | .. | 79·4 |
| Cotton-seed oil, Huebl iodine number 106·5. | 2 hours | 50 | 0·1294 | 103·0 | .. | 103·0 |
| | 3 ,, | 55 | 0·1370 | 115·3 | .. | 115·3 |
| | 5 ,, | 55 | 0·1320 | 120·1 | .. | 120·1 |
| Oleic acid, chemically pure | 2 ,, | 65·5 | 0·1216 | 93·8 | .. | 93·8 |
| | 2 ,, | 76·5 | 0·1569 | 100·0 | .. | 100·0 |
| | 2 ,, | 79·5 | 0·1273 | 105·2 | .. | 105·2 |

These experiments prove the complete absence of free hydriodic acid and consequently the absence of iodine substitution. But we now observe that the true *iodine addition figure* exceeds that which our theory demands for pure oleïc acid. What does this excess mean? What reactions take place jointly with the normal addition? Is our present theory of the constitution of oleïc acid, which has been doubted before, wrong? Experiments to solve these questions are being made, but the possibilities are so great and the subject so interesting that we invite our fellow-chemists to take up this matter in order to get at the explanation of these reactions.

We conclude by stating that, in our opinion, the addition and substitution of iodine depends directly on the state of the molecular complexus of iodine in the different organic solvents.

Kruess and Thiele (Zeits. f. anorg. Chem. **7**, 67) have published a paper on the colour of iodine in different solvents. According to them, carbon bisulphide and carbon tetrachloride give violet solutions, whereas methylic and ethylic alcohols dissolve iodine with brownish colour. Since the former iodine solutions, when acting on fats and oils, cause solely addition of iodine, and the latter predominantly substitution, the inference is justified that the molecular complexes of iodine, as represented by a violet solution, act chemically different from the molecular complexes of the brown solution.

This is a confirmation of the observation made by Gautier and Charpy (Comptes Rend. **111**, 645) on the different behaviour of the two solutions of iodine when acting on lead amalgam, and although E. Beckmann and A. Stock (Zeits. f. Phys. Chemie, 1895, 127) dispute the existence of such differences, they will have great difficulties in explaining our results in some other manner.

It is our intention to make use of E. Wiedemann's observation (Wied. Ann. **41**, 299) that violet solutions of iodine in carbon bisulphide become brownish when cooled by ether and carbonic acid, and to ascertain whether such a cooled solution, when acting on fats and oils, causes addition or substitution; and we hope to report on our experiments at an early date.

Finally, we state that our theoretical conclusions and interpretations were derived from those tests in which strictly neutral fats and oils were used to the exclusion of those tests in which we employed material containing hydroxy fatty acids, such as linseed oil, castor oil, and blown oils in general. Some observations made by us in the case of the latter oils show that they behave quite differently, and that, besides addition and substitution, very likely oxidation takes place. Our experiments in this respect have not yet been completed.

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# I.—GENERAL PLANT, APPARATUS, AND MACHINERY.

## PATENTS.

*Apparatus for Purifying Coal or the like Material by the Washing Process, Improvements in.* Ralph Clough, M. L. Mulholland, and Robert Clough, all of the county of Durham. Eng. Pat. 18,091, September 24, 1894.

The apparatus consists of a series of compartments, conical in shape, with dams or insets at their junctions, in which rotate agitators, carried on a shaft, driven by suitable gearing. The material to be washed is introduced by a suitable feeder, and wash water through a pipe of suitable capacity. The heavier portions of the material, under the action of the water in motion and gravity, separate from the lighter, and are carried against the stream of water by the agitators, whilst the lighter portions are carried along by the stream of water and discharged therewith. The apparatus is continuous in its action, and is particularly intended for washing coal.—R. B. P.

*Separation of Oils and Fats from Water, Process for the.* A. L. G. Dehne, Halle-on-the-Saale. Eng. Pat. 21,131, Nov. 3, 1894.

*See under* XVIII. B., *page* 1058.

*Apparatus for Distillation, Improvements in.* M. Otto, Paris, France. Eng. Pat. 24,447, Dec. 15, 1894.

The object of this apparatus is fractional distillation, effected by interposing between the still and the condenser a number of elements of cylindro-conical form, provided with two pairs of tubes for the entry and escape of liquids and vapours respectively. The vapour-inlet tube of each element allows the entering vapour to bubble up through a stratum of liquid, whereby part is condensed, whilst the remainder is led away to the next element above by the outlet tube, whilst the smaller tubes are arranged, one at the side and the other at the depending apex of its element, so that the overflow from one element discharges into the next below it. A series of elements arranged in this manner provides for the methodical washing of vapours from the still by means of the liquids of higher boiling points condensed out of the vapours. The distillate is collected in a vessel provided with a float for indicating the density of the liquid.
—E. G. C.

*Brine and other Liquors, Improvements in Evaporating, and Apparatus therefor.* E. G. Scott, Liverpool. Eng. Pat. 24,457, Dec. 15, 1894.

This process is an improvement upon that described in the specification of Eng. Pat. 12,774, 1893 (this Journal, 1894, 622). Instead of introducing the hot liquor from the heater above the level of the liquor in the vacuum pan, it is led in a circular tube surrounding the lower part of the pan, so as to issue into the lower part of the liquor through numerous small tubes, each supplied with a regulating cock, leading from the circular tube. The heater is an upright cylinder filled with vertical tubes, through which brine circulates, heated by steam admitted to the spaces between, and the brine thus heated passes by a pipe from the top of the heater into the circular tube already described. The pan is shallow; it is provided with a mechanical stirrer, an outlet at the bottom for the salt crystals, a pipe leading to a pump for circulating the brine, and a pipe leading from the dome of the pan to the vacuum pump.—E. S.

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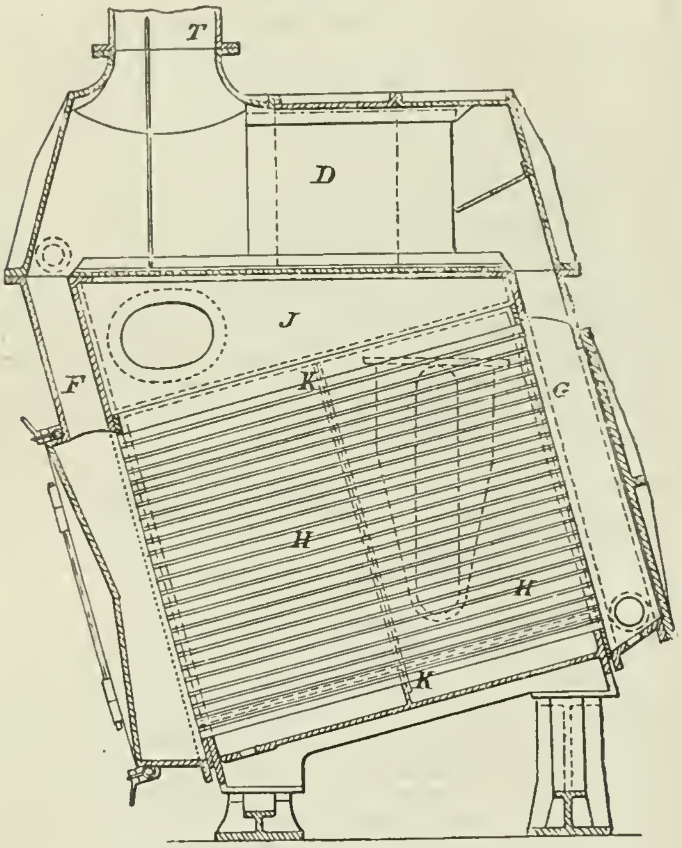
* Any of these specifications may be obtained by post by remitting 8*d.*—the price now fixed for all specifications, postage included—to Sir Henry Reader Lack, Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C.

*Multiple-Effect Evaporators, Improvements in.* J. McNeil and H. W. Aitken, both of Govan, county of Lanark, North Britain. Eng. Pat. 24,829, December 21, 1894.

This specification describes an improved form of apparatus, for the concentration of saccharine or other solutions. It consists of a suitable number of separate elements, each having an upper chamber D communicating at opposite ends with the nearly vertical spaces F G, so that the liquid supplied to the apparatus descends by the space F, and, passing through the inclined tubes H, ascends by the space G, thereby becoming heated by means of the steam circulating around the tubes H in the space K J. The vapour or steam separated from the liquid escapes by the outlet T, and is carried over to the next element, where it is used for evaporating and concentrating the liquid drawn from the first element. In the apparatus shown, three elements are used, either placed side by side or one above another, and connected by suitable pipes, so that the vapour and liquid may traverse their several chambers in proper order. —E. G. C.



Multiple-Effect Evaporators.

*Regulating the Flow of Compressed Gases, Improvements in Apparatus for.* A. T. Clarkson and J. B. Spurge, London. Eng. Pat. 918, Jan. 15, 1895.

Relates to improvements in apparatus of the type described in Eng. Pat. 11,518 of 1889 (this Journal, 1890, 794). The diaphragms used in the pressure-regulating apparatus are formed by stamping or spinning, and are supported on yielding surfaces of india-rubber or the like, whilst supports are provided to limit their motion and prevent damage by the action of the springs.—E. G. C.

*Wooden Vessels for the Transportation of Acids and other Corrosive Liquids, Improvements in.* C. Kramer, c/o A. A. Brodsky, Odessa, Russia. Eng. Pat. 4684, March 5, 1895.

Wooden vessels for the transport of the liquids mentioned, are coated inside and also outside with a mixture of asbestos and water-glass. The asbestos may be replaced by talc or by heavy spar. When the layer is dry, it is further coated with paraffin. For hydrochloric acid, the second layer is preferably of pitch or coal-tar. When the vessel is intended to contain petroleum, the second layer is either water-glass or glue.—E. S.

*Furnaces for Melting Glass, Puddling Iron, or like Operations, Improvements in.* C. Bateson and Chr. Bateson, Edge Hill, Lancashire. Eng. Pat. 7947, April 22, 1895.

To effectively concentrate the heat and to thoroughly consume the smoke or gases produced, the hollow bridge usually provided is used as an air-flue, communicating at one end with the outer air, and at the other with a flue passing first along the back, then along the end wall, and finally discharging the air, thus heated, through a comparatively narrow opening over the top of the fire. A damper is provided for regulating the strength of the current. Two outlet flues from the drum are provided, one at each side, and are kept separate for a considerable distance therefrom. —R. S.

*Purifying Liquids, New or Improved Process and Apparatus for.* H. F. C. Ebeling, of Gut Glinde, bei Reinbach, near Hamburg, Germany. Eng. Pat. 12,279, June 25, 1895.

"The object of the process is to recover from water or other liquid any useful matters contained therein," or "to separate unnecessary matters," and "produce therefrom useful products." A vessel or container, rotating about a central vertical axis, forms the armature of a dynamo, and water or other liquid to be purified, is poured into the vessel and thus subjected to strong magnetic influence combined with centrifugal action due to rotation. The solid matters, metallic salts and the like, collect upon the periphery of the vessel in consequence, and are drawn off by means of a suitable pipe, whilst the purified water or other liquid is retained at the centre of the vessel and delivered by a pipe into an annular trough. —E. G. C.

## II.—FUEL, GAS, AND LIGHT.

*Petroleum Oil, Criteria as to Burning Qualities.* H. Schweitzer, New York. Chem. Zeit. 1895, **19**, 1921.

The author points out the importance of the solidifying-point test in estimating the burning quality of petroleum of high flashing point. The larger consumers in America make stipulations about the solidifying point in buying such oils.

One of the large railway companies demands that—

(1.) 150° and 175° oils shall remain clear when cooled and kept for 10 minutes at 1° F. (− 17·8° C.).

(2.) That 300° oil shall remain clear when cooled to 32° F. (0° C.).

The amount of solid paraffins has a great influence on the illuminating power, since solid paraffins are less easily absorbed and soon clog the wick. Oils containing a large percentage of paraffins burn at first very well, but the flame soon becomes smaller, loses much of its brilliancy, and then clogs and carbonises the wick.

The solidifying point furnishes also a means of detecting adulterated oils made from a mixture of "tops and bottoms," *i.e.*, of naphtha and the last boiling (heavy) oil.

These mixtures can be made to show the same flash-point and specific gravity as the best burning oils. The boiling point of such an adulterated oil would only rise to 300° C., as in normal kerosene, so that a qualitative estimation of the boiling point would prove nothing, and only an exact fractional distillation would furnish means for detecting the adulteration.

The author advises the use of the solidifying test generally, and fractional distillation only in exceptional cases.

The yield of Pennsylvanian oil is continually decreasing, and a cheaper oil from Ohio (Lima oil) is being sent in large quantities to Europe.

It is therefore recommended that in making contracts the origin of the oil be stipulated.—H. M.

### *Magnesium Paper for Producing Light.* Papier Zeit. **20**, 2547.

This paper is used for producing the magnesium light, and is made in the following manner:—Powdered magnesium is placed between two sheets of impermeable paper which have been covered with starch paste, and they then adhere together. After drying, a sheet covered with potassium chlorate is pasted on each side, so that the powdered magnesium contained between the first sheets has a layer of potassium chlorate on each side. A further sheet pasted on serves as covering, and the whole, which forms a thick sheet, can be cut into strips. On lighting the end of a strip, the white dazzling magnesium light is obtained. This paper is said to be free from danger, and to keep well.—W. M.

### *Petroleum Burning Oil, Testing of.* R. Kissling. Chem. Zeit. 1895, **19**, 2037.

*See under* XXIII., *page* 1069.

### *Flame Temperatures and the Acetylene Theory of Luminosity.* A. Smithells. Proc. Chem. Soc. 1895, [155], 168.

The author has submitted to experimental and critical examination the acetylene theory of luminous hydrocarbon flames advocated by Lewes (this Journal, 1895, 738), and concludes that it is untenable.

Details of the measurement of the temperatures of different parts of hydrocarbon flames by means of the Le Chatelier thermo-couple are given. It is shown that to obtain readings of any value the wires constituting the couple must be bent so as to fit the particular region of the flame in which the measurement is desired, and that if the sheet of flame be thin, even this precaution is insufficient. The exploration of an ordinary flat coal-gas flame gives evidence of no sudden change of temperature in a vertical plane. Sudden changes are found, however, when the couple is moved from the middle of the flame outwards in a horizontal plane, and the mantle has a temperature higher than the melting point of platinum.

The author considers Lewes's description of the distribution of zones in flames to be based on erroneous temperature measurements, and finds no evidence of such a local condition of temperature as would point to the decomposition of acetylene. The conclusion in favour of the acetylene theory, based on the comparative luminosity of the ethylene and acetylene flames, is attributed to neglect of the consideration that in the latter there is a higher temperature and a greater relative amount of carbon. The indirect evidence derived from the behaviour of cyanogen is stated to arise from the yellow ammonia flame having been mistaken for one containing solid carbon. The theoretical arguments based on thermochemical considerations are adversely criticised.

The author maintains that the luminosity of hydrocarbon flames, including the flame of acetylene, can be adequately explained on the older theory of their structure confirmed and extended by his earlier experiments (Trans. Chem. Soc. 1892, **61**, 217). According to this view, a luminous flame is invested by a sheath of gas in non-luminous combustion. This sheath, which is double at the lower part, corresponds to the two cones of a Bunsen flame, and produces an exceedingly high temperature. The gas within this sheath is intensely heated as it ascends, and is gradually decomposed so as to furnish a sheet of carbon particles, becoming more and more numerous. These glow partly by heat and partly by combustion; the higher the temperature of the non-luminous sheath, and the greater the relative number of particles, the brighter will be the flame. This is well seen in the case of acetylene. The author believes that the precise steps in the decomposition of a hydrocarbon by which carbon is deposited are at present unascertainable by any direct means, but as the glow of the carbon particles in a hydrocarbon flame is in no case greater than that acquired by a platinum wire immersed in the same region, he considers that there is no ground for supposing that the endothermic decomposition of acetylene (of which substance only a very small quantity has been found in the flame gases) plays any appreciable part in the phenomenon.

## PATENTS.

### *Incandescent Gas-Lighting, Improvements in.* C. M. Lungren, New York, U.S.A. Eng. Pat. 16,925, September 5, 1894.

These improvements relate to the chemical composition and to the form of the incandescent body employed, and also to the method of its manufacture.

The materials generally employed in incandescent gas-lighting have the disadvantage that they "emit a peculiar greenish-white-coloured light, and that they are extremely fragile."

The patentee employs: "oxide of thorium, 96—98 per cent.; oxide of didymium, 1—2 per cent.; oxide of lanthanum, 1—2 per cent.;" and compounds the mixture into a dough with any suitable cementitious material, such as liquid glue.

By means of a press, the dough is forced out as threads; these are afterwards woven into a netting, and from the netting cap-like bodies are constructed. Supported upon suitable moulds of platinum or fire-clay, so that they may retain their shapes, these bodies are dried and incinerated, and are then ready for use. "They can be handled, for fixing on the burner, without falling to pieces."

According to the patentee, the "yellow warm tint of daylight, pleasing to the eye," which is characteristically produced by his incandescers, is due to didymia, but the percentage of this oxide must not exceed 5 per cent., or too yellow a light will be produced.

Thoria gives "resistance and durability." Lanthana "may, however, be wholly or in part substituted therefor without sacrifice of the advantages"; *e.g.*, a mixture composed of Lanthana 98 per cent., and didymia 2 per cent., may be employed.—E. R. B.

### *Prevention of Heating and Spontaneous Ignition of Combustible Materials, Improvements in or relating to the.* A. J. Boult, London. From A. Schörke. Eng. Pat. 21,125, November 3, 1894.

This invention relates to preventing spontaneous combustion among articles stored in bulk, as on board ship. The articles—for example, coal, fibrous peat, hay, Indian fibres, cotton-wool, flax, prepared bark, straw, wood fibres, &c.—are placed in air-tight receptacles having either an air-tight cover for the charging and discharging openings, or a rotary drum at those openings. In the latter case the periphery of the drum has three concave recesses therein, which, as they present their concavities to the openings, receive some of the materials, which are carried either to the inside or the outside of the vessel, as the case may be, the next convex portion of the drum entirely closing up the opening. A number of tubes enter the top of the receptacles, being provided internally with perforated dust-catchers, while externally they are connected to weathercock wind-aspirators, whereby a partial vacuum is kept up in the receptacles. Air-pumps may be used instead of aspirators. Each receptacle has also a vacuum-gauge, which is connected up so as to give audible notice of any increase of heat or pressure, without the latter of which, according to the inventor, no ignition will take place. Reference is also made in the specification to coal mines, in which a partial vacuum is kept up, compressed air or oxygen for breathing being supplied, at the working places only, from vessels or receptacles —R. S.

### *Petroleum Briquettes or Blocks, Improvements in the Manufacture of.* R. Denormandie and H. Hennebutte, Paris. Eng. Pat. 21,141, November 7, 1894.

The object is to produce briquettes sufficiently hard, with a high calorific value, and with a structure which is not liable to break up during combustion. The briquettes consist of a mixture of petroleums or petroleum residues free from water, resinous matters, an alkaline base or bases, and light carbon, preferably lamp-black as hydrogenated as possible. To make them, the petroleum, &c. is run, at a temperature of 50° C. or under, into a mixer, which also receives a fine stream of heavy oil of resin (11 per cent. as a minimum) or of resin (6 per cent. as a minimum) in solution in a hydrocarbon. Magnesia, calcined dolomite, or lime, proportionate to the resin or resinous matter, and afterwards, before the mass sets, 5 per cent. of lamp-black or light carbon as hydrogenated as possible, are added. The lamp-black is prepared by the incomplete combustion of gas-tar or tarry residues, the smoke produced being led to condensers, where it is subjected to the action of steam, causing the hydrocarbons present to condense on the particles of carbon.—R. S.

*Artificial Fuel, Improvements relating to the Manufacture of.* F. J. Koopmann, Munich. Eng. Pat. 23,559, December 4, 1894.

Coal dust or small coal is mixed with from 6 to 12 per cent. of pulverised marble or spar, and with from 4 to 8 per cent. of peels or waste of stones or nuts of the palm or other similar oleaginous fruit. The mixture is then pressed into moulds.—R. S.

*Uniform Mixture of Air and Inflammable Vapour, an Improved Process and Apparatus for Producing.* E. Edwards, London. From L. Feil, Amberg, Bavaria. Eng. Pat. 24,004, December 10, 1894.

These improvements relate to installations in which the combustible mixture is made by pumping air, by means of a gas or petroleum engine, through liquid hydrocarbon. In such installations it has been found, that, owing to the lowering of temperature sustained by the mass of the liquid hydrocarbon, consequent upon the evaporation of part of it, the resulting gaseous mixture is liable to become poorer in hydrocarbon vapour, and therefore less able to maintain, highly luminous, an incandescing body exposed in its flame. As remedy for this, it has been proposed to warm the liquid hydrocarbon by surrounding it with hot water, but it has been found impossible, by this method, to so regulate the temperature of the water as to obtain uniformity in the gaseous mixture. The patentee therefore proposes to warm the liquid hydrocarbon by the hot water, condensed by the engine, maintaining that by so doing, the operations become "entirely automatic." If more gas be consumed at the burners, more air is pumped through the liquid hydrocarbon, the water from the condenser becomes heated to a higher temperature, and more hydrocarbon is volatilised, and conversely.—E. R. B.

*Artificial Fuel, Improvements in the Manufacture of.* L. G. Harris, Toronto. Eng. Pat. 7664, April 16, 1895.

The objects are to produce a cheap gas oil fuel, and to utilise waste products. The composition is as follows:—

Oil product from petroleum, such as sodius oil, which is a mixture of gas oil and tar oil, crude oil, or any combination of these, 100 galls.; calcium chloride, 10 lb.; caustic soda, 333 grms.; powdered soap bark, 150 grms.; waste products, such as garbage, city refuse, sawdust, peat, manure, coal dust, coal screenings, slack coal, and the like, slightly less than 4 tons.

The first four ingredients are mixed together in a covered receptacle, and then the waste products are thrown in till the liquid is completely absorbed.—R. S.

*Furnaces for Melting Glass, Puddling Iron, or like Operations, Improvements in.* C. Bateson and Chr. Bateson, Edge Hill, Lancashire. Eng. Pat. 7947, April 22, 1895.

*See under* I., *page* 1036.

*Acetylene Gas Lamp.* F. Rossbach-Rousset, Tempelhof, near Berlin. Eng. Pat. 11,783, June 17, 1895.

By this invention, acetylene is obtained from calcium carbide and water; the water, required in the decomposition, being supplied from a water-holder in the lamp, in quantity proportionate to the quantity of gas burnt at the burner. The principal mechanism regulating the supply of water to the calcium carbide consists of a float, which rests on the surface of the water, and which actuates a valve. When the burner is turned off, the acetylene accumulates, under pressure, in the lamp; the surface of the water in the holder becomes lowered, and with it the float. As the float falls, the valve, on the tube supplying water to the calcium carbide chamber, closes.—E. R. B.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, Etc.

*Petroleum Industry. Importance of Establishing Uniform methods of Testing.* R. Zaloziecki. Chem. Rev. Fett. u. Harz-Ind. 1895, [25], 1—3.

A notable instance of the desirability of establishing well-founded methods for universal adoption, is afforded by the distillation test, which, although yielding concordant results when performed under identical conditions, is deficient in practical utility on account of its results always coming out lower (though not regularly so) than those obtainable in the refinery—variations of as much as 25 per cent. having been observed,—thus rendering the method inapplicable for the estimation of the value of a crude oil.

Again, it is pointed out that the determination of the so-called melting-point of ozokerite is surrounded with difficulty, a series of concurrent influences being at work.

The success that has attended the use of definite regulations in testing the flashing-point by the Abel-Pensky instrument is referred to as showing that no insurmountable obstacles stand in the way of the attainment of the desired uniformity.

As a preliminary substratum to work upon, the following points are proposed for consideration, to be eventually modified as discussion and conference may suggest:—

1. *Determination of Bases for the Valuation of Crude Oil.*—Distillation methods; specific gravity (instrument, temperature, factors in reduction to normal temperature) resin and ash content; colouring matters, paraffin, sulphur, water, and loss; value for refining; calorific power; characteristics and points of difference between crude and refined oils, and between crude oils of different origin.

2. *Fixing Bases for the Valuation of Ozokerite, Asphalt, &c.*—Determining specific gravity, melting and congealing points, resin and ash content, colouring matter, paraffin, sulphur, impurities, yield of ceresin, distillation test.

3. *Establishing Uniformity of Nomenclature for the Various Illuminating Oils,* with strict definition of properties, limits of specific gravity, and boiling-points. Determination of specific gravity, saturated and aromatic hydrocarbons, degree of purity, and amount, &c. of impurities. Distillation method. "Fat test" for benzine.

4. *Fixing Bases for the Valuation of Lighting and Burning Oils.*—Setting up a uniform method of distillation. Determining specific gravity, colour (agreeing on a standard and uniform classification and designation); degree of refining (acid and alkali tests); flashing and burning points (including testing apparatus, application, and "danger point"); acid content; ash; capillarity; illuminating power (photometric standard, instrument, and application; factors influencing illuminating power, and precautions for ensuring comparability of results). Judging heavy oils (pyronaphtha, solar oil, &c.).

5. *Lubricating Oils and Fats.*—Determination of consistency; resistance to cold; viscosity (tester, application, suitable unit); specific gravity, melting-point; flashing and burning point (apparatus and method); degree of refining; resin and acid content; paraffin; ash; reliability of friction testers. Examination of pure and mixed lubricants for impurities.

6. *Petroleum Residuum.*—Testing consistency; viscosity; resin, acid, and ash content; value for refining; calorific power; suitability for gas-making, and yield of gas.

7. *Paraffin and Ceresin.* — Determining physical characteristics, purity, impurities, and colouring matter.

It is mentioned that the Russian Technical Society in Baku has approved of a similar proposition already submitted by the author, and discussion is invited.—C. S.

*Petroleum Industry. Establishing Uniform Methods of Testing.* R. Wischin. Chem. Rev. Fett. u. Harz-Ind. 1895, [27], 1—4. (See preceding Abstract.)

The manner in which the distillation test for petroleum should be performed depends on the object to be attained, *i.e.*, whether it is desired to test the identity of a crude oil, &c., or the kind and quantity of distillation products it will yield, or again to obtain an idea of its quality. A method communicated by Johannes Hirsch, of the Pardubitz Refinery, possesses certain advantages over Engler's intermittent process. This method consists in the employment of a 300-c.c. bulb-flask (wrapped in several layers of gauze and an outer covering of asbestos) fitted with a Glinsky dephlegmator, also protected—with the exception of the return tube, left uncovered so that the progress of distillation may be watched—by means of a covering of metal gauze and linen cloth. The rate of distillation should be limited to 16—20 drops per minute when the temperature approaches within 10° of the limit, but may be increased at lower temperatures to 50—60 drops per minute. Whichever method be adopted, it is not advisable to work with less than 200 c.c. of oil.

When, however, it becomes a question of ascertaining the yield of a crude oil or crude product, it is necessary to work on lines more closely assimilating with actual practice, since it is not always convenient to make a trial distillation in the refinery, and the author proposes the following apparatus, which has constantly yielded him results agreeing with those obtainable on a manufacturing scale :—

A cast-iron still holding 2 litres of oil, and fitted with a lid that can be made vapour-tight by means of screw clamps and asbestos packing, is used, and is fixed in a surrounding cylinder of sheet metal. Two thermometers, one for taking the temperature of the oil, and the other—in the neck of the still—for that of the vapour, are inserted through stuffing glands in the lid, and a steam pipe for superheated steam is also provided. The distillation is to be regulated so that the distillate passes from the condenser at a rate just between dropping and flowing, and the distillates are divided into 20 equal portions of 100 c.c., each being, where necessary, made up to the precise quantity—after cooling down in water to exactly 15° C.—by the addition of a sufficient volume of the next higher fraction. Tables are given showing the results obtained with Caucasian crude naphtha, "Kunstöl," Pennsylvania oil, and Roumanian oil, agreeing in every instance with those yielded in the refinery.—C. S.

*Mineral Oil Refining, Theory and Practice of.* R. Wischin. Chem. Rev. Fett. u. Harz-Ind. 1895, [26, 27].

The action of sulphuric acid in refining petroleum is very complicated, and its clarifying effect on the oil is influenced by the duration of exposure as well as by the strength of the acid. The deeper colour of oil that has been too long in contact with the acid would appear to be due, in part at least, to the decomposition of the acid tar at first formed and the re-solution of some of its asphaltic constituents by the oil. For this reason the practice prevailing in Baku, of using sludge acid over again in the process of preliminary acidification, is not recommended, since in its diluted condition this acid cannot possess such solvent properties as fresh acid. The other novel practice in Baku, of running into the acid agitator just before the end of the process about 1 per cent. of 30° B. soda-lye and mixing the whole up for 10 to 15 minutes, causes, it is true, a rapid deposit of the sludge in the oil, but in some cases brings it down in big, hard lumps difficult of removal from the agitator; it is therefore unavailable for such oils (Galician, Hungarian, Roumanian).

Speaking of the prejudice existing in some quarters against air-blast agitators, the author points out that the presence of sulphurous acid is sufficient to counteract any oxidising action of the air, and the Eckenberg centrifugal agitator is declared to be unsuitable for the alkali treatment on account of its tendency to promote the formation of emulsions.

With reference to the action of light on the colour of the oil during refining, it is assumed that the acid asphalt is susceptible of molecular re-arrangement under the influence of the actinic rays. This is apparently the case in other instances; for example, a layer of bitumen found near Siebenbürgen, has in part been so altered as to be unworkable by the usual method employed for the remainder of the same deposit. It was experimentally proved that this change could only have resulted from the action of light, and this view is supported by the fact that a photographic process at present in use is based on the susceptibility of bitumen to light. It is, however, considered that light is without effect on these asphaltic bodies in their original form, and that it is only when secondary compounds of the same with sulphuric acid have been produced that the influence commences.

It is suggested that the formation of these secondary compounds may be due to the reduction of sulphuric acid, first to sulphur dioxide, and then to sulphur, which in a nascent state enters into combination with the asphaltic bodies to form true asphalt—a process that may have had its prototype in nature in the formation of asphalt from petroleum and sulphur, or sulphuretted hydrogen, under pressure and heat.—C. S.

*Spirit from Cellulose and Wood.* E. Simonsen. Journal of the Polytech. Soc. of Christiania, 1895.

Concerning "inversion" under high pressure, no systematic observations on the effect of different conditions, such as quantity of water and acid, pressure and time, are to be found in technical literature. The fact, however, that processes in this direction have been worked on the manufacturing scale, shows that observations may have been made but not published. These observations can scarcely have concerned the inversion under pressure, as this method has only been regarded as workable on the large scale within the last few years.

The purpose of the author has been to learn whether isolated cellulose can be inverted or if not, how much sugar at most can be obtained; also, by comparison with similar observations on wood, to gain a knowledge of the behaviour of the incrusting portions; also to determine the most economical method of inversion.

The materials were air-dried sulphite cellulose, and ordinary pine sawdust. In most of the experiments 40 grms. of cellulose or 100 grms. of sawdust were used, so that the observations might not be made on too small a scale. For the inversion, an ordinary Mnencke's autoclave for 25 atmospheres was used, the mixture being placed in a lead vessel surrounded by water.

The time is taken from the moment when the pressure attained the desired degree, all air having been expelled by opening the safety valve for a short time during the heating. The solutions obtained were titrated with Fehling's solution, and the numbers resulting, calculated as sugar, and serve for comparison.

*Sulphite Cellulose.*—The first experiments were made to determine the influence of pressure and quantity of acid.

40 grms. dried cellulose, 1,080 c.c. of 0·3 per cent. sulphuric acid; time 4 hours :—

| No. of Experiment. | Pressure. | Yield of Sugar. |
|---|---|---|
| | Atmospheres. | Per Cent. |
| 1 | 1·3 | 2·5 |
| 2 | 2·1 | 6·6 |
| 3 | 2·7 | 9·3 |
| 4 | 4·0 | 16·4 |
| 5 | 6·0 | 28·0 |
| 6 | 8·0 | 38·4 |
| 7 | 9·0 | 43·1 |
| 8 | 10·0 | 36·6 |

These results show a gradual increase in the yield of sugar as the pressure increases up to 9 atmospheres, when the maximum 43·1 per cent. is obtained.

The next six experiments were with an acid of 0·45 per cent. strength, the other conditions being as before :—

| No. of Experiment. | Pressure. | Yield of Sugar. |
|---|---|---|
| | Atmospheres. | Per Cent. |
| 9 | 1·3 | 2·7 |
| 10 | 2·1 | 8·6 |
| 11 | 2·7 | 11·3 |
| 12 | 6·0 | 30·7 |
| 13 | 8·0 | 45·0 |
| 14 | 10·0 | 30·0 |

Similarly, using 0·6 per cent. acid, a maximum yield of 43·9 per cent. of sugar was obtained at 6 atmospheres pressure. Other experiments were made with acid of greater and less strengths than those cited, but with lesser yields. The influence of time is next dealt with, and the results go to show that very little increase in the yield of sugar is obtained by increasing the time, a yield of 45·4 per cent. of sugar being obtained with a two hours' treatment with acid of 0·45 per cent. strength.

Variations in the quantity of acid showed that a yield of 40·9 per cent. of sugar could be obtained with 10 atmospheres pressure, using only 250 c.c. of 0·5 per cent. acid with 40 grms. of cellulose.

This being the case, it was attempted to shorten the time, and a maximum yield of 42·7 per cent. of sugar was obtained with $1\frac{1}{2}$ hours' treatment.

The best conditions for inversion were therefore 1 part of cellulose with 6 parts of sulphuric acid (0·5 per cent.) at a pressure of 10 atmospheres for $1\frac{1}{2}$ hours, giving a yield of over 41 per cent. of a reducing sugar.

To decide the question whether the high yields were due to the pressure or to the temperature employed, an experiment was tried with chloroform surrounding the lead vessel; by this means a pressure of 10 atmospheres was obtained with a temperature of 138° C., in place of 180·3° C. when using water. The yield of only 13·2 per cent. of sugar, shows definitely that the increased inversion is due to the higher temperature.

The best conditions for maximum yields being determined upon, experiments were made on the fermentation of the solutions obtained. The solutions were neutralised with calcium carbonate, evaporated to about a quarter of their original volume, and the residue was fermented with ordinary fresh yeast, and the fermented liquid distilled, the alcohol in the distillate being determined by the specific gravity and also by the ebullioscope. The yield was 20 c.c. of absolute alcohol out of a possible 27 c.c. calculated.

The sugar obtained may be taken to be chiefly if not entirely glucose. The spirit had a peculiar and somewhat empyreumatic smell, and had all the characteristic properties of ethyl alcohol.

Other acids, such as oxalic acid, were tried in place of sulphuric acid, with inferior results.

Attention is also called to the formation of organic acids during the inversion.

*Sawdust.*—Ordinary air-dried pine sawdust was used, containing about 8 per cent. of moisture. Similar experiments were made to those on cellulose to ascertain the conditions for obtaining the maximum yield. It was found that using 1 part of sawdust with 5 parts of 0·5 per cent. sulphuric acid, under the influence of the temperature required to raise the pressure to 9 atmospheres, a yield of 22·2 per cent. of reducing sugar could be obtained in 15 minutes.

It was also found that the residues could be further inverted by repeating the process, but not with a remunerative yield.

A comparison of the yields from cellulose and wood shows that the sugar obtained corresponds to the quantity of cellulose in the wood, and as the residues of the latter still show the phloroglucol reaction, it was concluded that the incrusting constituents do not contribute to the yield of sugar.

Fermentation experiments on the solutions from the wood were made, with the result that 60 per cent. of the sugar was fermented. Thus, from 100 kilos. of wood, 6.5 kilos. of absolute alcohol may be obtained by this process. It is noticed that the wood with its acid must not be subjected to direct heat, as, in this case, the sugar formed only appears to be fermentable in a very slight degree (this Journal, 1895, 879; Eng. Pat. 10,762, 1895).
—J. C. C.

*Oil of Turpentine.* The Ironmonger, 1895, 232.

THERE are always many difficulties in examining turpentine, since there are several varieties of it which possess essentially different properties. The chief of these varieties are French, English, or American, and Russian. The optical activity used to be regarded as a very definite test, as turpentine rotates the plane of polarisation, whilst none of its adulterants usually do so. The amount of rotation being fairly constant, any reduction was looked upon as indicating adulteration. But since French turpentine rotates the plane to the left, and American and Russian to the right, it is clear that mixtures of these varieties might give neutral results without the addition of any adulterant. The specific gravity, too, was once thought very valuable, but in reality this will only indicate adulteration with petroleum spirit, as the following figures show:—

| | |
|---|---|
| Turpentine.................. | 0·858 to 0·878 |
| Coal-tar naphtha........... | 0·860 to 0·875 |
| Rosin spirit................. | 0·856 to 0·880 |
| Petroleum naphtha......... | 0·700 to 0·750 |

The flash-point is also valuable in showing any adulteration with ordinary petroleum naphtha. It has always been found that in genuine samples this varied (taken by the official test in Abel's apparatus) from 92° F. to 98° F. The addition of 5 per cent. of petroleum naphtha will lower this figure very considerably. The residue, after drying on the water-bath, does not exceed 1 per cent. in the best samples, although in old samples it rises considerably. By far the most useful test, however, is the behaviour on distillation. With petroleum spirit or rosin spirit the initial temperature of distillation varies greatly with the quality of the spirit, and the temperature rises gradually without allowing any large quantity to come over at any specific temperature. With both of these adulterants a variable proportion of residue of very high boiling-point is usually left in the still.

The results are tabulated below of an examination of undoubtedly genuine specimens:—

| — | No. I. American Turpentine. | No. II. Russian Turpentine. | No. III. American Turpentine. | No. IV. American Turpentine. |
|---|---|---|---|---|
| Specific gravity . | 0·8768 | 0·8713 | 0·858 | 0·867 |
| Flash-point..... | 95° F. | 98° F. | 92°F. | 95° F. |
| Viscosity (Redwood) at 60°. | 27 seconds | 26 seconds | .. | 26 seconds |
| Residue at 100° C. | 1·6 % | 1·75 % | .. | 0·62 % |
| Boiling-point ... | 312° F. | 320° F. | 309° F. | 312° F. |
| Fraction below 160°.. | 46·5 % | .. | .. | .. |
| 165°.. | 35·0 % | 32 % | 66 % | 92 % |
| 170°.. | 5·0 % | 35 % | 12 % | 1 % |
| 175°.. | 1·8 % | 15 % | 6 % | .. |

The chief point of note is that American turpentine yields a heavy proportion of its distillate below 165° C., whereas the Russian oil distils at a slightly higher temperature.

*Carbolic Acid, Storage of.* W. v. Hankó. Chem. Zeit. 1895, 1143—1144.

BALLAND has recommended the use of aluminium vessels for storing carbolic acid (This Journal, 1895, 276), but the author finds tinned vessels equally resistant, whilst they are cheaper and stronger than those of aluminium. The red appearance of the phenol is a result of oxidation. When the action of ammonia, certain ammonium compounds, dust, the metal of the containing vessel, or direct sunlight is superadded, the reddening is more rapid. Stannous, chloride, shaken with the coloured liquid, renders it emerald green. And the addition of powdered stannous chloride to the pure melted phenol checks the reddening process, giving a product which remains long unaltered if stored in air-tight blue glass vessels. In packing, small receptacles should be used, and repeated re-melting in presence of air should be avoided. Enclosed in tinned iron, carbolic acid should remain unchanged for years.—W. G. M.

## IV.—COLOURING MATTERS AND DYES.

*Derivatives of Maclurin.* C. S. Bedford and A. G. Perkin. Proc. Chem. Soc. 1895, [155], 161.

WHEN an aqueous extract of old fustic (*Morus tinctoria*) is treated with a solution of diazobenzene sulphate, a colouring matter is produced. The chief constituents of old fustic are morin, $C_{15}H_{10}O_7$, and maclurin, $C_{13}H_{10}O_6$; only the latter reacts readily with diazobenzene. Benzene-azomaclurin, $C_{13}H_8O_6(C_6H_5.N_2)_2$, *o*- and *p*-toluene-azomaclurin, *p*-nitrobenzene-azomaclurin, and maclurinazobenzene-*p*-sulphonate of sodium have also been prepared. These substances dye wool and silk orange coloured to deep brown shades.

### *Constituents of "Artocarpus Integrifolia."* A. G. Perkin and F. Cope. Proc. Chem. Soc. 1895, [155], 161.

*Artocarpus integrifolia* is the well-known Jack Fruit tree of India, Burmah, and Ceylon. The wood is much esteemed for carpentry, and is used in conjunction with alum as a yellow dye. It contains a yellow colouring matter of the formula $C_{15}H_{10}O_7$, identical with *morin*, and a substance of the formula $C_{15}H_{12}O_6$, to which the name *cyanomaclurin* has been given. With diazobenzene it yields a compound, $C_{15}H_{10}O_6(C_6H_5.N_2)_2$, crystallising in scarlet needles, which dyes unmordanted wool and silk orange to orange-red shades, but which does not dye with mordants. Cyanomaclurin is not a glucoside.

### *Tetramethyldiamidodiphenylcarbinol: its Instability.* A. Rosenstiehl. Bull. Soc. Chim. 13, 275.

The leucobase of auramine, on treatment with acids in the cold, is decomposed into ammonia and tetramethyldiamidodiphenylcarbinol. If this action is prolonged, the hydrol itself is attacked, the leucobase of the hexamethylated violet being the chief product of this second reaction. Weil showed that dimethylamidobenzaldehyde is formed at the same time. This remarkable reaction is obtained much more easily and quickly with weak than with strong acids.

—C. O. W.

### *Resorcinol Black.* P. Monnet. Färber Zeit. 6, 207.

When resorcinol is heated with potassium bichromate and a nitrite in aqueous solution, a colouring matter is produced which is soluble in water, and dyes a black on wool, cotton, and silk. 20 kilos. of $K_2Cr_2O_7$ are dissolved in 100 litres of boiling water, and 200 kilos. of resorcinol are added. Boiling is continued, adding gradually 20 kilos. of dry sodium nitrite, and heat is maintained until the mass begins to thicken. It is then evaporated to dryness on the water-bath. Wool and silk are dyed in faintly acid baths, a small quantity of tartar emetic being a useful addition. The black is fast to soaping and to light.—R. B. B.

### *Constitution of β-Anthraquinone.* K. Lagodzinski. Ber. 28, 1422.

*See under* XXIV., *page* 1074.

## PATENTS.

### *New Black Colouring Matter, the Manufacture and Production of, and the Production of Black Colour on Vegetable Fibre.* J. Y. Johnson, London. From "The Badische Anilin and Soda Fabrik," Ludwigshafen, Germany. Eng. Pat. 22,603, November 22, 1894.

This is an extension of Eng. Pat. 10,996 of 1893 (this Journal, 1894, 630), and consists in heating with caustic alkalis, the dye B of the above-mentioned patent, which is produced by the action of certain reducing agents, such as sodium sulphide, on 1.1′-dinitronaphthalene. The new dyestuff, which is readily soluble in cold alkaline water, dyes unmordanted vegetable fibre in the cold. The same property is possessed by an alkaline solution of dye C, and hence the action of caustic alkalis on a mixture of dyes B and C gives a new dyestuff, which can be used directly for dyeing unmordanted fibre in the cold. About 200 kilos. of dye B (containing 30 per cent. of B alone or mixed with C) and 100 kilos. of caustic soda-lye (23 per cent. NaOH) are heated for an hour on the water-bath. The bluish-violet solution so formed may be used directly for dyeing purposes, or the product may be obtained as a black powder by evaporation. Mineral acids give a black precipitate, but excess of alkali does not precipitate the dyestuff. The solution in concentrated sulphuric acid is greyish-green. The following example describes the preparation of the new dyestuff from 1.1′-dinitronaphthalene without separation of B or C. About 10 kilos. of 1·1′-dinitronaphthalene are boiled with 2,000 litres of water and about 50 kilos. of sodium sulphide ($Na_2S.9H_2O$) are added. After boiling for about half an hour, 100 kilos. of 30 per cent. hydrochloric acid are added to the filtered solution, and the boiling is continued for two hours, the resulting precipitate being then filtered off and well washed. The product so obtained is mixed with sufficient water to make a 30 per per cent. paste, which, after mixing with half its weight of 23 per cent. caustic soda-lye, is treated according to the method given above in the foregoing example. In order to produce a black on cotton, the fibre is padded with a cold solution of the colouring matter for about half an hour, and is then washed and dried. One kilo. of the new dyestuff containing dye C in 45 litres of water, gives a dead black on 10 kilos. of cotton. In a similar manner the violet dyestuff obtained by Troost, by acting on dinitronaphthalene with sodium sulphide, can be converted into a blue-black colouring matter by digesting it with a caustic alkali.

—T. A. L.

### *Derivatives of Hydroxyanthraquinone, the Manufacture or Production of.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 23,927, December 8, 1894.

The products referred to are obtained by condensing hydroxyanthraquinones, such as quinizarin, purpurin, hydroxyanthrapurpurin, hydroxyflavopurpurin, anthrachrysone, alizarinbordeaux, alizarinpentacyanine, alizarin hexacyanine, and hexahydroxyanthraquinone with aromatic aminesand diamines, such as aniline, the toluidines, the naphthylamines, *p*-phenylenediamine, &c., in presence of suitable condensing agents, such as hydrochloric, sulphuric, or boric acid, or zinc chloride and the like. The above-mentioned hydroxyanthraquinones may be replaced by certain of their derivatives, such as nitropurpurin, α-nitroalizarin, dinitro-anthrachrysone, &c. The products obtained are, in general, mixtures which can be separated, but for practical purposes this is not usually necessary. Some of the compounds can be used directly as dyestuffs, whilst they can all be employed as colouring matters by converting them into sulphonic acids. The following example illustrates the methods employed:—10 kilos. of quinizarin, 10 kilos. of crystallised boric acid, and 150 kilos. of *p*-toluidine, are heated at 130°—140° C. until a sample dissolves to a green solution in aniline, and the product is purified by recrystallisation from this solvent. It separates from glacial acetic acid in dark violet needles melting at about 200° C., and is a di-*p*-toluide derivative of quinizarin, some of the mono compound also being formed simultaneously, and this can be obtained as the chief product by varying the conditions of working. The di-*p*-toluide derivative on sulphonation gives a sulphonic acid, which dyes green shades both on unmordanted and on chromed wool.

—T. A. L.

### *Certain Iron Residues [Aniline Works, &c.], Improvements in the Utilisation of.* C. Dreyfus, Manchester. Eng. Pat. 24,837, December 21, 1894.

The slimy iron residue from the reduction of organic nitro- to amido-compounds, is mixed with water or other liquid, and with an agglomerant, such as clay, the latter being in the proportion of from 2 to 10 per cent. of the residue, reckoned as dry. The mixture, after moulding into bricks and drying, or firing if necessary, may be used as a substitute for iron ore in the manufacture of iron and steel.

—W. G. M.

### *Polyazo Dyestuffs [Black Cotton Dyes] from Amidonaphtholsulpho Acids, New Processes for Producing.* S. Pitt, Sutton. From L. Cassella and Co., Frankfort-on-the-Maine, Germany. Eng. Pat. 25,018, December 22, 1894.

The present specification, which is an extension of Eng. Pat. 19,330 of 1890 (this Journal, 1891, 917), and of Eng. Pat. 9529 of 1894 (this Journal, 1895, 478), gives a number of combinations in the formation of polyazo dyestuffs which may be carried out, replacing in some instances the γ-amidonaphtholsulphonic acid of the above specifications by other components, which after combination are diazotisable, and employing also *m*-diamines as last components. For instance, the tetrazo-azo compound produced, according to Ex. 1 of Eng. Pat. 9529 of 1895, by combining equimolecular proportions of tetrazodiphenylamine and γ-amidonaphtholsulphonic acid, is mixed with one molecular proportion of 1.1′.3.3′-amidonaphtholdisulphonic acid in a solution kept alkaline with sodium carbonate. The black intermediate compound so formed, when combined with one molecular proportion of *m*-phenylenediamine, yields a dyestuff which gives bluish-black shades on unmordanted cotton. Also, the γ-amidonaphtholsulphonic acid may, in some of the processes described, be replaced, according to Eng. Pat. 6972 of 1891 (this Journal, 1892, 345), by the β-amidonaphtholdisulphonic acid, which is obtained by fusing β-naphthylamine trisulphonic acid with caustic alkalis. The tetrazo compound from 20 kilos. of diamidodiphenylamine is mixed with a solution of 32 kilos. of β-amidonaphtholdisulphonic acid in presence of sodium carbonate. A faintly alkaline solution of 25 kilos. of γ-amidonaphtholdisulphonic acid is then added to the intermediate compound produced, and the colouring matter, which dyes unmordanted cotton bluish-black, is formed directly.—T. A. L.

### *Azo Colours [Black Dyestuffs] on Fibre, the Manufacture or Production of.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 25,213, December 28, 1894.

This is an application of the *p*-nitraniline red process for the production of blacks on the fibre, and consists in combining the tetrazo compound of a diamido-azo compound containing a naphthalene nucleus with a salt of β-naphthol printed or padded on the cotton fibre. The shade can be altered by adding cupric chloride solution (40° B.) to the tetrazo compound. The following compounds are suitable for the purposes of this invention :—*p*-amidobenzene-azo-α-naphthylamine, amidobenzene-azo-amidonaphthol, amidobenzene-azo-amidonaphthol ether, amidotoluene-azo-α-naphthylamine, amidotoluene-azo-amidonaphthol and its ether, amidonaphthalene-azo-amidonaphthol, and amidonaphthalene-azo-amidonaphthol ether or the like.—T. A. L.

### *Colouring Matters [Red and Violet], and a New Material therefor, the Manufacture or Production of.* H. E. Newton, London. From "The Farbenfabriken vormals F. Bayer and Co.," Elberfeld, Germany. Eng. Pat. 25,214, Dec. 28, 1894.

The specification relates to the preparation of 2.4.2′-amidonaphtholsulphonic acid, which is a new product, and is obtained by the action of caustic potash on the sodium or potassium salt of 2.4.2′-naphthylaminedisulphonic acid. It also describes the production of dyestuffs from this compound by combining with it tetrazo compounds, or by using it as one of the components in a reaction of this kind. The shades obtained are bluish-red to reddish-violet, and are said to be fast. The production of the amidonaphtholsulphonic acid can be carried out under pressure, or else by heating 1 kilo. of 2.4.2′-naphthylamine disulphonate of potassium or sodium and 5 kilos. of potash to 130° C. The melt gradually changes from yellowish-red to dark-brown, the temperature rising to 185° C. After cooling, the melt is acidulated, when the new amidonaphtholmonosulphonic acid separates in crusts. When heated with water to 200° C., it forms dihydroxynaphthalenesulphonic acid, which is also obtained by heating 1.2.3′-amidonaphtholsulphonic acid with 5 parts of a 5 per cent. sulphuric acid solution to 200° C. The combination with a tetrazo compound is carried out in the usual manner, preferably in presence of sodium acetate and acetic acid.—T. A. L.

### *Colouring Matters [Cotton Browns], Improvements in the Manufacture of.* H. H. Lake, London. From K. Oehler, Offenbach-on-the-Maine, Germany. Eng. Pat. 676, January 10, 1895.

The brown azo dyestuffs referred to, contain the azo group at least eight times in a molecule, and are obtained from the Bismarck-brown sulphonic acids of Eng. Pat. 11,000 of 1889 (this Journal, 1890, 609), by combining 2 molecular proportions of these compounds with 1 molecular proportion of a tetrazotised diamidonaphthalenedisulphonic acid, and finally combining the resulting product with 2 molecular proportions of a diazotised amidosulphonic acid. The following example gives the quantities employed :—8 kilos. of diamido-β-naphthalenedisulphonic acid are suspended in 200 litres of water and 11 kilos. of hydrochloric acid (20° B.), and converted into the tetrazo compound by adding 3·5 kilos. of sodium nitrite in 8 litres of water. The solution is then poured, with constant agitation, into 500 litres of water containing 20 kilos. of soda and 23·1 kilos. of the dyestuff obtained, according to the above-mentioned specification, by combining 1 molecular proportion of tetrazotised tolylene diamine sulphonic acid with two molecular proportions of *m*-phenylene diamine. The formation of the dyestuff is completed in about 24 hours, and there is then added to it the diazonaphthalenesulphonic acid from 12·3 kilos. of sodium naphthionate, 20 kilos. of hydrochloric acid, and 3·5 kilos. of sodium nitrite, together with the necessary quantity of water. After standing 24 hours, the whole is boiled up, and the dyestuff is salted out. It forms a blackish-brown powder which dissolves in concentrated sulphuric acid with a violet-brown colour, turning yellowish-brown on addition of water. It dyes unmordanted cotton deep chestnut-brown from an alkaline soap-bath, and is fast to soap. The *m*-phenylene diamine of the above example may be replaced by *m*-tolylene diamine, and the naphthionic acid by other amidosulphonic acids, such as sulphanilic acid, β-naphthylamine sulphonic acid, &c. All these colouring matters dye various shades of brown.—T. A. L.

### *Black-Blue to Black Disazo Colouring Matters for Wool, Manufacture of.* O. Imray, London. From "The Society of Chemical Industry in Basle," Basle, Switzerland. Eng. Pat. 15,457, Aug. 16, 1895.

The colouring matters obtained by combining equimolecular proportions of a diazo compound and 1.1′.3.3′-naphthylene diamine disulphonic acid, yield brown and red to violet dyestuffs, sensitive to acids and of no technical importance. By further combination of these compounds with diazotised paranitraniline, they are converted into valuable colouring matters, which dye wool black from an acid bath. The diazo compound from 19·5 kilos. of *m*-sulphanilic acid is combined with 32 kilos. of 1.1′.3.3′-naphthylene diamine disulphonic acid in presence of acetic acid. After standing some hours, a solution of diazotised paranitraniline, together with sodium acetate or carbonate, is run in. The orange-brown solution turns blue-black, and after agitation for some hours the formation of the new dyestuff is complete. It forms a blackish-brown powder soluble in water with a violet colour, and dyes wool black from an acid bath. Other components may be used in place of the *m*-sulphanilic acid, and in some cases the combinations may be performed in the reverse order. Thus, for instance, diazotised paranitraniline may be first combined with the 1.1′.3.3′-naphthylene diamine disulphonic acid, and the resulting compound will then further combine with diazotised *p*-sulphanilic acid. All the dyestuffs are said to be fast to light and fulling.—T. A. L.

### *New Leuko Compound of the Gallocyanine Group [Blue Dyestuff], Manufacture of a.* J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, Basle, Switzerland. Eng. Pat. 16,301, Aug. 30, 1895.

According to Eng. Pat. 15,064 of 1894 (this Journal, 1894, 1055), a leuco compound of the gallocyanine series is produced by condensing resorcinol with gallamine blue. In the present specification, the patentees have replaced in the above reaction, the gallamine blue by the condensation product from gallaminic acid and nitroso-diethylaniline hydrochloride or diethylamido-azo-benzene hydrochloride, and the resulting leuco compound, an easily soluble product, when oxidised on the fibre, gives much bluer shades than the corresponding leuco compounds from gallamine blue. 300 kilos. of the gallocyanine colouring matter produced from gallaminic acid and the hydrochloride of diethyl-amido-azo-benzene or of nitroso-diethylaniline, 150 kilos. of resorcinol, 200 litres of water, and 900 kilos. of ordinary hydrochloric acid, are heated on the water-bath until the blue coloration has disappeared. The melt is then filter-pressed, and the residue dissolved in water. After boiling this solution, the leuco compound is precipitated by salt or an acid. The new substance, which is almost insoluble in acid water, alcohol, and sodium acetate, is readily soluble in pure water. In soda-lye, or a 10 per cent. sodium carbonate solution, it dissolves with a yellowish-green coloration, which rapidly turns blue. Concentrated sulphuric acid dissolves it with a yellowish-brown coloration, and nitric acid added to this solution produces first a blue and subsequently a red colour. By printing the leuco compound on cotton with a chromium mordant, it can be oxidised to a blue colouring matter on the fibre, whilst, owing to its easy solubility in water, it can be used for dyeing directly by adding an oxidising agent, such as sodium chlorate, to the dye-bath.—T. A. L.

*Sulphides and Sulphydrates of Alkaline Earths [Alkali Waste], Process for the Utilisation of, and the Production of Aniline, Toluidine, or Amidobenzaldehydes by the Treatment of the said Substances with Nitro Bodies.* H. Loesner, Leipzig, Germany. Eng. Pat. 16,407, Sept. 2, 1895.

In the existing modes of producing aniline, it has not been possible to obtain a greater yield than from 92 to 93 per cent. of the theoretical amount, owing to the fact that with the reduction by means of iron and hydrochloric acid there is always some iron chloride produced, which acts upon the aniline already formed and thus reduces the yield. It has been found that of the above-mentioned substances, calcium sulphide is best suited for the reduction, and for this purpose the residues of the Leblanc soda works can be directly used. These substances do not enter into combination with aniline, as neither caustic lime nor thiosulphate (the products of the reduction) have any action on aniline. Thus a detrimental subsidiary reaction, which considerably affects the yield, does not occur. Moreover, the aniline is obtained as a free base, so that the quantity of hydrochloric acid and the caustic lime necessary for decomposing the hydrochloride are saved.—D. B.

## V.—TEXTILES: COTTON, WOOL, SILK, Etc.

*Byssus.* H. Silbermann. Färber Zeit. **7**, 1895, 18—19.

Byssus has long been known as a textile material, and in antiquity the so-called *lana pinnæ* was largely used, especially in India and other oriental countries. At the present time only a small quantity of the raw material is collected on the coasts of Calabria and Sicily, where the mollusc, *Pinna nobilis*, which produces it, occurs very frequently. The author is of opinion that much larger quantities of this valuable fibrous substance might be obtained by collecting the material more systematically, and by not destroying the animals, as the latter are constantly producing fresh quantities of byssus fibres.

The physical and chemical properties of byssus are similar to silk, the fibre being more or less cylindrical, and of a homogeneous structure which shows on its surface very fine longitudinal lines. The fibres are about 3—8 cm. long, and their thickness varies between 0·01 and 0·1 mm. It is important to note that the byssus fibre contains somewhat less nitrogen than silk, and that its power of resistance against bleaching agents is greater. The author recommends the following treatment of the raw material:—It is first washed in a weak soap solution and then dried in a dark place. After that the fibres are combed, washed again in very dilute citric acid, dried, and finally ironed.
—H. S.

*Fabrics, Waterproofing of.* A. Lindemann. Färber Zeit. **6**, 246.

In this process, which is equally suitable for cotton, union, or woollen fabrics, two baths are used. The first of these consists of a solution of 140 grms. of olive-oil soap and 240 grms. of sodium silicate of 40° B. in 100 litres of water. The second bath is made up of 3·5 litres of aluminium acetate of 13° B. and 100 litres of water. The water used for the first bath should be free from lime and iron. For white and light-coloured goods, the aluminium acetate is prepared by dissolving 20 kilos. of powdered alum in 20 litres of boiling water. In a second vessel 13·44 kilos. of lead acetate are dissolved in 20 litres of boiling water. The two hot solutions are poured together, and, after some standing, the resulting clear solution is drawn off from the precipitate. A much cheaper solution is obtained by dissolving 17·45 kilos. of aluminium sulphate and 5·67 kilos. of commercial calcium acetate, each in 20 litres of boiling water, and mixing these solutions together. After the settling of the precipitate, a clear brown solution of aluminium acetate is obtained, containing small quantities of iron salts, for which reason it can only be used for dark or brown fabrics. If the aluminium acetate be prepared in this manner, the solution should always be tested if addition of more aluminium sulphate cause a further precipitation of calcium sulphate, as it is essential to have the solution as free from lime as possible. A small excess of aluminium sulphate is unobjectionable. The dry cloth is passed into the first of these solutions and worked in the cold solution from 15 to 45 minutes. The cloth is then passed through a pair of squeezing rollers, creases being carefully avoided, and passed into the second solution, in which it is treated in the cold for from 15 to 30 minutes. After this the cloth is washed first in water at from 65° to 75° C., then in cold water. These operations can be carried out in continuous-washing machines. The above described operations, in cases where highly waterproofed fabrics are required, may be repeated. The colour of the fabrics undergoing this treatment should be fast to alkali. Fabrics consisting of wool and silk ("gloria silk") should not lose their silky feel in this treatment, and it is therefore important not to use too little aluminium acetate, nor, on the other hand, to precipitate too much of the alumina salts upon the cloth. A fabric containing 75 threads of silk warp and 65 threads of wool weft to 1 sq. cm. is treated with a first bath containing 60 grms. of soap and 120 grms. of sodium silicate, 40° B., in 100 litres of water, the second bath containing 1·5 litres of aluminium acetate, 15° B., in 100 litres of water. The fabric treated in these solutions is washed, at 75° C., in water containing 200 c.c. of 50 per cent. acetic acid in 100 litres, and is then immediately dried without any further washings. Fabrics for tents, waggon-covers consisting of jute or hemp, are made waterproof by means of solutions of ammonio-cupric oxide, but this treatment is not suited to cotton goods, owing to the unavoidable staining of the whites.—C. O. W.

*Imitation Caoutchouc from Vegetable Fibres.* T. A. Edison. Papier Zeit. **75**, 1895, 2386.

*See under* XIII. C., *page* 1051.

### PATENTS.

*Textile Vegetable Fibres, an Improved Process for the Treatment of, more especially applicable to those of the Urtica Family.* A. F. B. Gomess, London. Eng. Pat. 19,485, October 13, 1894.

Improvements in a previous patent are described (Eng. Pat. 18,358 of 1892; this Journal, 1894, 248). Instead of steeping in sodium thiosulphate, the fibres are soaked for some hours in dilute nitric acid ($\frac{1}{4}$—2 per cent.), and then immersed in an alkaline bath, preferably a solution of a caustic alkali. A nitrate is formed on the fibre, and, on subsequent boiling with zinc and caustic alkali, hydroxylamine is among the compounds formed. After this treatment, follows a boiling bath of dilute alkali, and if necessary a bleaching process as described in the previous patent, *loc. cit.*—R. B. B.

*Prevention of Heating and Spontaneous Ignition of Combustible Materials, Improvements in or relating to the.* A. J. Boult, London. From A. Schörke. Eng. Pat. 21,125, Nov. 3, 1894.

*See under* II., *page* 1037.

*Removal of Dark Spots from Scoured Wool, or from Worsted or Woollen Goods, Improved Means applicable for use in the.* L. Rousseau, Paris, France. Eng. Pat. 11,335, June 10, 1895. Date under Internat. Convention, May 16, 1895.

In certain varieties of wool (particularly in Australian), dark spots or marks are noticeable after scouring. These are removed by immersing the scoured wool, either in the raw or manufactured state, in very weak alkaline baths, prepared with water free from calcareous or ferruginous impurities. The alkaline liquor may be warmed to 35°—40° C. for felt; for other fabrics or for loose wool it must be cold. When the dark spots are sufficiently softened, they are rubbed, while still in the liquor, either by hand or by mechanical means, until they disappear. Treatment in a hydro-extractor and washing, complete the process.
—R. B. B.

*Treating Raw Wool and Similar Animal Fibres with Solvents, Improvements in Process and Apparatus for.* E. Maertens, Providence, Rhode Island, U.S.A. Eng. Pat. 16,889, Sept. 10, 1895.

An apparatus for treating raw wool with volatile solvents, such as petroleum spirit, carbon bisulphide, &c. The fibre is contained in several inter-communicating digesters, through which the solvent liquid is made to circulate. The first impregnation of the fibre and the final distilling-off of solvent take place *in vacuo*. The sequence of operations is as follows.:—The fibre is dried by passing warm air through the digesters; a vacuum is then produced in the first digester and this vessel is connected at the top with a reservoir containing solvent already partially saturated with wool-fat from previous operations. When the first digester has been filled with this liquid, it is connected at the bottom with the top of No. 2; compressed gas is then applied at the top of No. 1, thus forcing the solvent into No. 2, where it acts upon a second lot of wool. No. 1 is then filled with solvent a little purer than before. In this way the solvent circulates through the series of tanks, and the wool is treated with solvent of increasing purity, and finally with pure solvent. The compressed gas used is preferably some inert gas which will not form an explosive mixture with the volatilised solvent.

When the final charge of solvent has been driven from a digester, the latter is connected with the storage tank containing the least saturated solvent—except pure solvent—and by means of compressed gas any liquid on the fibres is driven into this tank. To entirely remove any trace of solvent, the tank is connected through a vacuum pump and condenser to the pure solvent reservoir. Steam is applied to a heater in the bottom of the digester, and the solvent thus volatilised is removed by the pump, condensed, and delivered into the storage tank.

When distillation is completed, a current of air, or air and steam, is drawn through the digester to deodorise the fibre. Finally the wool is washed with water in an ordinary washing machine.—R. B. B.

## VI.—DYEING, CALICO PRINTING, PAPER-STAINING, AND BLEACHING.

*Dyeing, Theory of.* H. Silbermann. Chem. Zeit. **19**, 1683—1684.

The phenomena of dyeing are attributable to a diffusion of the colouring matters from the aqueous medium, in which they are present in extremely fine, solid suspension, into the intra-molecular interstices of the fibres.

In the case of most dyes, in which the colouring principle is present as a base in combination with an acid, or *vice versâ*, dissociation into colour-base or colour-acid, as the case may be, takes place when their solutions are diluted to the degree necessary for dyeing.

In any specific series of dyestuffs, it is found that an increase of molecular weight is accompanied by a decrease of solubility in water. The rate of absorption of the dyestuffs of greater molecular weight by the fibre, is not, however, correspondingly more rapid, but the contrary; a longer period being required for dyeing. This is explained on the assumption that molecular size and molecular weight correspond; in other words, that the dyestuffs of greater molecular weight are of higher molecular volume. Hence, in the process of diffusion, more difficulty is experienced by them in entering the intramolecular spaces of the fibres. On the other hand, relatively greater difficulty is also encountered by them in leaving the latter.

According to this view, the complex compounds obtained from those colouring matters which contain free amido groups (Primuline, Diamine and Diazo blacks &c.), by diazotising and combining them on the fibre with phenols and amido compounds, enter into more intimate union with the fibre than they can be induced to do, when formed apart from it, and afterwards applied in the ordinary process of dyeing. Therefore, their fastness to light, air, water, soap, rubbing, milling, and other influences, when they are thus produced on the fibre, is greater than when they are otherwise produced and applied (see also this Journal, 1894, 95).—E. B.

*Oxalic Acid, Use in Wool Dyeing.* P. Körner Färber Zeit. **6**, 263.

Ganswindt suggested in practical dyeing the substitution of oxalic acid for the expensive cream of tartar, and he confirmed this recommendation lately, giving satisfactory reasons why oxalic acid is not only capable of replacing cream of tartar in dyeing, but is even preferable to it. According to Ganswindt, the part played in dyeing by cream of tartar, consists either in the formation of double salts or it is due to the reducing action of tartaric acid, properties which are also found in oxalic acid. For chroming wool the best proportions to be used were found to be, for 2·5 per cent. of potassium bichromate, 3 per cent. of oxalic acid.—C. O. W.

*Coloured Aniline-Black Resists.* H. Schmid. Färber Zeit. **6**, 197.

The property of the basic coal-tar colouring matters of forming insoluble precipitates with ferro- and ferricyanides was first practically applied by C. Reber in 1884 (this Journal, 1895, 464). The use of zinc ferrocyanide as a constituent of resist colours printed under aniline black has recently been the subject of several patents. The process, however, has two disadvantages compared with the fixation of the colours as tannin lakes, viz. (1) the colours produced are greatly inferior in fastness to soap, (2) zinc ferrocyanide alone does not act as a resist for aniline black, but requires the addition of sodium acetate, sugar, or other organic substance.—R. B. B.

*Chromium Chromates as Mordants.* H. Silbermann. Färber Zeit. **6**, 182—184 and 201—203.

A chromium chromate mordant was introduced some years ago by the firm of Meister, Lucius, and Brüning, under the name Chromium Mordant G A. For its production the equivalent amounts of chromic oxide and chromic acid were added together to produce a salt, which forms crystalline needles containing 9 mols. of $H_2O$. Other similar mordants are basic chromium chromates and the basic chromium sulpho-chromate resulting from the solution of chromic oxide in potassium bichromate and sulphuric acid. These mordants are applicable to all fibres. If an oxidising mordant is to be avoided, the material is passed through a bath of sodium sulphite before dyeing. Alizarins fixed on cotton by means of these mordants do not rub off so readily as when other mordants are used.

The author gives details of a new process for preparing these mordants. Chromic acid and a reducing agent are added together in such proportions that a partial reduction takes place and the chromic oxide formed combines with the unreduced chromic acid. If the chromic acid be partly replaced by other acids, organic or inorganic, mixed salts, *e.g.* the sulpho-chromate, result. As reducing agents sulphurous acid or sulphites, stannous chloride, a metal *plus* an acid, nitrous acid, starch, glucose, &c., may be employed.

If sodium bisulphite be used, the following equation represents the reaction:—

$$5K_2Cr_2O_7 + 2H_2SO_4 + 6NaHSO_3 =$$
$$2Cr_2(CrO_4)_3 + 3Na_2SO_4 + 5K_2SO_4 + 5H_2O.$$

If organic reducing agents are employed, their reducing power must first be determined by running from a burette a standard solution of the reducing agent into a boiling solution of $K_2Cr_2O_7 + H_2SO_4$ until a drop of the solution on filter paper gives a green spot with a colourless (and no longer a yellow) rim. The use of organic reducing agents diminishes the cost of production. For the preparation of a basic salt the amount of sulphuric acid is reduced.

A mordant giving excellent results is a basic chromium sulpho-chromate of the constitution $Cr_2(SO_4)(CrO_4)_4(OH)_3$ made from 5 mols. $K_2Cr_2O_7$, 3 mols. $H_2SO_4$, and 12 mols. bisulphite, or 1·5 mols. dextrin. The mordanting is complete in 1–2 hours, instead of 12—16 hours as with ordinary chromium mordants. The mordant, however, does not keep for more than 2 or 3 days. Chromium aceto-chromate is especially suitable for printing, and when made from sodium bichromate it already contains sodium acetate, a necessary addition to other chromium mordants in printing. Chromium fluor-chromate is a useful wool mordant, and may in certain cases replace chromium fluoride. It may be made by mixing $K_2Cr_2O_7$ and chromium fluoride, though if required in the pure state it is prepared either by the above method of partial reduction, by dissolving chromic oxide in a mixture of sulphuric and hydrofluoric acids, or by the decomposition of chromium sulpho-chromate by means of calcium fluoride.—R. B. B.

*Improvement of Pieces after the "Bleeding" of Dyed Colours.* J. Börnstein. Färber Zeit. **6**, 218.

The author endeavours to explain the clearing [as effected by means of sodium hydrosulphite] of the white portions of alizarin-dyed animal fibres into which colour has bled. He considers that no decomposition of superficially fixed colour-lake takes place, and in support of this states that (1) the stained whites cannot be cleared by mere washing and rubbing; (2) it is impossible that a stable colour-lake should be decomposed by the dilute hydrosulphite solution employed. The theory is here put forth that the bleeding, which is due to the use of an excess of dyestuff, is caused by the unfixed colour being brought into solution by the alkaline washing liquor, and by this alkaline solution the whites become dyed. This theory is supported by the fact that the "bled" colour is that of the alkaline alizarin solution, not of the colour-lake. Perhaps the effect of the hydrosulphite is to reduce the colouring matter in an alkaline solution to a colourless compound analogous to indigo-white.—R. B. B.

*Water, Examination of, for Dyehouse Purposes by Means of Trial-Dyeings.* A. Lohmann. Färber Zeit. 1895, (24), 378—380.

When building a new dyehouse, care should be taken to prove by analysis the good condition of the available water supply. There are, however, many existing dyehouses which are compelled to use water polluted by the waste liquors from other works, or from other contaminated sources. Under these influences, and by the action which goes on in the bed of the river, and from atmospheric causes, ammonia, carbonic acid, nitric and nitrous acids are formed. Phosphates, chlorides, and sulphates have also to be taken into account. The rock formation from which the water is derived will indicate its mineral constituents.

The process under consideration does not require any special apparatus, and gives useful results.

The water in question is used to dye a "swatch" of material, against one dyed in distilled water under identical conditions as to temperature of dyeing, percentage of dye used, &c. Cotton yarn (5 grms.) is scoured and bleached with chloride of lime in the usual manner, then mordanted for six hours in a solution of tannic acid, containing 2 grms. per litre, and fixed by tartar emetic in the usual way, and then well washed.

The cotton can then be dyed with any suitable basic dyestuff, such as auramine or methyl-violet. After dyeing, the yarn is passed through a bath containing 1 grm. of Marseilles soap and 3 grms. of Turkey-red oil per litre, and dried.

If the colour of the pattern mordanted and dyed in a suspected water, lack brilliancy by contrast, it indicates that substances harmful to dyeing are present, and that it would not be possible to obtain bright colours with this water. If water show a hardness of 11°, it would not be suitable for dyeing, washing, &c. In a sample of water giving poor results by this method, a notable amount of iron, and larger quantities of magnesia and calcium sulphate, were found on analysis.

The above simple test takes the place of an elaborate analysis, with good practical results.—W. P. D.

## PATENTS.

*Coating Paper, Metallic Surfaces, and the like with Adhesive or Colouring Substances, Improved Means and Apparatus for.* A. W. Loveland, Norwich. Eng. Pat. 21,594, Nov. 9, 1894.

The invention relates to the employment of "rolls" so arranged that the coating material is lifted by one "roll" from a trough and fed to another roll, which is in contact therewith. A third is placed in proximity to the second, which although not in actual contact, is sufficiently close to bear upon the paper passing through between the rolls. When the paper is not thick enough for the third roll to be kept clear of the second, it is advisable to introduce a second thickness of paper. In cases where rolls have hitherto been used, it has always been necessary to work with coatings of a thin liquid character, but according to the present invention a comparatively thick fluid may be employed, the results obtained excelling in evenness of surface all previous attempts.—D. B.

*Dyeing [Insoluble Azo Colours on Cotton], Improvements in or relating to.* J. Arnold, Schwanden, Switzerland. Eng. Pat. 23,119, Nov. 28, 1894.

In the production of paranitraniline red on a ground of dianisidine copper blue by the process now well known, it is impossible to obtain very clear and brilliant colours. This may be accomplished, however, by adding to the paranitraniline printing colour an aluminium salt, *e.g.*, aluminium sulphate. Instead of paranitraniline, the printing colour may contain other amido compounds, such as α-naphthylamine, amidoazotoluene, benzidine, nitrotolidine, &c.—R. B. B.

# VII.—ACIDS, ALKALIS, AND SALTS.

*Production of Tartaric Materials in Italy.* Board of Trade Journal, December 1895, 687.

A report, dated November 13 last, has been received at the Foreign Office from Mr. E. Neville-Rolfe, Her Majesty's Consul at Naples, from which it appears that the production of tartaric materials in Italy for the 12 months, 1st October 1894 to 30th September 1895, amounted to:—

| —— | Quantity. | Value. |
|---|---|---|
| | Tons. | £ |
| Half-refined tartar | 1,166 | 61,215 |
| Vinaccia argols | 2,301 | 109,300 |
| Crude argols | 2,526½ | 93,480 |
| Winelees | 2,271½ | 34,075 |

Showing a total production of 8,265 tons, valued at 298,070*l*.

The exports to the United States reached 4,211½ tons; to Great Britain, 869 tons; to Germany, 783 tons; to France, 178½ tons; and to other countries, 2,223 tons.

*Coal Consumption in the Kessler Process for the Concentration of Sulphuric Acid.* M. Kessler. Bull. de la Soc. d'Encouragement, **113**, 544. (See also this Journal, 1895, 156.)

In a previous number of the *Bulletin*, M. Sorel calculates the consumption of coal necessary to effect the aspiration of the gas through the Kessler apparatus at 18 kilos. for every 100 kilos. of sulphuric acid of 66°. This, it is stated, is very greatly in error, because it is evident that the flow of gas in this apparatus (which produces 5,000 kilos. of acid in 22 hours of effective work) is not sufficient to enable the gas produced by 50 times 18 kilos. of coal to pass through it, since the orifice is at the most only 7 mm. in diameter. The opening is 6 mm. in diameter when the vapour pressure is 5 kilos. per square centimetre, and when the pressure falls it is enlarged so that at 4½ or 4 kilos. per square centimetre it is at the most 7 mm.

By actual experiment M. Kessler finds that with a 6-mm. orifice, and using a pressure of gas at 5 kilos. per square centimetre, the mean consumption of coal is less than 6 kilos. per 100 kilos. of acid at 66°, and that this consumption rapidly falls, if the pressure of the gas rise to 7 kilos. per square centimetre. It is thus possible to reduce it to 3 or 4 kilos. of coal per 100 kilos. of concentrated acid. The coal can be further economised by previously warming the acid in pans heated by copper tubes covered with lead. By mixing limestone with the coke, the value of the lime produced considerably reduces the cost of the fuel.—A. W.

*Aluminium Chloride, Crystallised.* L. M. Dennis. Zeits. anorg. Chem. **9**, 339.

Dry hydrochloric acid gas is passed into a solution of aluminium chloride in concentrated hydrochloric acid, hexagonal crystals of aluminium chloride, $AlCl_3 3H_2O$, being precipitated, and any ferric chloride which may be present remaining in solution.

The crystals are not affected when placed over sulphuric acid. They absorb moisture on exposure to air.—E. B.

*Nitrites, Three New Tests.* M. G. Denigès. Chem. Zeit. 1895, **19**, 328.

*See under* XXIII., *page* 1062.

## PATENTS.

*Brine and other Liquors, Improvements in Evaporating, and Apparatus therefor.* E. G. Scott, Liverpool. Eng. Pat. 24,457, Dec. 15, 1894.

*See under* I., *page* 1035.

*Carbon Dioxide, the Manufacture of, Improvements in or connected with.* J. S. Wallace, Belfast, and F. L. Ball, Farnham, Surrey. Eng. Pat. 24,652, Dec. 18, 1894.

The process, which is arranged so as to be continuous, consists in reducing carbonic acid gas to carbonic oxide by means of incandescent carbon (brought to incandescence by the aid of oxygen), and then re-oxidising the carbonic oxide by means of heated copper oxide, &c., re-forming carbonic acid. After starting the cycle of reactions, it is stated no further external heat is required. Copper oxide is reproduced by passing air over the heated metal.—E. S.

*Cyanides or Ferrocyanides, Improvements in the Manufacture of, from their corresponding Sulphocyanides.* J. Raschen, R. H. Davidson, and J. Brock, Liverpool. Eng. Pat. 24,814, Dec. 20, 1894.

A dry sulphocyanide (potassium sulphocyanide, for instance) is mixed with quicklime and carbonaceous matter, and this mixture is strongly and rapidly heated while being agitated. The heated mass is allowed to cool out of free contact of air, and is lixiviated to obtain a solution of (say) the potassium cyanide. Any calcium present as sulphide may be removed by addition of potassium carbonate. The filtered solution is evaporated to dryness to obtain the solid cyanide.

It is preferred to obtain the sulphocyanide required in the process by heating carbon bisulphide, ammonia, and milk of lime together in a closed vessel. The solution of the calcium sulphocyanide so obtained is decomposed by carbonic acid gas and the carbonate or sulphate of the base required. The filtered solution of sulphocyanide is then evaporated to dryness.—E. S.

*Potassium Chlorate, Improvements in the Manufacture of.* T. Parker, Tettenhall, Wolverhampton. Eng. Pat. 24,860, Dec. 21, 1894.

An electrolytic cell having a porous diaphragm, is charged in each division with magnesium chloride solution, and, in one division, magnesium hydroxide is added. The current is so passed that chlorine is liberated in the division containing the oxide, forming magnesium chlorate, whilst magnesium is deposited on the other electrode (which may be of iron), producing magnesium hydroxide, which, on termination of the process, is transferred to the inner department. The magnesium chlorate solution is decomposed by potassium chloride to obtain potassium chlorate, and the recovered magnesium chloride is returned to the cell. The process may be modified by electrolysing at once a mixture of magnesium and potassium chlorides with magnesium hydroxide. Calcium chloride and hydroxide may be substituted for the magnesium salts, the process being conducted as before.—E. S.

*Pure Ammonium Carbonate, Improvements in the Manufacture of.* C. Raspe, Berlin. Eng. Pat. 199, Jan. 3, 1895.

Impure ammonium carbonate solutions, such as are obtained by the distillation of bones, coal, or fossil bitumen, are distilled, and the vapour is brought into contact with a heated porous metallic oxide, such as iron oxide, which absorbs the sulphur and much of the empyreuma; the vapour is then passed through warmed porous carbon to free it completely from the empyreuma. In some cases the present process may be combined with that described in Eng. Pat. 7,846, 1893 (this Journal, 1894, 394), by agitating the crude ammonium carbonate liquor with oil, to separate the greater part of the empyreumatic products, after which the liquor may be distilled and the vapour be further purified as described. The metallic oxide, when spent, is regenerated by heating in a current of air, and the sulphurous acid evolved is utilised as may be desired.—E. S.

*Wooden Vessels for the Transportation of Acids and other Corrosive Liquids, Improvements in.* C. Kramer, care of A. A. Brodsky, Odessa, Russia. Eng. Pat. 4684, March 5, 1895.

*See under* I., *page* 1036.

*Sulphides and Sulphydrates of Alkaline Earths [Alkali Waste], Process for the Utilisation of the, and for the Production of Aniline, Toluidine, or Amidobenzaldehydes by the Treatment of the said Substances with Nitro-Bodies.* H. Loesner, Leipzig, Germany. Eng. Pat. 16,407, Sept. 2, 1895.

*See under* IV., *page* 1043.

*Alkaline Salts [Production of Hydrates], Improvements in and connected with the Electrolytic Decomposition of.* W. A. Rosenbaum, Montclair, New Jersey, U.S.A. Eng. Pat. 17,288, Sept. 17, 1895.

*See under* XI. A., *page* 1048.

*Gases resulting from Fermentation and from Lime Kilns, the Utilisation of, for the Production of Alkaline Bicarbonates and of Pure Carbon Dioxide, applicable for Treating Saccharine Matters, the Production of Liquid Carbon Dioxide, and other Purposes.* C. D. Abel, London. From H. Meeus, Wyneghem, Antwerp, Belgium. Eng. Pat. 18,016, Sept. 26, 1895.

The dilute and impure carbonic acid gas is passed through a series of purifying towers, and then employed in bicarbonating neutral alkaline carbonates, either solid or in solution. The alkaline bicarbonate thus obtained is heated to recover the carbonate, and to produce carbonic acid gas, which, being pure, may be readily compressed into the liquid state. The use of the carbon dioxide so produced for the purification and carbonisation of saccharine juices, syrups, and other products of sugar refineries, is claimed.
—E. S.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

*Portland Cement, Hardening of.* Chem. Zeit. 1895, **19**, 1005—1006.

Experiments have been made by Tomei on the resistance of set cement of known date to the action of certain solutions, with the view of throwing some light on the mechanism of hardening. Using a 5 per cent. solution of ammonium chloride in the proportion of 120 grms. of solution to 2 grms. of real cement, and of 100 grms. to 4 grms. of sand and cement (1 : 3), and boiling for 15 minutes, Tomei obtained quantities of lime in solution, which decreased with the age of the test-piece. A similar decrease was observed in the quantity of silica soluble in caustic soda. It therefore appears that the process of hardening involves the formation of silicates of increasing stability. A practical deduction from the resistance of the neat cement to the action of the ammonium chloride solution being greater than that of the sand mixture, is to the effect that a rendering of neat cement may be usefully employed in places where contact with ammoniacal liquids is to be expected.

Similar experiments with a solution of ammonium acetate made alkaline with ammonia, gave similar results. From the fact that sand test-pieces treated in this manner yielded a larger proportion of silica soluble in alkalis than did neat cement, Tomei concludes that the cement has an action on the sand with which it is mixed (this Journal, 1895, 574). Microscopic observation of thin sections of set cement showed numerous transparent glassy particles, without action on polarised light, embedded in the mass of the cement. These are considered to be colloidal silica. When the age of the cement increases, crystals become visible, together with crystalline plates showing double refraction. These are stated to be a consolidated and crystallised form of the aforesaid amorphous silica. Calorimetric tests on the heat evolved in the setting of cement are also described. For these, 20 grms. were treated with 32 per cent. of water in the calorimeter and the liberated heat measured in the usual way. Slow-setting cement gave 9,331 cals. ; cement of the same brand, but quick-setting, gave 7,752 cals. Cement made slow-setting by the addition of 0·5 per cent. of gypsum liberated 3,696 cals., and a quick-setting sample containing much silica and alumina, and a comparatively low percentage of lime, 9,044 cals.—B. B.

*Efflorescence of Double Ferrous Aluminium Sulphate on Bricks exposed to Sulphur Dioxide.* D. Paterson. Proc. Chem. Soc. 1895, [156], 203.

The author has analysed the efflorescence which appears on bricks composing chambers in which wool is bleached with sulphur dioxide. Four analyses were made, and the results agree well with the percentages required by the formula $Al_2(SO_4)_3$, $FeSO_4$, $24H_2O$. The salt forms white fibrous crystalline masses resembling asbestos in appearance. It is evidently identical with the salt often found in volcanic regions, and the author's analyses agree well with those made by Forchammer of a specimen obtained from Iceland.

### PATENT.

*Mixing Clays and other Materials of a Similar Nature, more especially suitable for Use in the Manufacture of Cement, an Improved Method of and Means for.* W. P. Campbell-Everden, London, and E. Prince, Barrington. Eng. Pat. 23,123, Nov. 28, 1894.

The clay or marl, often of an approximately suitable composition for cement-making, but needing to be rendered homogeneous, is passed through fluted rollers, softened by soaking in water, ground between wet stones, and mixed in a tank with side passages through which the slurry can circulate. The product is ready for drying and burning.
—B. B.

## X.—METALLURGY.

*Lead, Technical Analysis of.* H. Nissenson and B. Neumann. Chem. Zeit. 1895, 1141—1143.

*See under* XXIII., *page* 1063.

*The Assay of Gold Ores, Interference of Certain Metals in.* D. G. Buchanan. City Anal. Soc., Glasgow, 1894-95 [5], 18.

*See under* XXIII., *page* 1064.

*Arsenic in Iron and Steel, Volumetric Determination of.* A. Mignot. Rev. Chim. anal. Appliq. 1895, **3**, 101.

*See under* XXIII., *page* 1064.

### PATENTS.

*Aluminium and its Alloys, Improvements in or relating to the Soldering of.* L. Oliven, Berlin. Eng. Pat. 22,740, Nov. 23, 1894.

The surfaces to be united are coated with a flux of equal proportions of stearin and petroleum oil, after being previously heated. Unalloyed aluminium must be brushed whilst under the melted solder, as specified in Eng. Pat. 23,477, 1892 (this Journal, 1893, **12**, 274), and the solder to be employed is that described in Eng. Pat. 21,162, 1892 (this Journal, 1893, **12**, 932).—W. G. M.

*Certain Iron Residues, Improvements in the Utilisation of.* C. Dreyfus, Manchester. Eng. Pat. 24, 837, Dec. 21, 1894.

*See under* IV., *page* 1041.

*Precious Metals, Improved Method of Extraction from their Ores.* Ew. Fischer, E. Klein, and F. Mahlstedt, Breslau. Eng. Pat. 11,072, June 5, 1895.

From 10 to 30 per cent. of lead or other metal is added to the mercury used for amalgamation, in order to increase its bulk, and from 2 to 5 per cent. of sodium or potassium permanganate is used in conjunction with the amalgamating material.—W. G. M.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### (A.)—ELECTRO-CHEMISTRY.

### PATENTS.

*Electrolytic Apparatus for Decomposing Metallic Salts, Improvements in.* C. Kellner, Vienna, and Hallein, Austria. Eng. Pat. 20,259, Oct. 23, 1894.

This invention has reference to apparatus for the electrolysis of alkaline salts—common salt solution, for example —with the aid of a stationary mercury cathode. The amalgam, formed by electrolytic action, has its location changed from the decomposing chamber in which it is produced, to a combining chamber in which it is decomposed and the cation combined with water, an acid or other body. This is effected by the shifting of a partition, in the form of a bell, which is adapted to be moved to and fro in the mercury, and serves to separate the two chambers from each other.

The edges of the partitions or bells move over slots or are notched to obviate displacement of the mercury serving as a cathode at the bottom of the vessel. The mercury is short-circuited with a third electrode for the purpose of rapidly removing the alkaline metal from the amalgam (this Journal, 1893, 162). There are two sheets of drawings and five claims.—J. C. R.

*Storage Batteries, Improvements in and relating to.* C. S. W. Brown, Lower Edmonton, England. Eng. Pat. 22,973, Nov. 27, 1894.

In this cell there is a pair of cylindrical electrodes arranged concentrically, the inner one comprising a conductor or spreader having wings or blades embedded in active material, so as to form a solid cylinder that is enclosed within a perforated cylindrical casing of non-conducting material, such as celluloid; and the outer one comprising a perforated cylindrical conducting tube covered on each side with active material, and enclosed within a perforated cylindrical envelope of non-conducting material that covers both its inside and outside surfaces. The electrodes are maintained at a distance of a quarter of an inch apart by helices of non-conducting material, such as vulcanite, and similar helices separate the negative electrode from the containing cell.—G. H. R.

*Secondary Voltaic Batteries, Improvements in.* L. Epstein, East Twickenham. Eng. Pat. 21,714, Dec. 19, 1894.

These improvements relate to methods of circulating the electrolyte by revolving agitators. Between the electrodes, and extending through a series of electrodes, arranged in one tank, are agitators, wheels or spokes, set in and receiving motion from a spindle mounted in bearings on the ends of the tank or cell. The electrodes are perforated to receive the spindle. A negative plate for a secondary battery is claimed, "consisting of a sheet or a portion of a sheet of wire gauze amalgamated and electrolytically coated with zinc."—J. C. R.

*Potassium Chlorate, Improvements in the Manufacture of.* T. Parker, Tettenhall, Wolverhampton. Eng. Pat. 24,860, Dec. 21, 1894.

*See under* VII., *page* 1046.

*Electrical Decomposing Tanks, an Improved System of Conductors for.* J. Leith, St. Helens, and The Electro-Chemical Company, Ltd., London. Eng. Pat. 25,340, Dec. 31, 1894.

This invention is primarily to reduce the cost of the conductors in electrolytic installations. To this end, the conductors which lead the current to and from the generator, take the form of a number of wires (or strips), which are individually connected to the electrodes of the tanks, there being as many wires (or strips) as electrodes. In an installation of several tanks, arranged in series, the separate electrodes of one tank are connected direct to the separate electrodes of the next, and so on, until the electrodes of the end tanks are provided with taper cables leading to the dynamo-electric machine.—J. C. R.

*Substitute for Natural Cork, an Improved Composition Applicable as; and for other Purposes, such as an Electrical Insulating Material.* E. Hermet, Paris. Eng. Pat. 6473, March 29, 1895.

*See under* XX., *page* 1061.

*Voltaic Batteries, an Improvement in.* W. Shaw, Edinburgh. Eng. Pat. 11,728a, June 17, 1895.

The inventor claims the application and use in zinc-carbon batteries, of acetic acid. To the electrolyte of a 3-pint Leclanché cell he adds $\frac{1}{2}$ gill of acetic acid and, if desired, $\frac{1}{2}$ oz. of soda alum in solution, which "prevents crystallisation and unnecessary chemical action, and promotes a rapid recuperation of the strength of the batteries."—J. C. R.

*Secondary Voltaic Batteries, an Element for.* P. Vandersmissen, Alost, Belgium. Eng. Pat. 16,702, Sept. 6, 1895.

The inventor says: "On a leaden rod which forms one conductor, I string a number of compressed discs of lead oxide, alternating with lead discs. I enclose the series of discs in a tube of asbestos fabric forming the lining of an external lead tube (termed "the other conductor"), which is perforated with numerous holes, giving free access for the exciting liquid. The 'element,' instead of being circular in section, may be rectangular or polygonal."—J. C. R.

*Alkaline Salts [Production of Hydrates], Improvements in and connected with the Electrolytic Decomposition of.* W. A. Rosenbaum, Montclair, New Jersey, U.S.A. Eng. Pat. 17,288, Sept. 17, 1895.

Apparatus of the horizontal kind is shown and described for decomposing sodium chloride solution with a moving mercury cathode. The sodium amalgam is regularly decomposed electrolytically in a separate solvent chamber. These two electrolytes are separated by a dividing non-porous wall, dipping into a tray of mercury operated upon as a cathode in the chloride solution. A *separate anode* is shown in the solvent electrolyte. There are four claims. The first says: "In the manufacture of hydrates of alkaline metals, electrolytically depositing the metal upon a mercury cathode, which is then exposed to an electrolyte containing a separate anode ('preferably a row of carbon pencils . . . located as near the surface of the amalgam as possible') and cathode, the anode being so arranged that the oxygen liberated combines with the metal contained within the mercury, the resulting oxide being soluble in the electrolyte."—J. C. R.

## (*B.*)—ELECTRO-METALLURGY.

### PATENTS.

*Zinc-coated Wire and other Zinc-coated Metallic Articles, Improvements in or connected with the Manufacture or Production of.* The Cowper-Coles Galvanising Syndicate, Ltd., and S. O. Cowper-Coles, London. Eng. Pat. 19,797, Oct. 17, 1894.

According to this improvement, the wire or other article is coated with zinc by means of a strong electric current in a bath in which finely divided zinc may be maintained in suspension to complete the process. The current density employed is 100 ampères per square foot of cathode surface. The product of this operation has a dull appearance, and although the coating of zinc is protective, it is not sufficiently bright to be commercially available. The wire is now passed through a bath of a metal or alloy having a lower melting point than zinc, and good results are obtained with a bath composed of 50 parts tin, 25 parts lead, and 25 parts cadmium, by weight. The article is then passed through rubbers of asbestos or other suitable material, which give it a polish. Instead of submitting the article to this treatment, it may after the zincing bath, be passed into a bath which will cause a deposit of oxide of zinc in the pores of the metal, or into one of a solution of cadmium or a metal electropositive to zinc, with or without the application of an electric current. The zinc-coated articles may also be treated with silicate of soda, liquid glass, or vitreous compounds, which will give them a glazed appearance.
—G. H. R.

*Aluminium and Aluminium Alloys, Improvements in and connected with the Electro-Deposition of.* P. Marino, Vanves, France. Eng. Pat. 20,354, Oct. 24, 1894.

This invention relates to the preparation of baths suitable for the electro-deposition of aluminium, and of aluminium combined with tin, nickel, lead, zinc, copper, silver, gold, platinum, &c. An electrolyte suitable for depositing pure aluminium on metallic and metallised objects is composed as follows:—Well-washed hydrate of alumina, obtained from any convenient source, is dissolved in hydrochloric or sulphuric acid, or its equivalent, till a clear solution is obtained. To this is added an organic acid, such as tartaric, citric, or valerianic acid, or a saccharine substance, or a primary alcohol, or an albuminate, in order to maintain the alumina in solution. This liquid is then treated with nitric or hydrofluoric acid, or its equivalent. The resulting coagulated substance is dissolved in caustic potash or soda, and cyanide of potassium is added in the proportion of about one-fourth part of cyanide to that of the weight of alumina originally employed. The resulting solution is boiled from 15 to 20 minutes until its colour has changed from yellowish to dark brown. When cool, hydrate of lime or of baryta is added, and after filtration, the bath is ready. With suitable modifications, which are given, this bath serves for the electro-deposition of bimetallic alloys of alumina and tin, nickel, lead, zinc, copper, silver, gold, and platinum respectively. The nine baths may be employed with a strong current, either at the ordinary temperature, or at temperatures ranging from 40° to 80° C. A soluble anode composed of the same metal as that which forms the base of the salt dissolved in the electrolyte, is employed.—G. H. R.

*Electro-Fusion of Metals, and Apparatus therefor, Improved Methods of Effecting.* B. H. Thwaite and H. Allen, London. Eng. Pat. 21,879, Nov. 13, 1894.

This invention relates principally to improvements in a former invention, Eng. Pat. 6000, March 21, 1893 (this Journal, 528, 1894), and has for its aim the fusion of steel electrically and in a reducing atmosphere. The apparatus consists of a crucible of clay or plumbago, or a combination of the same, in which is suspended a funnel-shaped feed-vessel having an open bottom, which, when raised a little from the bottom of the crucible, allows the metallic materials fed into it to drop through and form a cone. Attached to the upper part of the central feed-vessel is an automatic electric carbon feed-arrangement, preferably such as that employed in the Brush arc lamps, by which two, four, six, or more positive carbons fixed on each side of the vessel are constantly supplied with the electric current, which forms as many arcs with the metal dropping through the orifice at the bottom of the funnel as there are carbons. A ring of copper on the inside of the funnel makes contact with the metal, and forms the negative lead. Means are provided for raising the inner vessel either automatically or by hand as the fused metal collects in the bottom of the crucible, and the feeding-vessel, which may have a tightly-fitting supply-door, is connected with a reducing gas supply, which prevents the oxidation of the fused metal or the formation of slag. Some modifications of this apparatus are described; for instance, the positive carbons may be arranged on the inside of the feed-funnel, the negative carbons being on the outside, and both sets projecting below the refractory material; or, instead of employing the two sets of carbons, the crucible itself may be formed of plumbago, and constitute the negative electrode, whilst the carbons connected to the central funnel form the positive electrode.
—G. H. R.

*Rich Alloys of the Metals of the Alkalis or Alkali Earths, and the Production of Halogen Elements, an Improved Electrolytic Process and Apparatus for Obtaining.* L. P. Hulin, Modane, France. Eng. Pat. 23,137, Nov. 28, 1894. Under Internat. Convent., May 5, 1894.

The inventor proposes to employ two or more anodes in electrolysing fused haloid salts of the alkalis or light metals, aluminium, magnesium, &c., to obtain alloys, instead of applying the metal to form an alloy with the light metal as a cathode, in a molten or highly heated condition. One of these anodes (carbon) does not combine with the halogen gas. These halogen gases, chlorine, &c., may be freed from the electrolyte in condensing-chambers, or washed. The separate metallic anodes are generally in the form of bars of any section. Where these metals, such as manganese, chromium, &c., are difficult to obtain in a metallic state, their oxides are intimately mixed with suitable quantities of carbon, and applied as compound rods.

Apparatus is shown in the shape of a containing-pot of iron set in a furnace, which answers for a common cathode. The anodes depend from an insulated lid. Outlets for gas at the top and for the alloy at the bottom (which may be stirred by a stirrer of iron placed therein) are provided, with a feed-inlet for the electrolyte at the side, leading into and sealed by dipping into the fused electrolyte.—J. C. R.

*Articles by Electro-Deposition, Process for the Manufacture of Metallic.* La Société des Cuivres de France, Paris, France. Eng. Pat. 23,679, Dec. 5, 1894.

The process consists in the electro-deposition of a layer of refined tough metal upon pattern-cores or moulds of corresponding shape to the object to be produced, and which serve as cathodes, and are caused to revolve, preferably about their vertical axis, in front of plates of appropriate form, which serve as anodes. The pattern-core forming the cathodes may be made of metal or other material rendered conductive, and where the shape of the article is such as to render it difficult to detach from the pattern or mould, the cathode may be made of fusible alloys, or in separable parts. The anode may be rotated instead of the cathode, or the two electrodes may be revolved in reverse directions or at different speeds. The thickness of the articles deposited may be varied by varying the distance between the electrodes and their relative superficial areas.
—G. H. R.

*Production of Copper by Electrolysis, Improvements in, and in Apparatus employed therein.* J. C. Mewburn, London. Eng. Pat. 25,145, Dec. 27, 1894.

The improvement consists in the electro-deposition of copper resulting from the decomposition of the electrolyte by a current of great intensity, on a revolving cathode, which is only partially immersed in the electrolyte, and which may be subjected to a rubbing action to remove bubbles of hydrogen and diminish polarisation. The apparatus consists of a lead-lined tank, divided by two partitions, which do not extend to the bottom, and which support lignum vitæ bearings on which rest cylindrical cathodes, the rotation of which is effected by means of bevelled wheels. The anodes consist of ingots of copper resting on bands of the same metal, the number of which depends on the length of the vessel. Provision is made for the continuous circulation of the electrolyte, and the rubbing of the exposed surfaces of the cathode may be effected in any suitable manner.—G. H. R.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

*Vegetable Oil Industry and Extraction of Oils from Kernels and Seeds.* H. Maijmon. Chem. Rev. Fett. u. Harz-Ind. 1895, [26], 4.

Spindler and Stautz have proposed a method for extracting the oil from seeds by boiling the cleaned and ground seeds with a solution of salt and molasses, and then pressing the mass (H. Becker, Chem. Rev. Fett. u. Harz-Ind. 1895 [21]). The author criticises the method, pointing out that the temperature employed would be too low to drive off rancid matters from the oil, the free fatty acids by which the rancidity is caused requiring temperatures of 250° to 280° C. for their removal. It is further remarked that the production of acrolein—to which Becker ascribes the bitter taste of hot-pressed oils—can only be effected above 290° C., a temperature never attained in practice.

The "extraction process" is the best for seed oils, as yielding a larger proportion of oil, freer from albuminoid and proteid substances than is obtainable by pressure alone, the residual cake being at the same time improved as a feeding stuff. For fine alimental oils this method is, however, unsuitable, the flavour of the oils being lost in the process of driving off the solvent by the aid of steam. For such oils cold-pressing is the only process suitable, though the cake may afterwards be treated with a solvent, and the oil thus obtained, mixed—after a process of refining—with the cold-pressed oil.—C. S.

*Seeds of Nephelium Lappaceum and the Fat contained in them, Chemical Investigation of.* M. Baczewski. Monatsh. für Chem. 1895, **16**, 866.

These oil seeds were brought by Dr. Schiffner from Java on the return of his expedition. The seeds were ground in a mill and analysed without further treatment. The following results were obtained:—

Water, 5·87; fats (soluble in petroleum ether), 35·07; ether extract (excluding fats), 3·00; ash, 1·95; albumin, 8·89; wood fibre, 6·90; starch, 25·63; sugar, 1·25 per cent.

No cholesterol, lecithin, or alkaloids could be found. The following is a summary of the investigation of the fat:—

| | |
|---|---|
| Melting point | 42°—46° C. |
| Solidification point | 38°—39° C. |
| Specific gravity | 0·9236 |
| Acid value | 42·9 |
| Saponification value | 193·8 |
| Iodine number | 39·4 |
| Oleic acid, percentage | 43·8 |
| Melting point of the fatty acids | 58°—61° C. |
| Solidification point „ | 57° C. |
| Saponification value „ | 186·4 |
| Mean molecular weight „ | 300·9 |
| Iodine number „ | 44·0 |
| Oleic acid, percentage in „ | 45·5 |

The high mean molecular weight of the acids indicates the presence of an acid of higher molecular weight than stearic acid. An acid melting at 75° C. was isolated; it had the composition of arachidic acid. Oleic acid also appeared to be present. In addition to these two acids, which are thus shown to be present in preponderating quantity (compare Oudemans, J. prakt. Chem. **99**, 418), a small quantity of stearic acid was obtained by fractional distillation under a pressure of 100 mm.; this was recognised by its melting point and composition. Palmitic acid is absent.—A. C. W.

### *Beeswax Oil (Wachsöl).* N. Kromer. Chem. Zeit. Repert. **19**, 280.

Beeswax oil, a popular Russian medicament, is obtained by distilling beeswax with lime or finely-broken bricks, and rectifying over quicklime. It is a clear liquid with an empyreumatic smell. On exposure to air it darkens and thickens, and at a low temperature it deposits a crystalline magma. The investigation of the latter shows that it consists principally of normal heptacosane, $C_{27}H_{56}$, with small quantities of a hydrocarbon of m.p. 53° C., and of normal hentriacontane, $C_{31}H_{64}$, a compound obtained by Krafft from palmitone, $(C_{15}H_{31})_2CO$, and previously recognised as a constituent of beeswax oil by Schwalb (Ann. **235**, 181).
—E. B.

### *Critical Temperatures of Solutions, a New Constant for the Analysis and Identification of Fatty Substances, Hydrocarbons, and Ethereal Oils.* L. Crismer. Bull. de l'Assoc. Belge des Chimistes, 1895, [5].

*See under* XXIII., *page* 1069.

### *Adulterated Beeswax, Rapid Detection of.* G. Buchner. Chem. Zeit. 1895, **19**, 1422.

*See under* XXIII., *page* 1070.

### *Beeswax in Admixture with Factitious Waxes, Buchner's Method of Estimating.* R. Kissling. Chem. Zeit. **19**, 1682.

*See under* XXIII., *page* 1070.

## PATENTS.

### *Separation of Oils and Fats from Water, Process for the.* A. L. G. Dehne, Halle-on-the-Saale, Germany. Eng. Pat. 21,131, Nov. 3, 1894.

*See under* XVIII. B., *page* 1058.

### *Soap, Improvements in the Manufacture of.* J. McLaren, Bootle. Eng. Pat. 24,669, Dec. 19, 1894.

The addition of powdered bathbrick and the like, to soap.
—B. B.

### *Power Presses for Soap, Improvements in.* A. F. Beyer and A. G. Beyer, Paris, France. Eng. Pat. 11,606, June 14, 1895.

The machine protected is provided with a driving screw working in a nut of special design, the action being controlled by a pedal in the usual way, and the fly-wheel being fitted with a brake to weaken the shock of the fly-wheel on its return motion.—B. B.

### *Oil Filters, Improvements in.* P. N. Brooks, Philadelphia, U.S.A. Eng. Pat. 14,441, July 30, 1895.

The oil to be filtered is passed in at the bottom of the filter, which is fitted with a heating coil, and forced through a layer of filtering material, *e.g.*, cork shavings, and then through a layer of water into an upper storage tank. A vertical perforated pipe with horizontal perforated arms allows the injection of water for cleaning the filtering material from time to time.—B. B.

# XIII.—PIGMENTS, PAINTS; RESINS, VARNISHES; INDIA-RUBBER, Etc.

## (*B.*)—RESINS, VARNISHES.

### *Gum Copal (Bucaramanquina) in Colombia.* U.S. Cons. Repts. Nov. 1895, 343.

The U.S. Consul at Cartagena announces the formation of an American company, bearing the name of the Colombian Algarroba Company, for the purpose of mining and exporting the *resina de Algarroba*, or gum copal, from Colombia.

In Consular Reports No. 152 (May 1893), p. 48, the Department published a report from the Consul-General at Bogota, describing a gum (or mineral, as it was then called) found in the alluvial deposits of that country, under the name of "bucaramanquina." Samples of this gum were sent to Washington and were subjected to analysis, with the following results:—

Mineral resin No. 1, laminated.
Mineral resin No. 2, lump.

| Components. | No. 1. | No. 2. |
|---|---|---|
| Moisture | 0·75 | 0·55 |
| Ash | 0·2 | 1·46 |
| Carbon | 77·93 | 68·15 |
| Hydrogen | 9·14 | 8·97 |
| Nitrogen | 0·11 | 0·14 |
| Oxygen | 11·87 | 20·73 |
| Total | 100·00 | 100·00 |

For comparison, analyses of the samples of a similar resin, reported in *Comptes Rendus*, vol. 96, page 1453, are given, and also an analysis of pine resin from the *Pinus palustris*:—

| Components. | From Bucaramanga. | From Province of Antioquia. | Pine Resin. |
|---|---|---|---|
| Carbon | 82·7 | 71·89 | 73·9 |
| Hydrogen | 10·8 | 6·51 | 9·35 |
| Nitrogen | .. | 0·03 | .. |
| Oxygen | 6·5 | 21·57 | 16·75 |
| Total | 100·60 | 100·00 | 100·00 |

Bucaramanquina appears to be identical with gum copal.

The pioneers of this enterprise in January of this year found large deposits of the valuable material in Gelares, 15 miles from the Magdalena up the San Jorge River; Punta Barrilla, 30 miles up the San Jorge; and Tasecaluma, 7 miles from Magangua, near the San Jorge River. At the last named place the best gum was found.

A concession was accordingly obtained from the Colombian Government giving the company the sole right to mine "gum copal" in Colombia for 20 years. In return for this grant the Government exacts the sum of 1 dol. (Colombian) for every quintal of copal shipped from the country.

A test of the samples procured by the Algarroba Company was made by Professor Doremus, of New York, who gave it as his opinion that the new gum would compare most favourably with the famous Kauri gum of New Zealand—the highest grade varnish gum known, so far, to commerce. Gums of this superior quality are at present found only in New Zealand, Zanzibar, and Australia. A few slight formations have been discovered in Mexico, but these have subsequently proved to be of no value. As this gum is the body of all varnishes, it will be readily seen that its production in large quantities in a country so near New York as Colombia is a matter of considerable commercial importance.

The gum is found in large lumps in the soft alluvial soil at the foot of the algarroba tree, and it is proposed to employ native women to dig for it, costing about 10 cents (Colombian) per diem each.

It is intended also to take out the gum at Rio Hocha, on the sea coast, where it is said to be plentiful, as well as in the San Jorge section, thus saving cost of transport.

Gum copal is an accumulation of exudations from the algarroba tree, extending over an indefinite period of time. The tree itself, which resembles the beech in appearance, can be tapped like a rubber tree, but the sap or gum thus produced, lacking the seasoning of age, is practically worthless. Indeed, the deeper in the ground, that is, the older the "resina de algarroba" is found, the more valuable it is as a varnish.

## (*C.*)—INDIA-RUBBER, &c.

*Imitation Caoutchouc from Vegetable Fibres.* Thomas A. Edison. Papier Zeit. **75**, 1895, 2386.

The author has discovered that by treating vegetable fibres with hydrofluoric acid, a peculiar substance is obtained, which may be employed for a number of purposes as a substitute for vulcanised rubber. The vegetable fibres, such as paper pulp, boards, bamboo fibres, &c., when treated with hydrofluoric acid, produce a transparent, tough, flexible, waterproof material. The excess of acid may be removed by pressure and the material dried, the treatment with alkali being unnecessary. To make blocks similar to those of rubber, sized or unsized sheets of paper are placed one upon the other according to the thickness required, and then treated with hydrofluoric acid and pressed. The block thus produced may be cut or rolled to any desired shape. The material is totally different from parchment, and is used by Edison as an insulating material, and for making carbon filaments for incandescent lamps.—S. P. E.

*India-Rubber, Contributions to the Chemistry of.* R. Henriques. Chem. Zeit. 1895, **19**, 1918.

The author insists on his former conclusions, viz., that vulcanised india-rubber is easily changed by heat, and that the change depends upon the amount of free sulphur contained in the same (this Journal, 1895, 758). The previous experiments have been repeated, starting with a good crude rubber, and testing it as such, and also in every stage of its purification. The results are shown in the following table :—

| Sample. | Sulphur. | Increase or Loss in Weight. Heated to 100° 2 hours. | 4 hours. | 6 hours. | Heated to 120° 8 hours. | After Heating. Loss of Sulphur. | Appearance. | Difference between Maximum and Minimum Weights (Absorbed Oxygen). |
|---|---|---|---|---|---|---|---|---|
| 1. Raw india-rubber .......... | .. | −3·8 | −3·65 | −3·65 | −3·8 | .. | Moist | 0·15 |
| 2. Sheet ...................... | .. | −2·9 | −2·9 | −2·9 | −2·9 | .. | Melted | .. |
| 3. Masticated and rolled ...... | .. | −0·53 | −0·53 | −0·43 | −0·44 | .. | „ | 0·10 |
| 4. Mixed with sulphur........ | 7·43 | −1·15 | −1·3 | −1·65 | −3·05 | 3·8 | Moist | 0·76 |
| 4*a*. „ sulphur extracted ... | trace | −0·4 | −0·3 | −0·25 | −0·15 | .. | Melted | 0·25 |
| 5. Vulcanised (weak).......... | 7·01 | −0·45 | −0·4 | −0·7 | −0·9 | 1·41 | Hard | 0·50 |
| 5*a*. „ sulphur extracted | 1·96 | −0·1 | +0·2 | +0·55 | +1·15 | .. | Very sticky | 1·25 |
| 6. „ (medium) ...... | 7·01 | −0·25 | −0·25 | −0·4 | −0·05 | 1·04 | Hard | 1·00 |
| 6*a*. „ sulphur extracted | 2·64 | +0·25 | +0·6 | +0·95 | +1·7 | .. | Rather sticky | 1·70 |
| 7. „ (strong) ........ | 7·01 | −0·35 | −0·1 | −0·3 | −0·1 | 0·74 | Hard | 0·64 |
| 7*a*. „ sulphur extracted | 3·04 | +0·7 | +1·2 | +1·45 | +2·6 | .. | Rather sticky | 2·60 |

It will be seen that 1, 2, and 3, after losing their moisture during the first two hours of heating at 100°, scarcely suffer any further change in weight. Much the same thing occurs in the case of 4*a*; in this case the trace of sulphur left in the sample would account for the small amount of oxygen absorbed.

The conclusion drawn is, as before, that the absorption of oxygen is increased with the increase in amount of chemically combined sulphur.

In order to afford additional proof of this, and to find out how much oxygen could be absorbed, fresh quantities of samples 5—7*a* were heated at 120° until the weight remained constant, and were then heated to 150°. No further increase in weight was then observed, but a decrease due to decomposition. The results of the heating are shown below :—

| Heated at 120° | Percentage Increase due to Oxygen absorbed. 5*a*. | 6*a*. | 7*a*. |
|---|---|---|---|
| 2 hours..................... | 0·5 | 0·4 | 0·6 |
| 4 „ ..................... | 0·9 | 1·0 | 1·4 |
| 6 „ ..................... | 1·1 | 1·4 | 1·7 |
| 8 „ ..................... | 1·9 | 2·7 | 2·6 |
| 10 „ ..................... | 1·9 | 2·9 | 3·1 |
| 12 „ ..................... | 1·9 | 2·9 | 3·2 |
| Combined sulphur .......... | 1·96 | 2·64 | 3·04 |

The amount of oxygen absorbed, as shown in the foregoing, is thus seen to be greater the greater the amount of chemically combined sulphur there was present in the rubbers tested. Further experiments showed that this correspondence does not occur with all vulcanised Para rubbers, and that the oxidation is not due to formation of products of the nature of sulphones, as the author suggested, but that products of an acid nature are in part formed.

By treating several oxidised samples with alcoholic caustic soda, 4—8 per cent. was extracted, giving, on addition of acid, a thick yellow oil, easily soluble in alcohol and ether, pointing to the possibility of the oxygen being in the form of hydroxyl. The products obtained by heating samples 5—7*a* lost their elasticity almost completely, and became dark and much more soluble. The solubility in carbon bisulphide, for instance, was as follows :—

| Sample. | 5*a*. | 6*a*. | 7*a*. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Fresh...................... | 2·25 | 2·00 | 2·35 |
| 8 hours at 100°—120° ........ | 28·82 | 20·25 | 29·10 |

All the experiments were made in a closed drying oven away from the light. Miller and Clarke (Journ. Chem. Soc. 1865) found that pure unvulcanised Para rubber absorbed 2·8 per cent. of oxygen in nine months by standing exposed to light. The author has exposed a sample for six weeks without any apparent change.

Some practical results from the experiments are : that the presence of a small quantity of free sulphur (not above 6 per cent.) is necessary to ensure the durability of the material, especially at a high temperature ; and that in the vulcanisation process, the presence of air should be avoided as much as possible.—H. M.

*India-Rubber, Discussion on.* E. Schultze. Chem. Zeit. 1895, **19**, 2042.

In a letter to the editor, the writer criticises the previous communications of Henriques. He says that Henriques is wrong in supposing that "white" substitute is used in large quantities in the india-rubber industry. In a well-known German factory the monthly consumption of rubber-substitutes was :—Brown, 7,500—8,000 kilos. ; White, 120—150 kilos.

Similar figures could be adduced from two other factories known to the writer. Intimations from German, French, and English works prove that the general consumption is similar.

"White" substitute, kept in closed bottles, decomposes comparatively quickly into a thick oily mass; some qualities in months, others after a few years. Good brown substitute is not decomposed in 12 years. All samples of "white" substitute that have come into the writer's hands, heated to 110° have changed more or less in a week, the majority becoming quite liquid.—H. M.

*India-Rubber, Discussion on.* R. Henriques. Chem. Zeit. 1895, **19**, 2043.

In a letter to the editor the writer answers that of Schultze (see previous abstract). As regards the consumption of "white" substitute, he says that of the works known to him the hard-india-rubber works use generally oils treated with sulphur ("Brown" substitute), whilst all the others use at least as much sulphur chloride addition products ("White" substitute). In four North German factories the consumption of "white" compared with "brown" substitute is between 2:2 and 5:2. He further denies that the best commercial "white" substitutes will decompose comparatively quickly in a closed flask. Rape-seed oil substitute will keep for years unchanged, whilst castor oil substitute decomposes after a few months.—H. M.

### PATENT.

*Gutta-Percha, Improvements in Treating.* R. Hutchison, Prestwick, and J. Binnie, Barassie, both in the County of Ayr. Eng. Pat. 24,673, Dec. 19, 1894.

Gutta-percha is dissolved in about two parts by weight of oleic acid in a steam-jacketed pan, provided with mechanical stirrers. On cooling, a portion separates in flakes. This is freed from the solution by simple pressure, and in order to remove the last traces of oleic acid, the residue is thoroughly washed with alkali and water. The substance thus obtained, which the inventors call "Tabanite," is dried and made into the desired articles, with the aid of heat, by compression or moulding. It is said to be of a compact, moderately hard and springy character.—D. B.

## XIV.—TANNING, LEATHER, GLUE, SIZE.

*Quebracho as a Tanning Material.** U.S. Cons. Reports, Nov. 1895, 269.

German tanners have adopted quebracho and other tanning materials, such as divi-divi, myrobalans, japonica, mimosa, valonia, algarrovilla, &c., in place of oak bark. The leather industry of Germany has shown great progress in recent years, and quebracho, the new tanning material, has produced a revolution in tanning upper and sole leather. It is now used all over Germany and other countries on the Continent.

Quebracho wood is imported principally in logs and on sailing vessels. It came originally from the province of Santiago, in Chile, but this source of supply is gradually becoming exhausted. In recent years, in the Argentine Republic, extensive forests of quebracho have been opened up. Of quebracho two varieties are known, the red and white. Red quebracho is richer in tannin than the white, the average contents being from 18 to 20 per cent. Considering the intrinsic value of this tanning material, it is cheaper than oak bark and nearly as cheap as hemlock. Owing to its very high percentage of tanning qualities, quebracho contains relatively a small proportion of so-called non-tanning substances, and in this respect has much resemblance to gambier. These non-tanning substances are an important factor in the manufacture of leather, as they fill and nourish the leather, and also impart the necessary acidity to liquors, although not assimilating in a direct manner with the fibre of the hide. Quebracho, it is stated, does not possess a sufficiency of these non-tanning properties to yield well-nourished leathers, and its use, therefore, is only to be recommended in combination with other agents stronger in non-tanning substances.

The supply of quebracho may be considered inexhaustible. Nearing the thirty-first degree of longitude in the Argentine Republic, the pampas, the largest grazing lands known to the world, gradually develop into immense forests known as chaco. The chaco is wonderful for its luxuriant and varied vegetation; among this, in abundance, the red and white quebracho are found. The red quebracho does not attain a great height, although the trunk is well developed. Of a reddish-brown, this wood is heavy and hard, and has tanning qualities which of late years have become highly appreciated in Europe. It is stated that the tract of country can furnish a fabulous amount of quebracho wood, practically an inexhaustible amount, while the present yearly consumption is but 1,000,000 tons.

Ten years ago the exports of wood from the Argentine Republic aggregated in value 75,000 dols.; during 1892 this value increased to 1,500,000 dols. Very recently a sawmill has been erected at each of the ten railway stations between Rosario and Beaurequiste. On the value of the woods arriving at the sea a tax of from 3 to 7 per cent. is levied. The unlimited supply and low cost of production make quebracho wood one of the cheapest vegetable tanning materials known.

The red quebracho contains in considerable quantity a red colouring matter which is hardly soluble in cold water, but will dissolve readily in warm water. For this reason, quebracho extracts, if not properly treated, will impart a reddish tint to leather. Used alone, quebracho extract will only yield a leather of poor colour, but when combined with alum and salt it yields finer results even than gambier. Leather tanned with quebracho, alum, and salt has a pale straw-yellow appearance, the flesh side being almost white. In first using quebracho extract, it is important to use much weaker liquors than those needed with other tanning agents.

There are large extract works in Renners and Benrath, near Hamburg; also in Oberlahnstein-on-the-Rhine and Frankfort-on-the-Main. In these factories, the wood is cut by machines specially built for that purpose. It is cut from the log in two different ways—side and head cut. The side cut is of fine, thin, small chips, up to about 1 in. long, and the head cut consists of smaller and coarser pieces. Quebracho extract is manufactured in crystal and soft paste. The crystal is put up in cases of 150 kilos. (330 lb.), and costs about 10·75 dols. It contains about 65 to 70 per cent. of tannin. The paste is put up in barrels of from 230 to 250 kilos. (507 to 551 lb.), and contains about 45 per cent. of tannin.

*Disinfection of Hides and Skins in the United States, Measures for.* Board of Trade Journal, Dec. 1895.

The French Consul at New York, in a recent report, forwarded to his Government the following information respecting the measures adopted in the United States relating to the disinfection of hides and skins:—

"Article 17 of the Customs law of the 28th August 1894, reproducing Article 20 of the McKinley tariff, absolutely prohibits the entry of hides and skins into the United States. At the same time, the Finance Minister has the power of authorising the admission of such of the above as are imported from countries declared free from epizootis, or even from suspected countries, provided that they undergo such preliminary measures of disinfection as are prescribed for the safety of American cattle. The States of the New World alone have been declared free from disease, and the products in question of these countries are admitted without formalities when they arrive direct from the country of origin. As for the other countries of the Old World, and especially France, they are declared suspected, and hides and skins therefrom can only be admitted into the United States after having been disinfected to the satisfaction of the Customs agents at the American port of arrival, and at the expense of the consigner.

Hides and skins of animals other than of the bovine species are not subjected to any prophylactic formality.

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* From information furnished by W. M. Kuhlow.

Up to the present, the Minister of Agriculture has not specified any particular means of disinfection as obligatory on all occasions, but has confined himself to suggesting certain methods of procedure, *i.e.*, the deposit in lime for 40 days, 24 hours' immersion in a solution of crystallised carbolic acid at $5\frac{1}{2}$ per cent., or of corrosive sublimate at 1 per 1,000.

Dried, salted skins, skins prepared with arsenic, and clippings of skins treated with lime are exempt from disinfection; a declaration on oath made by the importer that they have been so prepared is sufficient.

A decision was given last August by the Minister of the Treasury that the skins must be *immersed* in the solution, and that it was not sufficient that they should be sprinkled with it only.

*Albumin and Glue-yielding Substances, Action of Alcoholic Soda Solution on.* W. Fahrion. Chem. Zeit. 1895, **19**, 1000.

*See under* XXIII., *page* 1072.

## XV.—MANURES, Etc.

*Alkaline Salts in Manures, Estimation of.* A. Cameron. City Anal. Soc. Glasgow, 1894–95, [5], 16.

*See under* XXIII., *page* 1065.

### PATENT.

*Animal Blood. Treating for Manurial Purposes.* R. T. Savage and E. G. Walker, both of Norwich. Eng. Pat. 8101, April 24, 1895.

The blood is exposed to the air until decomposition sets in. To every 16 lb. are then added 3 oz. of ferrous sulphate and 3 oz. of hydrochloric acid.

The mass is then dried and powdered, yielding an inodorous substance.—L. de K.

## XVI.—SUGAR, STARCH, GUM, Etc.

*Sugar Maple, Cultivation of, in North America.* May. Wochenschr. Centralver. f. Rübenzuckerind. 1895, **43**, 672.

The cultivation of this tree as a source of sugar is, contrary to general opinion, increasing; the total production amounts yearly from 3 to $3\frac{1}{2}$ million mtr.-centners, 16 kilos. per head being consumed in Vermont State. The trees flourish in a dry soil, rich in potash, and in a sunny southern aspect; the most favourable situation being by the outskirts of woods. They supply sugar from their 20th year, and, if precautions be taken, such as necessary limitation of the amount of juice, the stopping-up of boreholes, the tree suffers no harm. Cold and dry winters, in which windy nights are followed by sunshine, appear to favour the transformation of starch into cane sugar. The harvest commences early in March and continues for about 30 days. A tree yields usually from 1 to 3 kilos. of sugar annually, or in very exceptional cases 15 kilos.; 48 to 56 litres of juice produce 1 kilo. of sugar. A tap-hole slanting downwards, $1\frac{1}{2}$ cm. wide and $2\frac{1}{2}$ cm. deep, is bored from 50—75 cm. above the ground, and a tin tube with a curved end carrying a small pail of the same metal and fitted with a lid, is inserted into the cavity. The juice is collected twice daily, and at once evaporated in boiling pans into syrup or massecuite. The latter is either run into loaf moulds containing 10 kilos., or into cake moulds with finely-perforated bottoms and divided into 12 partitions, each containing 1 kilo. Taking into account the qualities of the sugar maple, the author considers that its cultivation might well be taken up in Europe. —J. L. B.

*Juice, Nature of, from the Nodes and Internodes of the Sugar Cane.* Beeson. Bull. Ass. Chim. 1895, **13**, 362.

The proportion of reducing sugar in the juice from the node of the cane is smaller than that found in the internode, whereas the latter contains larger quantities of organic non-sugar. This consists of cellulose, hemi-cellulose, gums (saccharifiable by acids), and amides; and of albuminates which are only capable of coagulation in the case of the juice from the nodes. The purity of the node juice is generally about 10 per cent. lower than that of the internode, an amount which increases when the canes are damaged; the resulting gums and hemi-celluloses giving rise to large quantities of reducing sugar. For young canes with but few roots, the nodes perform a similar function as seeds for blossoming plants, that is to say, they afford the first nourishment to the cane at its earliest stage, the sugar from the internode giving some supplementary assistance. Since the ripe sugar cane does not contain starch, glucose may be regarded as the first assimilation-product—an assumption in harmony with the fact that the young and growing parts contain reducing sugar.—J. L. B.

*Heydecke's "Foam-Crystallisation" of Sugar.* Köhler. D. Zuckerind. 1895, **20**, 1374.

By means of a pressure pump and of suitably situated distribution-tubes, air is forced into the massecuites from after-products which have been evaporated to the consistency of the "thread test," until a frothy mass of somewhat less than sp. gr. 1·00 is formed. In pans holding 30 cb. m., this requires from 6—8 hours; the mass must not sink together, but should remain frothy and mobile. It is allowed to stand without warming for 10 days in the case of runnings from first products, and for 8—10 weeks with those of second products. The homogeneous crystalline mass can then be run off, or pressed out, and centrifugated with or without a slight washing with syrup. Runnings from first products yield 30—40 per cent., those from second products 20—30 per cent., of a bright good sugar. Comparisons on a large scale show better results than those with the usual processes, whilst the purity quotients of the runnings are correspondingly lower.—J. L. B.

*Inverting Action of the French Officinal Chloride of Iron Solutions.* M. H. Herissey. J. Pharm. Chim. 1895, **6**, Sér. 2, 203.

The author found that 581 grms. of cane sugar per litre* had been inverted in a chloride of iron syrup which had been prepared for six weeks. For a more minute examination of the conditions of inversion, he made the following experiments:—

1. Solutions containing 13·3 per cent. of ferric-chloride (in which the absence of hydrogen chloride, free chlorine, and ferrous chloride had been ascertained) were exposed to light at 14°—15°, and kept in darkness at the same temperature. At the end of 25 days, small quantities of free acid and ferrous chloride were detected in the former, and to a lesser degree in the latter.

2. Such solutions of ferric chloride, after exposure, yielded, when mixed with solutions of cane sugar, almost the same amount of invert sugar in either case.

3. Two solutions containing ferric chloride and cane sugar were prepared; the one exposed to, and the other carefully protected from, light, and both were maintained at the same temperature. Inversion took place to a greater extent in the former; from this it appears that light alone has a comparatively slight effect upon solutions of ferric chloride, but that a decided and rapid change ensues when organic substances such as cane sugar are present.—J. L. B.

*Starch, Changes of, when dissolved in Heated Glycerin.* K. Zulkowsky and B. Franz. Biedermann's Centralbl. 1895, 557.

When pure potato-starch is heated with glycerin, varying products are produced according to the temperature employed.

At 190° C. soluble starch is produced. This is precipitated by lime-water, baryta-water, or alcohol. When the precipitate from alcohol is kept for a long time in the dry state, it is gradually re-transformed into the ordinary (insoluble) form. A similar change, with gelatinisation, occurs with strong aqueous solutions on keeping. Iodine gives a deep blue coloration, and the specific rotation is + 188·3°.

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* The *sirop de sucre* of the French Pharmacopœia is prepared by dissolving 1,700 grms. of cane sugar in 1 litre of water.

At 200° C. erythrodextrin is formed. It is precipitated by alcohol as a white, sandy, and non-hygroscopic powder. Baryta-water only precipitates it from aqueous solutions on the addition of alcohol. It gives a cherry-red coloration with iodine, and has a specific rotation of + 181°. It reduces Fehling's solution, though less strongly than does Lintner's malto-dextrin.

At 210° C. achrodextrin is formed. This is hygroscopic, gives a brownish-yellow coloration with iodine, and has a specific rotation of + 173·5°. Its action with Fehling's solution is similar to that of erythrodextrin.

When the glycerin solution of starch is heated for a long time at 210°, two products soluble in alcohol are gradually formed. The one, soluble in dilute alcohol, has a specific rotation of + 151·5°; the other, soluble in strong alcohol, resembles gum Arabic, and has a specific rotation of + 98·9°.—L. T. T.

*Cane Sugar, its Distribution in Plants, its Physiological Importance, and the Soluble Carbohydrates which accompany it.* Schulze and S. Frankfurt. Zeits. f. Spiritusind. 1895, **18**, 222.

*See under* XXIV., *page* 1074.

### PATENTS.

*Crystallisation of Sugar out of Sugar Solutions or Mass Cuite, Improved Device for Promoting.* L. Fuchs, Brunswick, Germany. Eng. Pat. 16,340, Aug. 31, 1895.

The device consists of a single chain or series of endless chains arranged so that they may be kept in motion either continuously or intermittently; and which move partly in and partly outside the solution, thus effecting a circulation of a small portion of that solution.—A. L. S.

*Adhesive Pastes, Improved Manufacture of.* A. J. Boult, London. From C. M. Higgins, Brooklyn, New York, U.S.A. Eng. Pat. 17,337, Sept. 17, 1895.

White dextrin is dissolved in water at 150° F., in the proportion of about 4 lb. to the gallon, and the solution is cooled to 40°—50° F., and kept at that temperature for a few days, when, it is stated, the resulting substance will form a useful paste.—A. L. S.

## XVII.—BREWING, WINES, SPIRITS, Etc.

*Saccharomyces Marxianus, S. Apiculatus, and S. Anomalus.* A. Klocker, Carlsberg Laboratoriets Meddelelser, 1895, **4**, 20—29.

Hansen carried out his researches on three varieties of *S. Marxianus*, which differed from one another in their capability of spore formation, one developing these with considerable difficulty. The limits of temperature within which sporulation took place were about the same for all three varieties, consequently the difference between them consisted in the number of spores formed, and in the time which they took to develop. The spores, like those of other wild yeasts, are completely filled with a highly refractile plasma; they are sometimes reniform, but more often bean-shaped, and occasionally round or oval. Their greatest diameter amounts to 3·5 μ; generally there are two spores in a mother cell, seldom one or three, and very rarely four. The film formation of *S. Marxianus* takes place slowly, and sometimes not at all; on the other hand, a yeast ring develops quickly. *S. Marxianus* and *S. Ludwigii* cannot ferment maltose; the variety of the former which forms spores with difficulty, and the non-sporing form of the latter, exhibit ready spore formation when grown in yeast water containing dextrose.

Beyerinck (Centralblatt. Bakt. Parasitkd. 1890, 49) states that *S. Apiculatus* forms asco-spores. The author has carried out numerous experiments with this organism, and was in no case able to detect sporulation. He found, however, in the cells round and strongly refractile bodies, bearing a certain resemblance to spores, and capable of being stained. Sometimes it was noticed that they were connected with the cell walls by threads of plasma, that they became brown when exposed to the action of osmic acid, and were occasionally dissolved by benzene, the entire cell being filled with a homogeneous substance. These bodies are only present when the cell is deprived of food, and are, without doubt, the fore-runners of death; in no case were any spores observed in the yeast.

The author has also examined *S. Anomalus*, which is identical with, or at least bears a close relation to, *Endoblastoderma pulverulentum*, a new genus and species described by B. Fischer and C. Brebeck (Zur Morphologie, Biologie und Systematik der Kahmpilze der Monilla Candida Hansen und des Soorerregers. Jena, 1894), which forms endogenous spores. He was unable to obtain the slightest indication of this method of propagation, and *S. Anomalus* must therefore be regarded still as belonging to the Saccharomycetes. —J. L. B.

*Malt, Occurrence of Glucase in, and Absence of a Saccharose-inverting Enzyme in.* E. Kröber. Zeits. f. ges. Brauw. 1895, No. 40, 325—327; No. 41, 334—336.

Lintner (this Journal, 1892, 1021) detected glucose, by the phenylhydrazine test, in the products obtained by the action on starch of extracts of air-dried and kilned malt, as well as by that of precipitated diastase. As Morris disputed this (this Journal, 1893, 367), the author has carried out a series of experiments in order to confirm the presence of glucase in malt, and the conditions under which it acts. His results are as follows:—1. Besides dextrose and saccharose, the presence of which had been previously proved, levulose, but no maltose, occurs. 2. The absolute and relative quantities of dextrose and saccharose are very variable. 3. In extracts of malt prepared at 15°—55°, no enzyme capable of inverting saccharose was found. 4. Glucase is present in malt, and its action appears to be most energetic at 55°. 5. Proportionately to the temperature attained in the kilning process, a portion of the reducing sugars pre-existent in green malt is converted into substances of a lower reducing power.—J. L. B.

*Water, Purification of, for Brewing Purposes with Calcium Permanganate.* Bordes. Wochenschr. f. Brauerei, 1895, **12**, 1063.

The author regards this compound as peculiarly suited to the sterilisation of water, since it is decomposed with extreme ease in the presence of organic substances and micro-organisms. As an antiseptic, calcium permanganate is far inferior to corrosive sublimate, and, unlike the latter, it is neither poisonous nor corrosive. A quantity of 0·01 grm. dissolved in a litre of water, effects complete sterilisation of the latter in five minutes. Experiments have shown that the disinfecting power of potassium permanganate is about a hundredth of that of the calcium compound.—J. L. B.

*Alcoholic Fermentation, Influence of Organic Acids on.* F. Lafar. Zeits. f. Spiritusindustrie, 1895, **18**, 238—239.

It is found that the influence which organic acids are capable of exerting on alcoholic fermentation, varies with the species of yeast employed. Thus, with Schwarzhofberg yeast the carbon dioxide liberated from a given quantity of must within a stated period was as follows when the must was neutral, normal, or acidified with the acids named; the numbers represent grms. of carbon dioxide:—Neutralised must, 25·7; normal must, 25·4; acidified with tartaric acid, 25·2; oxalic acid, 24·8; citric acid, 24·6; malic acid, 24·4; succinic acid, 24·3; acetic acid, 24·2; alkaline must, 23·7; acidified with lactic acid, 23·6.

With Geisenheim yeast the order was as follows:—Normal must, 25·1; acidified with tartaric acid, 25·1; oxalic acid, 24·9; citric acid, 24·8; neutralised, 24·5; malic acid, 24·3; succinic acid, 24·1; acetic acid, 24·0; alkaline, 23·6; lactic acid, 23·5.

Greater differences are found at intermediate stages during the fermentation, and in the presence of acetic acid, for instance, the activity of the two yeasts was very different.

When the fermentations were at an end, the number of yeast cells and the amounts of alcohol, acid, and glycerin were determined, and from the results obtained it is concluded that each of the acids mentioned exerts an influence, not only on the progress of the fermentation, but also on the products.

A second series of experiments to determine the maximum amount of acetic acid which might be added to must without destroying its fermentability, showed that normal must to which 0·74 per cent. acetic acid had been added was still fermentable. Fermentation was found to start soonest in normal must or in must to which only 0·27 per cent. acetic acid had been added. Three yeasts out of 15 were able to ferment must containing as much as 1 per cent. of acetic acid.—A. K. M.

### *Volatile Acids in Alcoholic Fermentation, the Causes which lead to the Production of.* Wochenschr. f. Brauerei, **12**, 505—506. From Researches on Alcoholic Fermentation. P. Biourge. La Cellule, 1895, **11**, 95.

Duclaux found that these acids were produced by the yeast when the carbohydrate food became exhausted, and Biourge agrees with this. His experiments may be summed up as follows:—

(1.) The amount of volatile acid has no relation to the amount of alcohol. In fermentation with *Mucor Racemosus* it is absent.

(2.) The concentration of the fermenting liquid has no effect on the amount of volatile acid.

(3.) The amount of volatile acid varies directly with the time of fermentation.

(4.) The influence of the different varieties of yeast on the production of volatile acids must be further investigated. The amount of volatile acid produced in beer by yeast is very small; if there is any considerable quantity it points decisively to bacterial infection.—A. L. S.

### *Fermentation Temperatures.* Windisch. Wochenschr. f. Brauerei, 1895, 982—983.

The author discusses the so-called American system of fermentation at higher temperatures than those prevalent in German breweries, since the points claimed in favour of the former are—a shorter period of fermentation, greater attenuation, saturation with carbonic acid by means of a weak after-fermentation, and better clarification of the beer. The following procedure was tried on a large scale in the brewery:—

The wort was pitched in the morning at 7° R., and gradually cooled down by the following morning to 5·8° R., after which the temperature was gradually allowed to rise to a maximum of 7·4° R. by the evening of the sixth day. From this point gradual cooling sufficed to reach 6° R. by the 12th evening, and the beer was then passed over refrigerators to the storage casks at 4° R.

During storage the amount of fermentation was very small, but the beer was well saturated with gas, and of good flavour. The author contends that the main characteristic of this method is not so much the higher fermentation temperature, or the longer duration of the higher temperature, but the superiority of a higher pitching heat.
—T. A. G.

### *Apples used for Cider, Oxidation of the Tannic Acid in.* L. Lindet. Bull. Soc. Chim. **13**, 277.

The red or brown discoloration which is noticeable on exposing the inner parts of the apples to the atmosphere, does not take place if that exposure be made after boiling the apples in water or after crushing them in boiling alcohol. These facts can only be explained by the assumption that this discoloration is due to an oxidation in which an oxidising diastase, similar to Bertrand's laccase, plays an important part. This oxidation is accompanied by the evolution of carbonic acid. (See under XXIV, page 1074.)
—C. O. W.

### *Malt Extraction.* R. Kusserow. Wochenschr. f. Brauerei, 1895, 1007—1008.

The author's experiments are based upon the well-known fact that the physical properties of malt are considerably influenced by the amount of moisture which it contains. Dry malt with but 1·5 to 2 per cent. of moisture yields, when ground, particles of varying size besides malt-flour, but as the moisture increases so does the amount of flour produced by grinding decrease until, when about 12 per cent. is present, the particles are regular in size, and there is *no* flour. Windisch has shown (Wochenschr. f. Brauerei, 1891, 84; and *ibid.* 1892, 1424) that a greater yield of extract is obtained from finely-ground than from coarsely-ground malt, but in practical operations there is a limit to the fineness of grinding employed, because the worts are correspondingly inferior in point of brightness and speed of filtration. Portions of the same original malt containing 3·0, 5·3, 6·7, 8·0, 10·0, 11·5, and 12·3 per cent. of moisture, were ground through the same mill and mashed under the same conditions, when it was found that the more moisture the malt contained, the quicker and brighter did the wort filter.

A badly-draining malt was made to drain well by increasing its percentage of moisture before grinding, and thus preventing the formation of malt-dust which is the cause of bad filtration, by choking up the pores of the filter on the one hand, and giving cloudiness to the filtrate on the other. A comparison of the specific gravities of these several worts showed a gradual decrease of extract, so that the difference between 3·0 and 12·3 per cent. of moisture represented a loss of 2·2 per cent. of extract reckoned on the dry malt. Since it is desirable on the practical scale to obtain high extracts along with clear and rapid filtration, experiments were conducted with finely-ground malt possessing a high moisture percentage, when *both* conditions were found to be fulfilled, whereas finely-ground grist from dry malt yielded unsatisfactory filtration. Finally, malt containing a high percentage of moisture was first coarsely ground, and then triturated with water in a mortar, the result being that a wort of higher extract was obtained which also filtered brighter and more quickly than that from the same coarsely-ground malt when not so triturated. Just as in the other cases, the filtration from a triturated malt deteriorated with the relative dryness of the malt when ground.

The author suggests that the method of using finely-divided moistened malts might find valuable application on the large scale.—T. A. G.

### *Steeping of Grain (especially Maize) before Steaming.* R. Heinzelmann. Zeits. Spiritusind. 1895, **18**, 214.

In order to avoid the use in distilleries of high pressures and temperatures in the steaming of grain and the consequent disadvantages, many methods of previous steeping have been tried at various times, but with only moderate success. The re-adoption in Belgium and Holland of the old plan (with modifications) of previous steeping in sulphurous acid, appears, however, to be very successful.

The maize is introduced into a wooden vat containing a perforated false bottom, and is then just covered with water at 50° C. (122° F.), and containing 4—5 litres of commercial sulphurous acid of 4° B. to every 100 kilos. of maize. At this temperature the maize readily absorbs the acid, swells rapidly, and warm water must be added from time to time to keep it just covered. The temperature should be maintained as near 50° C. as possible. In about 12 hours the necessary amount of sulphurous acid is absorbed; the remainder of the water is then drawn off, and the maize washed several times with cold water. Treated in this way, the grains can be crushed between the fingers like green malt and can be skinned readily. If it is passed through rollers and then boiled under the ordinary pressure, it yields a thin mobile liquid, which is very suitable for fermentation. Its use has also proved very satisfactory in the manufacture of pressed yeast.

In preparing the sulphurous acid solution, the acid (either the ordinary commercial solution or the liquefied gas) should be mixed with the warm water just before the latter enters the vat, as by that means the minimum amount of sulphuric acid is formed, and it is very desirable to have as little of the latter acid present as possible. The mixing is best managed by allowing the outlets of the water and acid tanks to join in a common pipe, and regulating the quantities by taps attached to the tanks.

Other grains appear to give good results with this process, though up to the present it has been chiefly adopted in the treatment of maize.—L. T. T.

### *Worts, Colouring of, by Influence of Water.* Kukla. Oesterr. Brauer- und Hopfenzeit. 1895, [19], 249.

Mierau (this Journal, 1895, 668) came to the conclusion that during hop-boiling additional coloration of the wort was noticeable when water containing calcium bicarbonate was used. The author states that hard water in which calcium bicarbonate is present can form a deeply-coloured unhopped wort; he further adds that his experiments show that the final colour of the beer is not so great in comparison with that of the wort as deduced from the analysis of the malt. He considers that the colour of the beer is also influenced by the following factors:—(1.) The colouring brought about in the boiling of the unhopped worts, is dependent upon their concentration and albuminoid content. (2.) The influence of different kinds of hops. (3.) The action of the yeasts. Windisch has ascertained that waters containing alkaline substances give additional colouring to the wort before hop-boiling, this being due to the presence in the husks of the malt of a substance which does not colour water by itself, but which, in the presence of small quantities of alkali, imparts a yellow colour.—J. L. B.

### *Distinguishing Yeast from Beer brewed from Malt, and that from Malt Substitutes.* Wochenschr. f. Brauerei, **12**, 506. From Wiedring. The American Brewer, 1895, 245.

The author finds that yeast from beer brewed from malt substitutes cannot be freed from the adhering dirt by washing with water, whilst with yeast from beer brewed from malt this is possible; but that both can be washed clear with beer. To make the test, two large beer glasses are taken and in each is placed about one-eighth part of yeast from beer brewed with malt substitutes. One of these glasses is filled up with water and one with beer. After well shaking and subsequent standing for five minutes, it will be seen that the yeast in the second glass has been freed from dirt, whilst in the first this is not so. This procedure may also be used to clean the yeast before using.
—A. L. S.

### *Yeast, the Use of the Lactic Acid Process or of Hydrofluoric Acid in the Manufacture of.* P. Wittelshöfer. Zeits. Spiritusind. 1895, **18**, 181—182.

Whilst admitting the importance of the work of Effront, and Maercker and Cluss, on the use of hydrofluoric acid in the growth of yeast, the author disputes its great superiority over the lactic acid process. When hydrofluoric acid is used as an antiseptic, the greatest care has to be employed in regulating the quantity, as the addition of too little renders its antiseptic action inoperative, whilst a very slight excess seriously retards the growth of the yeast.

Cluss claims for the Effront method the following advantages:—1. The absence of loss of fermentative material. 2. The simplification of the process; and 3. The fact that it is possible to work with pure yeast. The author analyses the results obtained by Cluss and by Effront to show that the loss is scarcely, if at all, greater when lactic acid is produced as an antiseptic during the fermentation than when hydrofluoric acid is added before fermentation is commenced. He maintains that, if anything, the lactic process can be more safely left in the hands of an ordinary workman than can the hydrofluoric process, and finally, that by judicious use of the lactic process almost, if not quite, as pure yeast is obtained as by the addition of hydrofluoric acid.—L. T. T.

### *Hydrofluoric Acid and the Lactic Treatment of Yeast.* J. Scheibner. Zeits. f. Spiritusindustrie, 1895, **18**, 221.

This is a reply to Cluss (see last abstract), and is in defence of the lactic treatment of yeast.—A. K. M.

### *Effront's Hydrofluoric Acid Treatment of Yeast.* A. Cluss. Zeits. f. Spiritusindustrie, 1895, **18**, 166 and 206—207.

In the first paper the author describes some highly satisfactory results obtained by Effront's hydrofluoric acid treatment in a distillery at Buir, whilst in the second he defends the Effront treatment against Wittelshöfer's criticisms. A. K. M.

### *The Enzyme of some Yeasts.* E. Fischer and P. Lindner. Wochenschr. f. Brauerei, 1895, 959—960.

*Behaviour of Melibiose towards Beer Yeasts.*—This sugar, investigated by Scheibler and Mittelmeier, is known to be fermentable by bottom-fermentation yeasts, but not by many top yeasts. The authors find, however, that bottom yeasts of the type Frohberg and Saaz contain a ferment capable of splitting up melibiose, which ferment can be extracted from the dried yeasts with water. Two pure cultures were employed, which, after growing in beer wort contained in Pasteur's flasks, were carefully washed with water, dried on porous tiles for three days at 20°—25°, then ground up with one-twentieth the amount of water, digested for 20 hours at 30°, and repeatedly filtered until the solution was quite bright. The estimation of the inversion products (glucose and galactose) was made by means of phenylhydrazine, since melibiosazone is fairly soluble in hot water. Melibiose was prepared and purified according to Scheibler and Mittelmeier's method. It was tested for freedom from Raffinose and Hexoses. Toluene and thymol were employed to prevent fermentation. A higher yield of phenylglucosazone was obtained when using yeast as the inverting agent in place of yeast extract. With top Frohberg and Saaz, no inversion whatever was obtained either from dried or fresh, moist yeast, from which the inference is drawn that the necessary enzyme is absent. Since cane sugar is inverted by top Frohberg and Saaz yeasts, these results are contrary to those of Scheibler and Mittelmeier (Berichte, **22**, 3121), who state that melibiose is completely inverted by continued digestion with invertin. The authors repeated these experiments with melibiose, using an active invertin, but found it possessed no influence upon melibiose. They conclude therefore that Scheibler and Mittelmeier's invertin must have contained also the other enzyme of beer yeast.
—T. A. G.

### *Action of Alum on Wine, and its Detection.* F. Sestini. Chem. Zeit. Rep. 1895, **19**, 216.

The addition of 0·03 per cent. of alum to wine was not found to result in a corresponding increase of alumina in the ash. This was found to be due to the slow formation of a precipitate consisting chiefly of alumina and phosphoric acid, with smaller quantities of lime, acid potassium tartrate, sulphates, and colouring matter. Thus the sulphates in the ash of the wine were increased, and the phosphates somewhat decreased; determinations of these would afford a more certain test of the addition of alum than the amount of alumina in the ash. The sediment should also be examined. The total acidity and the volatile acids especially were increased by the action of the alum, which thus appears harmful both by diminishing the keeping power of the wine and by abstracting useful phosphoric acid.
—A. C. W.

### *Maltose and Dextrose, Estimation of, by Fehling's Solution.* R. Kusserow. Wochenschr. f. Brauerei, **12**, 574.

*See under* XXIII., *page* 1072.

### *Phosphoric Acid in Wine, Determination of.* R. Wirth. Chem. Zeit. **19**, 1786.

*See under* XXIII., *page* 1070.

### *Boric Acid in Wines, Detection of.* A. Villiers and M. Fayolle. J. Pharm. Chim. 1895, **6**, Ser. 2, 241.

*See under* XXIII., *page* 1069.

### *Glycerin, Estimation of, in Beer and Wine.* Partheil. Wochenschr. f. Brauerei, 1895, **12**, 1066.

*See under* XXIII., *page* 1071.

*Gravimetric Estimation of Maltose by Fehling's Solution.* T. A. Glendinning. Proc. Chem. Soc. 1895, [155], 163.

*See under* XXIII., *page* 1073.

*Fining by Iron Balls; the Employment of Electricity to produce an Old Vinous Taste.* Wochenschr. f. Brauerei, **12**, 506. F. C. Wiedring, 1891. U.S. Pat. 514,102.

In place of the usual chips employed for fining lager beer, the inventor proposes to use iron balls, and instead of the usual addition of raw wort to the beer (which is added to produce sufficient carbonic acid to saturate the beer), he proposes to add purified yeast.

To produce the desired old flavour, which he considers is communicated by dead yeast cells, he passes a current of electricity through the beer so as to kill some, but not all of the yeast cells.—A. L. S.

### PATENTS.

*Apple, Wine, and other Presses, Improvements in.* C. J. Ollaguier, Tours, France. Eng. Pat. 17,848, Sept. 19, 1894.

This is a press arranged for continuous working. It consists of a frame supporting a table having upon its circumference a channel with outlet tubes. The table serves as a support for a pan divided into compartments, by means of perforated plates. The whole is capable of rotation, and is so arranged that as this takes place each compartment is successively charged with the material to be pressed by being brought below the mouth of a hopper which is filled with the same; the charged compartment then passes under a stamp, which compresses its contents, and the juices thus liberated pass away through the perforated sides and are collected; the rotation then causes the stamp to lift, and subsequently the sides of the compartment are raised and the pressed residue removed by a scraper. The rotation being then completed, the apparatus passes to its original condition, and repeats the same cycle.—A. L. S.

*Vinegar, Improvements in the Manufacture of.* J. Holt, Wanstead Park, and J. G. Lorrain, London. Eng. Pat. 24,113, Dec. 11, 1894.

The inventors oxidise fermented wort by means of nascent oxygen.

Electrodes are immersed in the wort in such a manner that the cathode, which is made of platinum-wire gauze is placed vertically above the anode, which consists of a platinum foil punctured with a pointed tool so as to cause the edges to project upwards, the two electrodes lying in horizontal planes. They are then connected with a dynamo, or other source of electricity, and, to render the liquid more conductive, a small quantity of acetic acid is added. The oxidation is most effective at a temperature of 75°—90° F. The hydrogen from the cathode and the unused oxygen from the anode may, if desired, be collected in any suitable way and utilised.—L. de K.

*Composition for the Destruction of Phylloxera and for Developing the Stocks of the Vine, Improvements in and relating to.* J. Y. Johnson, London. From F. Gennadius, J. Aghion, and E. Nauffal, Paris. Eng. Pat. 25,295, Dec. 29, 1894.

*See under* XVIII. C., *page* 1059.

*The Beer Industry of Austro-Hungary.* Board of Trade J., Dec., 655.

*See under* Trade Rep., *page* 1077.

*Reports on German Chemical Industries in* 1894 [*Spirits*]. Ber. über Händel u. Industrie, Berlin, 1894.

*See under* Trade Rep., *page* 1079.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY AND WATER PURIFICATION, DISINFECTANTS.

### (*A.*)—CHEMISTRY OF FOODS.

*Sterilisation of Milk and Lactic Fermentation.* P. Cazeneuve. Bull. Soc. Chim. **13**, 502.

The following conclusions are arrived at:—

1. If it be true that a temperature of 110° C. (Pasteur, Hueppe) for half an hour be required to kill the lactic ferment, heating for one hour to from 98° to 100° C. often answers the same purpose; in every case it is brought to the point of sterility. At the same time, all pathogenic ferments are entirely destroyed.

2. Sterilising the milk in bottles which are completely immersed in boiling water, and thereby also freeing it entirely from oxygen, insures its conservation for an indefinite space of time, without giving rise to rancidity or coagulation.

3. The digestive and nutritive properties of milk sterilised at from 98° to 100° C. have been proved to be at least equal to those of ordinary milk, but the former is superior to the latter owing to the total absence of pathogenic microbes. The milk sterilised as mentioned is also superior to that sterilised at from 110° to 120° C., as it is free from the yellowish tint and the burnt or peptonic taste so frequently noticeable in the latter.

4. The lactic ferment is only sparsely distributed through the air, so that contamination of the milk by it is chiefly caused by its coming in contact with contaminated objects. For this reason frequent and thorough washing of all the vessels in which the milk is handled is to be recommended.
—C. O. W.

*Vegetable Fibre in Feeding or Linseed Cake, Pepper, &c., Estimation of.* R. Cusiter. City Anal. Soc., Glasgow, 1894–95, [5], 13.

*See under* XXIII., *page* 1071.

*Ginger, Analysis of.* W. Skinner. City Anal. Soc., Glasgow, 1894–95, [5], 7.

*See under* XXIII., *page* 1071.

*Boric Acid and Formic Aldehyde, Detection and Estimation in Milk.* R. T. Thomson. Read before the City Anal. Soc., Glasgow, 1894–95, [5], 3.

*See under* XXIII., *page* 1070.

### PATENTS.

*Treating Frozen Carcases or the like, Improvements in or appertaining to.* J. Atherton, Liverpool. Eng. Pat. 19,865, Oct. 18, 1894.

The object of the invention is to thaw frozen meat in such a way as to prevent discoloration or deterioration in quality.

The carcases (or parts of them) are hung in a closed chamber, the walls of which should be capable of resisting external or internal pressure. Heated carbonic acid, or a mixture of this with air or nitrogen which has been dried by passing it through sulphuric acid or calcium chloride, is then forced in, and after a while the surplus air of the chamber is allowed to escape through an exit-pipe communicating with the closed channel through which the gas passes to the drying chamber, by which means a continuous circulation of dry gases will be maintained. When about three-quarters of the time required for thawing has elapsed, about 5 per cent. by volume of carbonic oxide is introduced. This gas acts as a powerful antiseptic, and is said to give the meat a good colour.—L. de K.

*A Substitute for Coffee, Improvements in Preparing, and Apparatus therefor.* E. W. Fischer and H. Zedler, both of Breslau, Germany. Eng. Pat. 24,706, Dec. 19, 1894.

The inventors utilise corozo nuts for preparing a coffee-substitute to be known as "Phytelephten."

The nuts are cut into small pieces, steamed in a closed kettle to destroy bacteria and remove decayed parts. They are then washed with water containing 0·2 per cent. of permanganate of potash, exposed to sulphurous acid fumes, and finally cleansed with pure water. The residue is roasted in drums, some of which contain coffee berries exclusively, the arrangement being such that the aqueous vapours and fumes (essential oils, &c.) from the coffee pass over and are absorbed by the corozo nuts. The roasting is then completed.—L. de K.

*Bread and Flour, Improvements in the Manufacture of.* J. T. O'Callaghan, London. Eng. Pat. 15,427, Aug. 16, 1895.

Unhusked rice is soaked in a mixture of lime-water, phosphoric acid, and bicarbonate of potash. The rice is then malted in the usual way, and finally ground and dressed. Degerminated white maize is also treated with the aforesaid liquid, to which, in addition, sugar candy has been added. The flour is then re-dried and [illegible] To prepare flour for making fine white bread, 267 lb. of [illegible] flour are mixed with 6 lb. of the prepared rice flour, 4 lb. of the maize and 3 lb. of salt.

Meal for brown bread is prepared by mixing 267 lb. of ground entire wheat, 5 lb. of the prepared rice, 5 lb. of the maize, and 3 lb. of salt. The inventor claims that foodstuffs so prepared keep longer and are more nutritious than when prepared from ordinary flour.—L. de K.

*Treatment of Milk, Bouillon, and the like to produce an entirely Germ-free and Transportable Alimentary Product, an Improved Process and Apparatus for.* From E. Hilberg, Essen, Germany. W. P. Thompson, London. Eng. Pat. 16,145, Aug. 28, 1895.

The inventor sterilises milk, bouillon, &c., in a special apparatus. This consists of a pressure-vessel and an overflow-vessel. By heating in a current of steam, the contents of the vessel are alternately submitted to pressure and a partial vacuum, and on repeating the process several times, germs and spores are destroyed. The contents are finally submitted to pressure either by cooling before closing or by means of a screw after closing. The pressure, it is claimed, prevents fat globules separating, and kills the spores of the potato bacillus, &c.—L. de K.

## (*B.*)—SANITARY CHEMISTRY.

*Water, Purification of, for Brewing Purposes, with Calcium Permanganate.* Bordes. Wochenschr. f. Brauerei, 1895, **12**, 1063.

*See under* XVII., *page* 1054.

### PATENTS.

*Filter Beds for the Filtration of Liquids from Sewage Sludge, Mud, Bleachers', Dyers', Tanners', and Manufacturers' Refuse, and in Apparatus or Arrangements for Use therein, and covering the same, Improvements in the Construction of.* H. L. Hinnell, Bolton, Lancaster. Eng. Pat. 19,482, Oct. 13, 1894.

The filter-beds are composed of the usual materials, coarser below and finer above, in superposed layers, and at the bottom, drain pipes or tiles open at the top, communicating with a cavity wall which surrounds the filter-bed, are laid. This mode of construction and arrangement is said to allow of a more thorough permeation of the substance of the filter-bed by the air from the drain tiles or conduits beneath. The whole is covered and protected from rain by a roof of open construction and walls of louvre boards, so that there may be a free circulation of air to dry the deposit which remains upon the bed.—L. A.

*Filtration of Water, Sewage, and other Liquids, an Improved Method of.* W. J. Lomax and C. J. Lomax, Bolton, Lancaster. Eng. Pat. 19,761, Oct. 17, 1894.

The liquid flows into a trough or receptacle, from which, by the action of tipping vessels, intermittent siphons, or the like, a limited volume is periodically withdrawn and flushed over the surface of the filter-bed. The interval between the successive flushings is made long enough to allow each dose of liquid to sink into the filter-bed, air following it before the next flushing occurs, and thus the filtering material is maintained in a properly aërated and highly efficient condition. In order to prevent the rush of liquid from disturbing the surface, the filter-bed is covered with fibrous matting, felting, canvas, netting, timber, or other suitable material.—L. A.

*Apparatus for Removing Subaqueous Deposits from Settling Tanks, Improvements in and connected with.* J. Corbett, Salford. Eng. Pat. 20,058, Oct. 20, 1894.

The apparatus consists of an open bell-mouthed funnel or collector mounted on wheels or rollers, connected by a flexible pipe to a floating inspection chamber, from which a flexible discharge pipe leads to a pump, or to a lower level. The inspection chamber is supported by a floating pontoon, which can be moved over the surface of the water in the tank by means of overhead rope travelling gear, and from the pontoon the collector can be caused to traverse the whole floor area and sides of the tank, and all sludge and deposit is thus removed and discharged.—L. A.

*Separation of Oils and Fats from Water, Process for the.* A. L. G. Dehne, Halle-on-the-Saale, Germany. Eng. Pat. 21,131, Nov. 3, 1894.

The process is applicable for separating oil from greasy water, such as that obtained from a condensing engine. The water is collected in a tank, any large globules of oil which may collect on the surface are drawn off by a cock, and the remainder, containing finely divided oil emulsified with the water, is passed into a second tank, where it meets hydrated alumina made into a cream with water. The tank for preparing the alumina cream, and that in which it is ultimately mingled with the water to be treated, are provided with agitators. The mixture of water, oil, and alumina is filtered, *e.g.*, through a filter-press, and the oil thus retained by the alumina; the purified water passes away. For an engine giving 1,000 litres of condensed water per hour, about 3 kilos. of "powdered hydrate of alumina with about 70 per cent. humidity" are required per hour.—B. B.

*Destructor Furnaces, Improvements in.* W. P. Abell, Hinckley; and Essequebo, British Guiana. Eng. Pat. 22,086, Nov. 15, 1894.

A number of furnaces are arranged in the form of a battery, and each charged with the refuse or waste materials by a hopper of usual construction. The heavy portions fall down to the grate, but the light bits of paper, carbon flecks, and other materials are carried by the draught, along with the light and heavy gases evolved, into a circular combustion chamber, having an outlet near the centre. This forms a whirling chamber, wherein the combustible materials travel until consumed, whilst the heavy incombustible materials melt, and finally fall through a vertical tangential opening to a receptacle, from which they are discharged. This receptacle is provided with a damper for admitting air to the combustion chamber, whilst horizontal tangential air openings, having dampers, are also provided. The air for burning the material on the grate enters at the top of the furnace, passes down between air walls encircling the furnaces, and then over hot corrugated iron plates, forming the base of the ash pit, under which pass the hot gases on their way to the chimney, after heating the boilers, &c.
—R. S.

## (*C.*)—DISINFECTANTS.

### PATENTS.

*An Improved Cleansing and Disinfecting Wash for Cattle Trucks, Cow Sheds, and other Structures,* C. T. Macadam, London. Eng. Pat. 24,085, Dec. 11, 1894.

A suitable disinfecting material is mixed with an inert substance, such as china clay, with or without an added colouring material, such as ochre, and used as disinfecting wash, or "white wash."—L. A.

*Composition for the Destruction of Phylloxera, and for Developing the Stocks of the Vine, Improvements in and relating to.* J. Y. Johnson, London. From F. Gennadius, J. Aghion, and E. Nauffal, Paris. Eng. Pat. 25,295, Dec. 29, 1894.

The composition consists of olive oil, 800 parts; mineral pitch, 190; calcium carbonate, 18; silica, 1·5; iron oxide, 0·75; assafœtida, 0·5 part.—L. A.

*An Improved Sheep Dip and Antiseptic Dressing and Preservative for Hides and the like.* G. R. Morrison, Plaistow, Essex. Eng. Pat. 11,785, June 17, 1895.

*For a "Sulphur" Dip.*—Sodium or other metallic thiosulphate mixed with an acid sulphate or free acid, is dissolved in water, *e.g.*, sodium thiosulphate, 26 lb., and sodium bisulphate, 50 lb., are dissolved in 1,000 to 1,200 galls. of water.

*For a Poisonous Dip.*—24 lb. of either sodium arsenite, antimony chloride, or tin chloride, or 12 lb. of mercuric chloride, are added to the above.—L. A.

## XIX.—PAPER, PASTEBOARD, Etc.

*Resin Sizing and the Durability of Paper.* Papier Zeit. 1895, **89**, 2834—2835.

The Prussian "Instructions with reference to the quality of paper for official purposes," and proposed as a standard for all civilised countries, are calculated to ensure the durability of all important official papers; but unfortunately they do not take into consideration the difference between animal and vegetable sizing. Members of the trade and chemists have repeatedly pointed out the probable deleterious influence of resin sizing on the strength of paper. The fact that animal-sized papers, manufactured centuries ago, now exist with the cellulose fibres practically unaltered, tends to prove that this form of size has no injurious action upon the cellulose, or strength and durability of the paper. It is well known that resin-sized rag papers, in the manufacture of which the generation of free acid seems impossible, generally become fragile after a number of years, which gives rise to the supposition that the decrease in strength is due to the action of the resin. It has also been pointed out that pure rag papers treated with animal and vegetable size, show different degrees of strength after keeping at high temperatures (up to 100° C.). Paper treated with vegetable size loses much more in strength than that in which animal size was employed. The short time the papers were kept during such experiments at a high temperature may be taken as equivalent to a longer period at the normal temperature. The theories that have been advanced as to the possibility of the influence of resin on cellulose, coincide with the above-mentioned practical results.

Dr. Wurster has proved that in the process of vegetable sizing, the resin is set free and does not exist in the paper as a resinate, as formerly believed. It is a well-known fact that pine resin acts as an oxidising agent, by converting the oxygen of the air into ozone. Equally well known is the fact that the cellulose of various paper fibres has the property of becoming converted by strong oxidation into oxycelluiose, which can easily be recognised by the breaking and low strength of the paper. Up to the present time only one single direct proof has ever been brought forward to show that the resin precipitated on the paper fibre acts as an oxidising agent. At the 65th meeting of the British Association, recently held at Ipswich from 11th—18th September, D. J. P. Berridge cited a case in which he had saturated a piece of resin-sized paper containing starch with a solution of iodide of potassium, and then exposed it to the light under a negative in a printing frame. The colour of the paper thus exposed turned to a chocolate brown. On the paper being brought into contact with water, the colour changed to a distinct blue. Berridge ascribed this to the generation of starch iodide in the presence of an excess of water. The cause, however, can only be found in the generation of ozone by the free resin in the paper. Another experiment may confirm this. Paper containing starch, sized with strong vegetable size and dipped in a solution of iodide of potassium, ought, according to this, at the expiration of some considerable time, to show a weak bluish tinting. At this point it may not be out of place to remark on the decrease in strength of paper containing mechanical wood pulp after it has been stocked some time. Here, likewise, the well-known rapid deterioration of the strength is to be ascribed in a great measure to the powerful ozonising action owing to the presence of resin in the pulp. As a counter-argument it would probably occur to many, that the percentage of resin in a paper containing only a small quantity of mechanical pulp would be far lower than in a rag paper treated with strong vegetable size, whilst the latter shows less signs of deterioration than the former; this, however, is explained by the different ozonising properties of different resins. Pine resin in its original state, as found unchanged in mechanical pine pulp, is the strongest ozoniser. During the different melting operations that pine resin has to undergo during its transformation into the resin of commerce, conversion may take place into isomeric or kindred resin acids, less capable of ozonising.

The very different actions of the raw pine resin and the pure resin when exposed to the air, appear to furnish strong argument in favour of this theory. It is also quite possible that the acids given off during the process of vegetable sizing are not identical with those contained in pure resin.

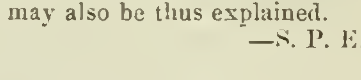
From the foregoing it may be taken for granted that the free resin used in sizing paper acts as an oxidising agent, and with this it is possible to explain other phenomena connected with which up to the present time only conjecture exists. It is well known that the rapid deterioration of strength has been especially noticeable in unbleached sulphite papers. The possibility of sulphuric acid being formed by the ozonising action of the resin size in such sulphite papers is quite as explicable as the accelerated deterioration of the paper by the formation of oxycellulose. The appearance of traces of free sulphuric acid in papers that by virtue of their process of manufacture can have contained no free sulphuric acid, but have contained free sulphurous acid or free sulphur (originating through the use of hyposulphite (thiosulphate) of sodium) may also be thus explained.
—S. P. E.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES AND EXTRACTS.

*New Phenetidine Derivatives.* L. Wergböffer. Chem. Zeit. **19**, 1753—1754.

The phenetidine (*p*-amidophenol) derivatives known up to the present are phenacetine (acet-*p*-phenetidine), phenocoll (glycocoll-*p*-phenetidine), lactophenine (lactyl-*p*-phenetidine), and malakin (salicylide-*p*-phenetidine, $C_2H_5O.C_6H_4.N:CH.C_6H_4.OH$). Dulcin, or *p*-phenetol carbamide, $C_2H_5O.C_6H_4.NHCONH_2$ (this Journal, 1893, 951, and 1894, 542), is also a substituted *p*-phenetidine. The author describes some newer derivatives.

*Benzyl-p-phenetidine*, obtained by heating together benzyl chloride and *p*-phenetidine, crystallises in plates melting at 45°—46° C. It is almost insoluble in water, is soluble in alcohol and chloroform, and very easily soluble in ether. It dissolves in hot sulphuric acid, and is precipitated unchanged by water, whilst even hot soda lye does not act upon it. The substance is a powerful febrifuge, and it has been used with good results in cases of headache.

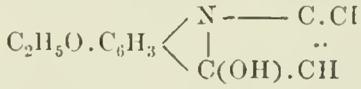


*Ethoxyphenyloxamide*, $\left.\begin{matrix}CO\\ \cdot\\ CO\end{matrix}\right\rangle(HN.C_6H_4.OC_2H_5)_2$ forms thin needles melting at 263° C., and is obtained by heating anhydrous oxalic acid and *p*-phenetidine to 110°—115° C. It is insoluble in water and sparingly soluble in absolute alcohol, benzene, and chloroform, but more easily in hot acetic acid. By heating with a solution of an alkali, the substance is decomposed into *p*-phenetidine and an alkaline oxalate. This decomposition, however, does not appear to take place in the organism, since 2 grms. per day given to a cat for some weeks did not have any ill-effect.

*Amygdalyl-p-phenetidine*,

$$C_2H_5O.C_6H_4.NHCOCH(OH)C_6H_5$$

is obtained by heating *p*-phenetidine mandelate, which melts at 105° C., to 170° C. After washing the melt with dilute soda lye, the new condensation product is recrystallised from 60 per cent. alcohol, when it separates in shining white plates melting at 140·5° C. The substance possesses both antipyretic and antiseptic properties. It yields an acetyl derivative melting at 151° C., which has similar properties, and dissolves easily in alcohol and acetic acid, but sparingly in ether and hot water. By condensing *p*-phenetidine with aceto-acetic ether, *β-phenetidyl crotonic ethyl ether*, $C_2H_5O.C_6H_4.NHC(CH_3):CHCO_2C_2H_5$, is produced, which crystallises in white plates melting at 53° C., and is insoluble in water, but soluble in alcohol and ether. On rapidly heating to 225°—240° C., it gives off alcohol and is converted into *p-ethoxy-γ-hydroxyquinaldine*—



$$C_2H_5O.C_6H_3\left\langle\begin{array}{l} N\text{——}C.CH_3 \\ |\qquad\quad\ \ddot{} \\ C(OH).CH \end{array}\right.$$

This substance forms silky plates, sparingly soluble in cold water and ether, more easily in hot water, and readily in alcohol. It has a pleasant bitter taste, and acts as a powerful antipyretic.—T. A. L.

*Chloroform, Prevention of decomposition of.* L. Allain. Chem. Zeit. **19**, 310.

The addition of alcohol or ether to chloroform somewhat retards the formation of carbon oxychloride and hydrochloric acid, but does not altogether prevent it. Sulphur, purified by digesting for 24 hours with ammonia and carefully washed and dried, will effectually prevent the decomposition of chloroform, and in a sample saturated with sulphur, after exposure to sunlight for four months, no impurities could be detected and the sample produced a normal anæsthesia.—T. A. L.

*Quinine, the Hydrogenation of.* E. Lippmann and F. Fleissner. Monatsh. für Chem. 1895, **16**, 630.

By the repeated action of sodium on an absolute alcoholic solution of quinine, and subsequent purification of the product with lead acetate and animal charcoal, a yellow oil was obtained, which soon solidified to a hard amorphous mass. This appears to be tetrahydroquinine, $C_{20}H_{28}N_2O_2$; it is slightly soluble in water, and liquefies in alcohol, benzene, and chloroform. It could not be crystallised. It forms salts with one and two equivalents of hydrochloric acid, which are also uncrystallisable, reduces ammoniacal silver nitrate, gives the quinine reaction with ammonia and chlorine water, and a very characteristic green coloration with oxidising agents in weak acid solutions. Like quinine, tetrahydroquinine contains a hydroxyl and a methoxy group, and can be converted into tetrahydro-apoquinine. The physiological action is as follows:—0·01 grm. injected under the skin of a frog, causes, after a short time, arrest of respiration and loss of voluntary and reflex movements, although the heart movements remain normal. 0·05—0·01 grm. is a fatal dose. An injection of 0·01—0·02 grm. into the veins of a rabbit causes stoppage of respiration and paralysis, with continuation of heart movements; nerves and muscles are directly excitable. 0·1—0·15 grm. causes convulsions, 0·5 grm. causes death from general convulsions following on tetanic convulsions.—A. C. W.

*Calcium Glycerophosphate, Preparation of.* Lambotte. Repert. Pharm. 1895, **51**, 152.

A mixture of 250 grms. of powdered glacial phosphoric acid with 500 grms. of glycerin, is boiled in a dish over the naked flame; the acid dissolves rapidly in the glycerin, darkens, and emits vapours; and in half an hour the reaction is complete, when the mass is cooled and mixed, first with water, and then with about 127 grms. of slaked lime, until only faintly acid. The liquid is strained through flannel, and the collected paste is then suspended in water and filtered. Strong alcohol is added to the mixed filtrates, until the calcium salt of the acid is completely precipitated; the latter is filtered off, treated several times in succession in the same way with fresh alcohol, to remove traces of glycerin, and, after the final filtration, is dried in the air or in an oven. So prepared, it is a white neutral and light powder, unchanged by the air, and soluble in water in the proportion of 6·25 : 100.—W. G. M.

*Acetone, Testing.* H. Schweitzer and E. E. Lungwitz. Chem. Zeit. 1895, **19**, 1384.

*See under* XXIII., *page* 1069.

*Iodine, Estimation of, in Organic Substances.* M. C. Schuyten. Chem. Zeit. 1895, 1143.

*See under* XXIII., *page* 1071.

*Inverting Action of the French Officinal Chloride of Iron Solutions.* M. H. Herissey. J. Pharm. Chim. 1895, 6 Sér. 3, 202.

*See under* XVI., *page* 1053.

*Orthobenzoic Sulphinide (Saccharine).* W. J. Pope. Proc. Chem. Soc. 1895, [155], 163.

The author finds that pure orthobenzoic sulphinide in large well-defined crystals may be obtained from the commercial mixture known as "saccharine" by crystallisation from acetone.

## PATENTS.

*Caseïn Compounds, Manufacture of.* Farbwerke vorm. Meister, Lucius, and Brüning. Eng. Pat. 22,190, Nov. 16, 1894.

The manufacture of caseïn salts of the alkalis and alkaline-earths, is claimed. There are two classes of salts: (1) those neutral to phenolphthaleïn and not coagulated by rennet; (2) those acid to phenolphthaleïn and coagulated by rennet in presence of calcium salts. The latter contain about two-thirds of the quantity of base contained in the former. The salts are made by dissolving caseïn in the calculated quantity of alkali, alkaline carbonate or phosphate, or milk of lime, and evaporating *in vacuo*, and whilst hitherto compounds of caseïn with alkalis and alkaline earths have only been obtained in solution, by this method it is said to be possible to prepare the alkali and calcium salts in the form of dry powders.—T. E.

*A New Solid Silver Compound which is not Precipitated by Albumen or Salt.* Farbwerke vorm. Meister, Lucius, and Brüning. Eng. Pat. 22,191, Nov. 16, 1894.

The substance claimed is made by mixing the neutral sodium salt of caseïn (3 kilos.) with 300 grms. of silver nitrate and dissolving the whole in water with the aid of gentle heat. This solution is then precipitated by alcohol and the precipitate dried, or it is evaporated to dryness *in vacuo*. The substance so obtained differs from a mixture of the sodium salt of caseïn with silver nitrate inasmuch as its solution is not precipitated by treatment with sulphuretted hydrogen, and subsequent addition of ammonia, but only gives a clear brown solution, nor is it precipitated by albumin or salt.—T. E.

*Chemically Pure Carbon, Method of Producing.* A. Schmöle, Iserlohn, Germany. Eng. Pat. 25,223, Dec. 28, 1894.

Magnesium or silicon is volatilised by subjection to electrical action within a closed, exhausted iron or steel vessel, connected to a reservoir containing liquid carbonic acid, and thus exposed to great pressure. Pipes are arranged within the vessel, cooled by flow of water, and the carbon set free by action of the magnesium vapour on the carbonic acid gas, collects on such cooled surfaces. The claims involve the subjection, in general, of a carbon compound to the action of a metal or metalloid, strongly heated under pressure, to obtain pure carbon.—E. S.

*Toluenesulphonic Chlorides, Improvements in the Manufacture of.* H. Imray, London. From Prosper Monnet, Lyons, France. Eng. Pat. 25,273, Dec. 29, 1894.

The preparation of toluene sulphonic chlorides, especially orthotoluenesulphonic chloride, used in the manufacture of benzoyl sulphonic imide (saccharine) as usually carried out, involves a number of processes and gives rise to small yields. The action of hydroxysulphuric chloride on toluene was studied some time ago by Claesson and Wallin (Ber. **12**, 1848), who, however, succeeded in converting only about half the toluene into toluenesulphonic chloride. The present inventor finds that by keeping the temperature of the reacting mass between the limits of 0° and 5° and employing a large excess of hydroxysulphuric chloride (4 to 1 of toluene), the conversion takes place according to the equation :—$C_7H_8 + SO_2(OH)Cl = C_7H_7SO_2Cl + H_2O$.
—D. B.

*Substitute for Natural Cork, an Improved Composition applicable as; and for other Purposes, such as an Electrical Insulating Material.* E. Hermet, Paris. Eng. Pat. 6473, March 29, 1895.

The new composition is called "Liegine." It is prepared by "mixing together the powdered material to be treated" (cork, wood, leather, cardboard) "with collodion, or 'acetic' cellulose, or celluloid in solution in acetone, with or without the addition of linseed or other oil and acetic acid, such mixture being subsequently moulded, dried, and compressed." Acetic cellulose, a novel chemical agent, is produced by heating gun-cotton, or, if preferred, filtering-paper or tissue paper, or indeed any similar body capable of producing the same results, together with anhydrous acetic acid at about 190°.—W. M.

*Para-phenetidine-succinic Acid and Para-phenetidine-dihydroxysuccinic Acid, Manufacture of.* G. W. Johnson, London. From F. von Heyden, Radebeul, Dresden. Eng. Pat. 14,231, July 27, 1895.

These new compounds are obtained by heating together molecular proportions of succinic or tartaric acid and para-phenetidine ($C_6H_4.NH_2.OC_2H_5$) at 150° C. for some hours. From the solution obtained by boiling the product with soda, mineral acids precipitate the anilide—

$$COOH.C_2H_4.CONH.C_6H_4.OC_2H_5 \text{ or}$$

$$COOH.C_2H_2(OH)_2.CO.NH.C_6H_4.OC_2H_5$$

The former melts at 163°—164° C., the latter at 195° C.; both dissolve very readily in hot water and in soda solution. If two molecular proportions of phenetidine be employed, the dianilides are obtained; these melt at 156° and 265° respectively, and because of their insolubility in water and soda, are of little medicinal value.—A. C. W.

*Vanillin from Protocatechuic Aldehyde, Improvements in Manufacture of.* J. Imray, London. From La Société Chimique des Usines du Rhône, Lyon, Rhône, France. Eng. Pat. 17,322, September 17, 1895.

The prevention of the methylation of the para-hydroxyl group in protocatechuic aldehyde is claimed, by condensing the latter with nitro-paratoluene sulphonic chloride, $C_6H_3(CH_3)NO_2.SO_2Cl[CH_3:NO_2:SO_2Cl = 1:2:4]$. This substance, formed by direct nitration of paratoluene sulphonic chloride, melts at 36° C., boils at 175°—180° C. under a pressure of 7 mm., and with ammonia yields an amide melting at 143°—144 C. The condensation takes place at ordinary temperatures by the action of dilute soda on a toluene solution of the sulphonic chloride mixed with aqueous solution of the aldehyde; the product is precipitated from the aqueous solution by sulphuric acid and methylated in the cold by the action of dimethylsulphate and alcoholic potash. The methylated compound is washed with cold water, dissolved in alcohol, and decomposed on the water-bath by alcoholic potash; the alcohol is then distilled off, the residue extracted with water, and the crude vanillin precipitated in the cold by sulphuric acid. In the condensation, the formation of a meta substitution product is completely avoided.—A. C. W.

*New Carbonic Esters of Acidyl Derivatives of Amidophenols and of their Alkylised Derivatives, Manufacture of.* O. Imray, London. From The Farbwerke vorm. Meister, Lucius, and Brüning, Höchst-on-the-Maine, Germany. Eng. Pat. 24,901, Sept. 23, 1895.

The carbonic esters of the general types $COOR.O.C_6H_4.NHAc$ and $COOR.O.C_6H_4.NAc.R^1$, where Ac represents an acid radical, R and $R^1$ alcoholic groups, are obtained by dissolving the substituted amidophenol in the calculated quantity of soda-lye and shaking with a slight excess of a chlorcarbonic ester, care being taken against any considerable rise in temperature. The product is purified by recrystallisation from dilute alcohol. The acidyl amidophenol carbonic esters are colourless, well-crystallisable substances, easily soluble in alcohol and hot water, less soluble in ether and benzene. They are decomposed by heating with acids or alkalis.—A. C. W.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

### PATENTS.

*Caseïn Compounds, Manufacture of.* Farbwerke vormals Meister, Lucius, and Brüning. Eng. Pat. 22,190, Nov. 16, 1894.

*See under* XX., *page* 1060.

*A New Solid Silver Compound, which is not precipitated by Albumen or Salt.* Farbwerke vorm. Meister, Lucius, and Brüning. Eng. Pat. 22,191, Nov. 16, 1894.

*See under* XX., *page* 1060.

*Albumen and Albumen-like Matters, Casein, Albuminose, and the Products of Conversion of Glue and Gelatin, a Process for rendering insoluble.* From Chemische Fabrik auf Actien vorm. E. Schering, Berlin, Germany. A. Zimmermann, London. Eng. Pat. 23,585, Dec. 4, 1894.

The solution of the said substances, is mixed with a suitable quantity of a 40 per cent. solution of formalin (formaldehyde). The solution does not coagulate, but remains clear for a long time. Once, however, the liquid is evaporated, the residue will have become absolutely insoluble in water.

The same result may be obtained by first drying and then exposing the mass to vapours of formalin, or moistening with solution of the same and then re-drying. The inventor claims that the process may be utilised for all purposes where it is desired to produce an insoluble albuminous layer upon a backing, such as a glass or metal plate or paper, and that it will be found of especial use in photography. It is stated that in the case of insoluble gelatin films, the methylene blue test distinguishes in a striking manner between them and those which have not been treated with formaldehyde.—L. de K.

## XXII.—EXPLOSIVES, MATCHES, Etc.

*Manufacture of Matches in Belgium.* U.S. Cons. Reports, Nov. 1895, 390.

Consul Morris, of Ghent, writes to the Department under date of September 4, 1895 :—

A recent number of the bulletin of the labour bureau of France states that the following new regulations are in force in Belgium relative to the manufacture of matches :—

It is not sufficient in the future that the dipping plates of white phosphorus matches should be covered with hoods connecting with a strong draft chimney; a suction tube connected with a mechanical ventilation must be established on the level of the dipping plates and vessels which contain the paste. Respecting the composition of the pastes, they must not contain more than 80 per cent. of white phosphorus, without counting the water; the least infringement will not be tolerated, as it is satisfactorily proven that an excellent match paste can be manufactured from this consistency.

The dryers, except the tunnels in which workmen must remain, must, after June 1, 1895, be aired by mechanical ventilators. Permanent committees exist which are to fix the amount of air. The working tables upon which white phosphorus matches are filled must likewise be ventilated so that the phosphorus vapours may be immediately drawn off to the lower part of the workshop and thrown out.

This ventilation must be such that, combined with the other causes of removal of the air in the workshops, the expulsion of air per hour and per workman in each room where white phosphorus matches are handled, shall be at least 2,119 cubic feet. The removal of air in the rooms where Swedish matches are handled, must be 1,060 cubic feet per hour and per workman, and, further, each workman must always dispose of at least 353 cubic feet of air.

Independently of a cloak room, there shall exist in each factory a room where vessels containing water and soap for the use of workmen shall be placed. The severest control will be exercised in this respect.

Workmen shall be subject to a preliminary medical examination, and afterwards to a monthly visit, the results of which shall be duly inscribed in a record book. They shall be excluded from work from the time when they may have been attacked by phosphoric necrosis, or as soon as they appear to be threatened with an attack of this disease.

*Glycerin, Testing for Dynamite Manufacture.* J. Lewkowitsch. Chem. Zeit. 1895, **19**, 1423.

*See under* XXIII., *page* 1073.

## PATENTS.

*"Lucifer" Matches and the like, Improvements in or relating to.* A. Thimann, Vienna. Eng. Pat. 20,593, Oct. 27, 1894.

In making matches without tips or heads, the thoroughly dry splints (matchwood) are steeped in a solution (which may be saturated at a temperature of from 90° to 100°) either of sodium chlorate or potassium chlorate, with or without the addition of alkaline perchlorates, and to which are added in sufficient quantity suitable adhesives.

After the match splints have been impregnated with the explosive material and thoroughly dried, they may be dipped in a solution of paraffin, ozokerite, or ceresin, &c., with or without addition of animal or vegetable fats or oils; or in petroleum, benzene, petroleum spirit, to which volatile substances or vegetable or animal fats or oils have been added. The matches are then placed in a warm room to allow the unstable or volatile matter to evaporate. They are then ready for use.—W. M.

*Nitrocellulose, Improvements in and Apparatus for the Manufacture of.* J. W. Swan, Bromley, Kent. Eng. Pat. 21,729, Nov. 10, 1894.

The chief point in this invention is the production of nitrocellulose in a continuous manner by passing cellulose, in the form of a long web, band, or sheet of cotton or paper, continuously through the mixed acids at such a rate as to allow the cellulose to be sufficiently nitrated.—W. M.

*Smokeless Powders, Improvements relating to the Preparation of.* C. P. Du Buit, Paris. Eng. Pat. 23,260, Nov. 30, 1894.

The inventor proposes to prepare charges of sporting smokeless powders by bringing the powders, in a suitable state of division, into the condition of moulded bodies, by compression, thus ensuring uniformity of weight and state of compression for each charge.—W. M.

*Explosives, Improvements in.* B. J. Pettingell, Victoria, B.C., Canada. Eng. Pat. 16,790, Sept. 7, 1895.

The composition of the explosive patented is:—Raw nitre, 63; mineral coal dust, 20; crude sulphur, 15; wood pulp, 2 parts.

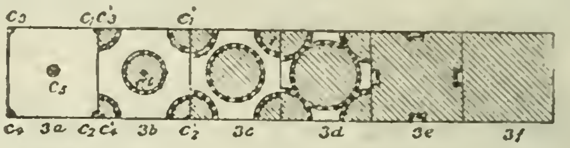
The nitre is dissolved in water and the coal dust added; the mass is then thoroughly mixed and dried, and then mixed with the sulphur and wood meal.—W. M.

# XXIII.—ANALYTICAL CHEMISTRY.

## *INORGANIC CHEMISTRY.—QUALITATIVE.*

*Carbon Steels, General Method for the Micrographic Analysis of.* F. Osmond. Bull. de la Soc. d'Encouragement, **113**, 480—516.

(See also this Journal, 1894, 1065). In a lengthy paper the author deals with the micrographic examination and separation of the constituents of steels tempered at different temperatures and containing different percentages of carbon. The results of many experiments are given and theoretical explanations put forward. In explaining the condition of the carbon in steel, he employs the following diagrammatic solution:—



□ Practically pure iron (ferrite).

▨ Zones of uniformly distributed tempering carbon (martensite).

☰ Zones of transition (troostite).

■ Centres of undecomposed carbides (cementite and sorbite).

In explaining the above diagram, he assumes the square $3a$ to represent a certain section of iron surrounding a nucleus of carbide of iron $c_5$, together with portions of equidistant points of carbide in each corner of the square.

In the process of tempering at comparatively low temperatures, it is assumed that the square $3b$ illustrates the changes which have taken place. It is here shown that the black points of carbide have become reduced in size, and are surrounded by circular areas of steel containing uniformly distributed tempering carbon.

Outside these areas are rings of the transition stage between the tempered steel and the pure iron which forms the remainder of the square. The square $3c$ illustrates the result of using a higher temperature. In this case the carbides have disappeared, the areas of the tempered steel have increased in size, the rings of transition still exist, and the area of pure iron proportionately reduced. If the temperature is still further increased, the rings become larger, and gradually coalesce, as shown in $3d$ and $3e$. The area of pure iron gradually diminishes until the whole surface becomes tempered, as in $3f$.

In the case of hard steels, the points of carbide are nearer together, and the transition is more complete within shorter limits of temperature. In the case of very soft steels, the transition may not be complete.

It would appear, from a micrographic examination of the tempered steels, that the diffusion of hardening carbon determines in the iron the cubic system of crystallisation, or, in other words, its existence as "*Martensite.*"

In concluding the paper, from a practical point of view, the author refers to the precision with which the three principal circumstances of the calorific treatment of steel, namely, the temperature of heating, the temperature of tempering, and the rapidity of cooling, influence its ultimate structure, and he suggests that the micrographical examination of steels should be more fully studied, with a view to providing data of practical utility.—A. W.

*Nitrites, Three New Tests.* M. G. Denigès. Chem. Zeit. 1895, **19**, 328.

The reagents proposed by Griess, which are so much used, and notably the salts of *m*-phenylenediamine, are easily altered by halogens, hypochlorites, &c., and by exposure to the air. The author recommends the following reagents:—

(1.) (*a*.) Phenol, 1 grm.; sulphuric acid, 4 c.c.; and water, 100 c.c. (*b*.) Mercuric oxide, 3·5 grms.; glacial acetic acid, 20 c.c.; and water, 100 c.c.; mixed together, ½ c.c. of sulphuric acid added and the solution filtered. Equal volumes of the solutions (*a*) and (*b*) are mixed together, heated to boiling, and one or two drops of the substance under examination added. A solution containing only 0·5 grm. of nitrite per litre still gives a red coloration when tested in this way.

(2.) 2 c.c. of aniline are dissolved in 40 c.c. of glacial acetic acid and diluted with water to 100 c.c. 5 c.c. of this solution are mixed with from one drop to 10 c.c. of the solution to be tested, according to its concentration, and the mixture boiled. Nitrous acid produces a coloration varying from straw yellow to deep orange, which is changed to red by carefully adding acid. Hypochlorites, hypobromites, or free halogens interfere with the reaction, as also does a large excess of free acid.

(3.) Resorcinol, 1 grm.; water, 100 grms.; sulphuric acid, 10 drops. Four drops of the solution to be tested are mixed with 2 c.c. of pure sulphuric acid and five drops of the resorcinol solution, and shaken. Nitrous acid produces a carmine-red or blue-violet coloration, even when so little as 0·01 mgrm. of the acid is present.—T. E.

## *INORGANIC CHEMISTRY.—QUANTITATIVE.*

*Lead, Technical Analysis of.* H. Nissenson and B. Neumann. Chem. Zeit. 1895, 1141—1143.

A sketch is given of rapid, but accurate, methods employed in the laboratory of the Actien Gesellschaft für Bergbau zu Stolberg, u. in Westfalen.

*Market Lead.*—A total of some hundredths of one per cent. of Ag, Cu, Bi, Cd, Zn, Fe, Ni, Co, Sn, and Sb, has to be estimated (As and Mn rarely occur). 200 grms. of the lead, in small pieces, are placed in a 2-litre flask, and treated first with 1,275 c.c. of water, and then with 325 c.c. of nitric acid (sp. gr. 1·4). The flask is warmed on a sand-bath, and when the metal is completely dissolved, it is cooled, and 62 c.c. of strong sulphuric acid are slowly added whilst constantly shaken. After cooling, the solution is made up to 2 litres and shaken vigorously; the lead sulphate is allowed to settle, and 1,750 c.c. are filtered off into a porcelain dish and evaporated to dryness, the residue mixed with a small quantity of water, filtered, and washed. A. The precipitate is washed into an Erlenmeyer flask, and treated with caustic soda and 25 c.c. of a cold saturated solution of sodium sulphide to dissolve any antimony that may be present; after filtration, the antimonial solution is reserved. B. The filtrate from the original lead sulphate precipitate should be slightly acid or made so by hydrochloric acid, and is treated with hydrogen sulphide until the supernatant liquid (D) is clear; it is then filtered from the precipitate (C). C. The sulphide precipitate is digested with 25 c.c. of sodium sulphide solution; and if arsenic be absent, the solution is added to the antimonial solution from A. The volume of the liquid is then made up to 200 c.c., and the solution is electrolysed boiling in a platinum dish with a current of 1—2 ampères and 2 volts. ($N.D_{100}$ = 1·2, and time for deposition, half an hour.) Antimony is thus deposited, and the sodium sulphide in the solution is converted into the ammonium compound by the addition of 25 grms. of solid ammonium sulphate. After boiling and making up to 200 c.c., the liquid is then electrolysed by a current of the same strength as that used for separating the antimony, which should deposit the whole of the tin within 20 minutes. Or, the solution freed from antimony is decomposed by dilute sulphuric acid, and the precipitated tin sulphide filtered, gently roasted in the muffle, moistened with nitric acid, and weighed as $SnO_2$. When arsenic is present, the three sulphides are, at the first, precipitated by means of sulphuric acid, and digested with cold ammonium carbonate solution to dissolve the arsenic, which may then be estimated in the usual way, the residual sulphides being dissolved in 25 c.c. of sodium sulphide solution, and separated as above described. The residue, after treating precipitate C with sodium sulphide, is boiled with aqua regia, filtered from silver chloride, evaporated to dryness with a few drops of sulphuric acid to remove final traces of lead, taken up with water, neutralised with ammonia, and mixed with an excess of ammonium carbonate solution. Bismuth thus precipitated, is filtered, dissolved in nitric acid, evaporated in a porcelain crucible, and weighed as $Bi_2O_3$. In the ammoniacal solution, 1 grm. of potassium cyanide is dissolved; a few drops of sodium sulphide solution then serve to separate the cadmium as sulphide, which is filtered, dissolved in nitric acid, evaporated in a crucible, and weighed as oxide. Or the nitric acid solution may be evaporated down with sulphuric acid, taken up in water, neutralised with ammonia, and, after adding ammonium sulphate, electrolysed for $\frac{1}{4}$ hour with a current of 0·5 ampère and 2·5—3 volts. The cyanide filtrate from the cadmium is decomposed by sulphuric acid, evaporated down until fumes of sulphuric acid appear, cooled, taken up in water, diluted to 200 c.c., and electrolysed for 1—2 hours in a platinum dish by a current of 1—1·5 ampères and 2·5—3 volts, the precipitate being received on the smaller electrode to minimise the errors of weighing. Or the acid solution is treated with 0·5 grm. of solid sodium thiosulphate and boiled, and the separated copper sulphide roasted to oxide in a muffle. D. The filtrate from the sulphides is boiled to expel hydrogen sulphide, peroxidised with bromine water, and treated with caustic soda solution; the resulting precipitate is dissolved and re-precipitated, to ensure the separation of zinc; it is then again dissolved, and the iron is thrown down by ammonia, re-dissolved, and titrated by dilute permanganate (it cannot be weighed as oxide because of the alumina introduced in the caustic alkali). In the ammoniacal filtrate the nickel and cobalt are precipitated by electrolysis, after adding ammonia and 25 grms. of ammonium sulphate, using a current of 1·5 ampères and 2·5—3 volts. ($N.D_{100}$ = 1·2; time = $\frac{1}{2}$ hr.) The solution of the zinc in the alkali is just acidified with hydrochloric or sulphuric acid, then mixed with 25 c.c. of ammonia, made up to 500 c.c., and titrated. In the absence of nickel and cobalt, the iron may be separated directly by ammonia and weighed as oxide, whilst the filtrate is made up to 500 c.c. for titration. The zinc titration is made by Schaffner's process, using a sodium sulphide solution of 4 grms. per litre, and conducting a test of the solution from the lead simultaneously with a test of 0·001 grm. of zinc dissolved in acid, rendered ammoniacal, and made up to 500 c.c., the end-point in each case being fixed by the discoloration of "polka paper." The silver is separately determined by cupellation. Lead is found by difference. In calculating results, the volume of lead sulphate must be taken into account—it is 46 c.c.—so that the actual weight of lead tested must be reckoned as—

$$200 \times \frac{1750}{1954} = 179 \cdot 12 \text{ grms.}$$

The separation of the antimony and arsenic group by electrolysis is quicker and more accurate than the usual method.

*Hard Lead.*—Usually only the antimony percentage, which is always high, is required. 2·5 grms. of the material are dissolved in 10 grms. tartaric acid, 15 c.c. water, and 4 c.c. nitric acid (sp. gr. 1·4) in a 250-c.c. flask; to the clear solution is added 4 c.c. of strong sulphuric acid; the mixture is then diluted, cooled, and made up to the 250 c.c. with water. With this large amount of tartaric acid, the whole of the antimony passes into the solution, so that 50 c.c. of the solution (= 0·5 grm. of substance) may be withdrawn, made strongly alkaline with caustic soda, mixed with 50 c.c. of saturated sodium sulphide solution, boiled, filtered, washed, and electrolysed hot with a current of 1·5—2 ampères. ($N.D_{100}$ = 1·2—1·5; time = 1 hour at most.) The copper may be determined, if necessary, after dissolving the sulphide residue, either electrolytically or by colorimetry.

*Work Lead.*—From 10 to 50 grms. of the lead, according to quality, are dissolved in water and (1·4) nitric acid (60 c.c. of the former and 16 c.c. of the latter for each 10 grms. of lead used), to which is added 5—10 grms. tartaric acid. To precipitate the lead, 3 c.c. of strong sulphuric acid are used for each 10 grms. of lead, and the volume of lead sulphate to be taken into account in the final calculations is 2·15 c.c. per 10 grms. of lead. The filtrate is evaporated somewhat, and treated with caustic soda and sodium sulphide, as in the case of hard lead; the solution containing Sb, As, and Sn, and the precipitate containing the other metals are treated as are those from soft lead. If only silver, copper, and antimony are to be determined, the former is found by cupellation, the latter by the process used for hard lead.

*Galena.*—Usually, only lead and silver as useful, and arsenic and zinc as objectionable constituents have to be determined. Silver and (in the absence of copper and antimony) lead are determined in the dry way. Otherwise, 0·5 grm. of the ore is dissolved in 30 c.c. of nitric acid (1·4 sp. gr.), boiled, diluted, filtered into a platinum dish, and electrolysed hot with a current of 1—1·5 ampères and 2·5 volts. ($N.D_{100}$ = 1 ampère; time = 1 hour.) The dish is made the anode, and receives a deposit of lead peroxide, which is dried at 180° and weighed. For the rapid determination of arsenic, 1 grm. of ore is dissolved in 10 c.c. of nitric acid, evaporated with dilute sulphuric acid (until fumes of the latter are evolved), cooled, diluted, and filtered. To the filtrate are added 5 grms. of tartaric acid, 30 c.c. of ammonia, and 15 c.c. of magnesia mixture. The precipitate is dissolved off the filter into a tared porcelain crucible in nitric acid, and the solution is evaporated and ignited. Phosphoric acid does not occur in galena, and therefore cannot interfere. For the zinc determination, 2 grms. of ore are thoroughly decomposed by 25 c.c. of boiling strong hydrochloric acid in a ½-litre flask; when all hydrogen sulphide is expelled, 5 c.c. of nitric acid are added and then 8 c.c. of sulphuric acid. The solution is evaporated to half its bulk, and after the addition of an excess (50 c.c.) of ammonia, it is boiled, filled to the mark with water, and filtered. 250 c.c. (= 1 grm. of ore) are then used for titration as already described.

*Lead and Copper Mattes.*—The silver is found by cupellation. The lead is determined as peroxide by electrolysis, any copper on the cathode is re-dissolved in the solution poured off from the lead peroxide, and the solution is evaporated to dryness with sulphuric acid, re-dissolved in water, and the copper precipitated by sodium thiosulphate and weighed as oxide after roasting. The direct separation of the lead and copper by electrolysis is not possible, owing to the interference of silver, antimony, and arsenic.—W. G. M.

### *Arsenic in Iron and Steel, Volumetric Determination of.*

A. Mignot. Rev. Chim. anal. appliq. 1895, **3**, 101. Through Chem. Zeit. Rep. 1895, **19**, 164.

Ten grms. of the metal are dissolved in nitric acid, the solution is evaporated, and the residue, after gentle heating to decompose the nitrate, is treated with strong hydrochloric acid in the cold for one hour. The whole is transferred to a 500-c.c. flask with a long neck, and made up to 300 c.c. with strong hydrochloric acid; 50 c.c. of saturated ferrous chloride solution are then added, and the flask is connected with a condenser, the end of which is bent and passed through one perforation of a two-holed stopper for the length of a few centimetres into a small flask; through the other perforation is passed a tube which reaches to the bottom of the flask, and is bent over outside into an open vessel containing cold water. On heating, the evolved hydrochloric acid gas, after expelling the air, fills the apparatus, and by its solubility causes water to be sucked back into the distillation flask. The delivery tube in the open vessel must therefore at once be raised above the water level, to admit air, or the reduction of pressure in the apparatus will lead to a dangerous ebullition in the heated flask. Distillation is continued until only 100 c.c. are left of the original liquid, the distillate is then made up to 500 c.c. and treated with hydrogen sulphide. After filtering and washing, the precipitate of sulphide of arsenic is dissolved in 20 c.c. of (1:3) ammonia; the solution is acidified with 20 c.c. of acetic acid (of such strength that 16 c.c. will neutralise about 20 c.c. of the ammonia), mixed with a known volume of iodine solution, and titrated back with sodium thiosulphate. The iodine solution is standardised by means of a known weight of a pure arsenic compound, dissolved, precipitated as sulphide, and re-dissolved as above. Five mgrms. of arsenious acid can thus be estimated.—W. G. M.

### *Zinc, Volumetric Estimation of.*

H. Lescœur. Bull. Soc. Chim. **13**, 280.

In the volumetric estimation of the zinc, with standard caustic soda solution, in zinc salts containing excess of acid, two indicators are used. Methyl-orange is employed to indicate, by its change from purple into yellow, the point when all free acid has been neutralised by the standard soda employed. At this point phenolphthalein is added, and the titration continued until free alkali is indicated in the solution. Formation of basic salts of zinc in this titration, contrary to Barthe's statements, has never been observed. Barthe (Bull. Soc. Chim. **13**, 472) states that in the reaction the basic salt $(ZnO)_4SO_4Zn$ is formed, and hence the direct results of titration require multiplying by a corrected factor $\frac{5}{4}$. He contradicts Lescœur's statement above, that the precipitate formed is pure hydrated oxide of zinc.—C. O. W.

### *The Assay of Gold Ores, Interference of certain Metals in.*

D. G. Buchanan. City Anal. Soc., Glasgow, 1894–95, [5], 18.

*Cupellation Process.*—4 mgrms. of pure gold were wrapped in 37 grms. of lead foil (the same weight of lead gave no silver bead on cupellation alone) together with 0·5 grm. of zinc, tin, antimony, and copper respectively. On cupellation, practically all the gold was recovered.

The same weight of gold was then tried with 2·5 grms. of each of the metals.

With zinc, the cupel was covered with a film of oxide, and the amount of gold recovered varied from 1·2 to 3·65 mgrms. With tin, the edge of the cupel was covered with a light yellow film, and 3·4 mgrms. of gold were recovered in one case, whilst in another, no bead was obtained, the gold remaining in small pellets in the slag. With antimony, practically all the gold was recovered. With copper, the cupel turned black and the copper was absorbed, and in two trials 3·85 and 3·75 mgrms. of gold were recovered.

It is worthy of note that, if a cupellation of lead and copper ceases before all the copper is absorbed, more lead may be added and the cupellation continued, provided the cupel is not saturated and there is not too much copper present.

The difficulty with zinc and tin is not likely to occur, as these metals do not easily find their way into the lead button during a pot assay.

With 5 grms. of each of the metals, very unsatisfactory results were obtained, owing to the large residue left on the cupel.

No gold appears to pass into the cupel, and the amount of lead used does not influence the yield of gold.

*Fusion Process.*—An artificial ore was prepared for these experiments by adding the weighed quantity of the metal used to 8 mgrms. of gold, and making up the bulk to 50 grms. with sand. The flux used consisted of a mixture of 60 grms. of soda-ash, 15 grms. of borax, 40 grms. of litharge, and 5 grms. of starch.

Two prepared ores, containing 5 per cent. and 40 per cent. of zinc in the form of oxide, were fused with the above mixture, and practically all the gold was recovered.

The zinc did not pass into the lead button.

Ores containing the same weight of tin as oxide gave similar results. With an ore containing 5 per cent. of antimony as oxide, the antimony passed into the lead button, but all the gold was recovered as a bead at the bottom of the cupel. On using an ore containing 5 per cent. of copper as oxide, all the gold was recovered; but with 7·5 per cent. the bead contained a good deal of copper.

An ore that contains much copper should be treated with hydrochloric acid to dissolve out the copper, diluted, and sulphurous acid gas passed through to precipitate any dissolved gold. The excess of sulphurous acid should be expelled by boiling and a crystal of potassium iodide added to precipitate any dissolved silver without precipitating much copper. The insoluble matter is filtered off, washed, dried, and assayed in the usual manner.

In the following experiments, an ore was prepared by mixing together 8 mgrms. of gold, 25 grms. of sand, and 25 grms. of an iron ore containing 52 per cent. of iron.

When this ore was fused with a fluxing mixture containing no starch, no lead button was obtained; when the fluxing mixture contained 2·4 grms. of starch, a button was obtained weighing 16 grms.; and when the mixture contained 5 grms. of starch, the button weighed 32·9 grms., and practically all the gold was recovered.

The iron ore in the first experiment contained no iron in the ferrous state; in the second experiment there was 26·8 per cent. of the iron existing in the ferrous state; and in the third experiment, 64·7 per cent. of the iron existed in the ferrous state. It is therefore not necessary to have all the iron reduced to the ferrous state.

It was found that for 50 grms. of fairly pure oxide of iron with 8 mgrms. of gold, the fluxing mixture should contain 7 grms. of starch in order to get a large enough lead button and to recover all the gold. With larger quantities of starch, the lead button produced was no larger, and the yield of gold was the same as with 7 grms. of starch.

When the ore contains much oxide of iron, it is best to add some sand to aid the fusion.

In general, if an ore fuses easily with the above-mentioned flux, and yields a lead button which is soft, of good weight, and cupels easily, leaving little slag in the cupel it, may safely be assumed that none of the metals named have interfered.—A. S.

### *Phosphoric Acid, Estimation of.* A. Cameron. City Anal. Soc., Glasgow, 1894–95, [5], 14.

A sample of perfectly pure tricalcium phosphate was prepared for these experiments on the different methods of estimating phosphoric acid.

With the *citrate* process, it was found that citric acid has a solvent action on the magnesium phosphate precipitate, and that it is therefore advisable to use the minimum quantity of citric acid.

Iron salts have also a solvent action.

The *molybdate* method gave too high results, but by the addition of a small quantity of citric acid (0·1 grm. citric acid to 0·5 grm. calcium phosphate), results were obtained which only differed by 0·2 to 0·3 per cent. from the theoretical.

Tests were made with samples of superphosphate to compare the hot and cold methods of extracting the "soluble phosphoric acid."

Two variations of the cold water extraction were tried, taking a much longer time for the second than for the first. In the hot water extraction, the superphosphate was first extracted with cold water, then boiled with water, filtered, and the residue washed with hot water. The hot method gave slightly higher results than the two cold methods.

The author tried the method of Kalman and Meissels, described in this Journal, 1894, 842, and found it very unreliable.—A. S.

### *Alkaline Salts in Manures, Estimation of.* A. Cameron. City Anal. Soc., Glasgow, 1894–95, [5], 16.

The method of estimating the alkaline salts in manures, consists in adding barium hydrate to the aqueous extract, to remove phosphoric acid, lime, magnesia, &c., then adding ammonium carbonate to remove the excess of barium hydrate, filtering, evaporating, and then igniting off the ammonium salts, either directly, in which case the alkaline salts are weighed as carbonates, or after the addition of sulphuric or hydrochloric acid, and then weighing as sulphates or chlorides. The potash in the residue is estimated by Tatlock's process.

It was found that by weighing the alkaline salts as sulphates and carbonates, satisfactory results are obtained, but by weighing as chlorides, the results are not satisfactory, owing to the sensible volatility of the chlorides of sodium and potassium on igniting over a Bunsen flame.
—A. S.

### *Separation of Soluble Active Silica from Quartz.* W. Michaëlis. Chem. Zeit. 1895, **19**, 1422—1423.

The author recommends the use of caustic soda in place of sodium carbonate for the separation of soluble silica from quartz. Although strong caustic solutions undoubtedly attack quartz, yet a solution containing 10 per cent. of $Na_2O$ does not act upon it even after several hours' boiling. The contrary belief is due to the fact that quartz often occurs in clays and marls in a condition so finely divided, as to pass through a filter paper, needing as much care in collection as barium sulphate often does.—B. B.

### *Analytical Characteristics of a Mixture of the Salts of Barium, Strontium, and Calcium.* H. Baubigny. Bull. Soc. Chim. **13**, 326.

Supposing all metals precipitable by ammonium hydrosulphide to be eliminated, barium, strontium, and calcium are precipitated by ammonium carbonate in the presence of ammonium chloride in the form of their carbonates. The precipitate is filtered, and washed with a warm solution of ammonium chloride. The washed precipitate is redissolved in hydrochloric acid, a slight excess of which is corrected by the addition of a corresponding quantity of sodium acetate. From such a solution all the barium is precipitated by potassium bichromate, barium chromate being insoluble in chromic acid or dilute acetic acid. In the filtrate from this precipitate, strontium is detected by adding to it a solution containing 2·5 grms. of potassium sulphate in 1,000 c.c. of water. Only strontium sulphate can be precipitated under these conditions, any calcium sulphate formed remaining in solution. To detect the presence of calcium, the chromic acid must first be eliminated. For this purpose the filtrate from the strontium precipitate is treated with potassium carbonate, the precipitate formed consisting of calcium carbonate, and as much strontium carbonate as escaped precipitation as sulphate in the previous operation. The washed precipitate is redissolved in hydrochloric acid, excess of the latter being corrected in the above-mentioned manner. To this solution a large excess of ammonium chloride and a few drops of potassium ferrocyanide are added. The precipitate, which at first forms rather slowly, consists of a double salt of the ferrocyanides of potassium and calcium, which is insoluble in ammonium chloride. No strontium is precipitated by this treatment, but barium is. Hence the necessity of first completely eliminating the latter. Should it be desired to test merely for calcium in the presence of barium and strontium, it is simpler to precipitate these two by means of an excess of potassium sulphate, and to test in the filtrate for calcium with potassium ferrocyanide.—C. O. W.

### *Evolution of Carbon Monoxide by Alkaline Pyrogallol Solution during Absorption of Oxygen.* F. Clowes. Proc. Chem. Soc. 1895, [156], 200.

It has long been known that under certain conditious carbon monoxide is evolved during the absorption of oxygen by alkaline pyrogallol. When a solution, 100 c.c. of which contain 10 grms. of pyrogallol and 24 grms. of potassium hydroxide, is used for the absorption of oxygen, it evolves no carbon monoxide until the percentage of oxygen in the gaseous mixture exceeds 28. The carbon monoxide evolved, however, increases in amount as the percentage of oxygen rises above that limit, until the carbon monoxide finally reaches about 6 per cent. of the volume of oxygen absorbed.

The process of estimation of oxygen is rendered perfectly accurate if the carbon monoxide which has been produced during the absorption is removed by means of cuprous chloride solution before the reading is taken.

Experiments with pyrogallol solution containing larger proportions of potassium hydroxide than that given above, proved that the evolution of carbon monoxide may be entirely prevented under all conditions if the potassium hydroxide is present in sufficiently large proportion.

A solution, 100 c.c. of which contain 10 grms. of pyrogallol and 120 grms. of potassium hydrate, proved perfectly satisfactory in this respect; the weight of pyrogallol may be reduced to 5 grms. in this solution.

A solution containing 18 per cent. of quinol (hydroquinone) and 24 per cent. of potassium hydroxide, absorbed oxygen slowly, but the absorption was complete, and no carbon monoxide was evolved.

It is therefore evident that serious error may arise in estimating the proportion of oxygen present in a mixture containing only small proportions of other gases, unless the absorbent pyrogallol solution is prepared of suitable strength, or unless the absorption of oxygen be followed by the treatment of the residual gas with cuprous chloride solution.

## *ORGANIC CHEMISTRY.—QUALITATIVE.*

Detection of Artificial and Natural Colouring Matters on the Fibre. (Supplementary Tables.) (*Continued from page* 992.)

(Specially contributed by Messrs. The Clayton Aniline Co., Ltd.)

| Colouring Matter. | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Caustic Soda-Lye. | Ammonia. | Stannous Chloride and Hydrochloric Acid. | Alcohol. | Ammonium Acetate. |
|---|---|---|---|---|---|---|---|---|
| Oxyphenine. (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre not altered, liquid light yellow.<br>*Dil.*:—Heated—liquid slightly coloured yellow. | *Conc.*:—Fibre not altered, liquid yellow; on addition of water—fibre decolorised.<br>*Dil.*:—Heated—liquid slightly coloured yellow. | *Conc.*:—Fibre brownish-red; on addition of water—liquid light brown.<br>*Dil.*:—No action. | *Conc.*:—No action.<br>*Dil.*:—No action. | No action. | Fibre at first dirty yellow, then an old gold, and finally decolorised. | No action. | No action. |
| Cotton Brown R. (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre dark maroon, liquid crimson; on addition of water—fibre dark reddish-brown, liquid brown.<br>*Dil.*:—Heated—fibre a little bluer, liquid slightly coloured reddish-brown. | *Conc.*:—Fibre dull red, liquid yellowish-brown; on addition of water—fibre decolorised.<br>*Dil.*:—Heated—fibre nearly decolorised, liquid yellowish. | *Conc.*:—Fibre purple; on addition of water—fibre brown, liquid light brown.<br>*Dil.*:—Little or no action. | *Conc.*:—Fibre darkened; on addition of water—fibre, original colour restored, liquid colourless.<br>*Dil.*:—Heated—liquid reddish. | Fibre reddened, liquid yellowish-brown. | Fibre dull red, then rose, and finally decolorised. | Very little action; warming—liquid becomes a dull orange. | No action. |
| Cotton Brown Y. (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre reddish-brown, liquid red; on addition of water—fibre yellowish-brown, liquid yellowish-brown.<br>*Dil.*:—Heated—fibre a little bluer, liquid yellowish. | *Conc.*:—Fibre very yellowish-brown, liquid yellowish-brown; on addition of water—fibre decolorised.<br>*Dil.*:—Heated—Fibre nearly decolorised, liquid yellow. | *Conc.*:—Fibre dark maroon; on addition of water—fibre brown, liquid light brown.<br>*Dil.*:—Heated—liquid yellowish. | *Conc.*:—Fibre reddish-brown; on addition of water—no alteration, liquid colourless.<br>*Dil.*:—Heated—liquid yellowish-red. | Fibre yellowish-brown, liquid yellowish-brown. | Fibre reddish-orange, and finally is decolorised. | Liquid yellowish. | No action. |
| Clayton Yellow. (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre orange, liquid yellow.<br>*Dil.*:—Fibre orange, liquid colourless. | *Conc.*:—Fibre orange, which becomes yellow, and finally the colour is destroyed; liquid lemon-yellow.<br>*Dil.*:—Fibre orange, liquid colourless; heating—fibre orange, liquid yellow. | *Conc.*:—Fibre dirty-yellow; on addition of water—liquid light yellow.<br>*Dil.*:—Fibre orange, liquid colourless. | *Conc.*:—Fibre bright red; on addition of water—no alteration, liquid colourless.<br>*Dil.*:—Fibre scarlet, liquid nearly colourless; heating—liquid orange. | Fibre orange, liquid light yellow. | Fibre orange, finally decolorised. | Liquid tinged yellow. | No action. |
| Aurotine. (Cl. Co.)<br>(*Animal fibre.*) | *Conc.*:—Fibre colourless, liquid colourless; on addition of water—fibre is faintly coloured yellow.<br>*Dil.*:—Heated—fibre is decolorised, liquid colourless. | *Conc.*:—Fibre becomes light straw; on addition of water—no change, liquid colourless.<br>*Dil.*:—Fibre slowly decolorised, liquid colourless. | *Conc.*:—Fibre dirty brown; on addition of water—fibre colourless, liquid colourless.<br>*Dil.*:—Heated—fibre is decolorised, liquid colourless. | *Conc.*:—No action.<br>*Dil.*:—Warmed—fibre becomes reddened, liquid yellow. | Fibre not altered, liquid yellow. | Fibre is decolorised. | No action. | Heated—liquid yellow. |
| Clayton Cloth Red. (Cl. Co.)<br>(*Animal fibre.*) | *Conc.*:—Fibre dark maroon, liquid magenta-coloured; on addition of water—fibre dull red, liquid pale red.<br>*Dil.*:—Heated—fibre brownish-red, liquid colourless. | *Conc.*:—Fibre dull red, which becomes brighter, and finally decolorised; liquid rose; on addition of water—fibre reddish-yellow, liquid yellow.<br>*Dil.*:—Heated—fibre turns yellower, liquid straw-yellow. | *Conc.*:—Fibre deep purple, which changes to a magenta; liquid violet, changing to a magenta; on addition of water—fibre dirty brown, liquid dull reddish-brown.<br>*Dil.*:—No action. | *Conc.*:—No action.<br>*Dil.*:—Fibre dull brownish-red, liquid colourless. | Fibre not altered, liquid tinged. | Fibre maroon, finally decolorised. | Liquid pink. | No action. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Clayton Cloth, Scarlet. (Cl. Co.)<br>(*Vegetable fibre.*) | *Conc.*:—Fibre darkens, liquid slightly coloured magenta ; on addition of water—fibre dull red ; liquid reddish.<br>*Dil.*:—Heated—fibre becomes yellower ; liquid pink. | *Conc.*:—Fibre reddish-orange, liquid colourless ; on addition of water—fibre dirty yellow, liquid brownish-yellow.<br>*Dil.*:—Fibre becomes a dull reddish-orange, liquid colourless ; heated—fibre dull red, liquid straw. | *Conc.*:—Fibre magenta, liquid ruby ; on addition of water—fibre brown, liquid dull red.<br>*Dil.*:—Fibre little or no alteration, perhaps a little yellow. | *Conc.*:—No action ; on addition of water—fibre dull bluish-brown, liquid nearly colourless.<br>*Dil.*:—Fibre deep maroon, liquid reddish. | Little or no action ; liquid light pink. | Fibre slowly decolorised. | No action. | Heated—fibre a little bluer, liquid light saffranine. |

## Detection of Artificial and Natural Colouring Matters on the Fibre.

(Specially contributed by the Schoellkopf Aniline and Chemical Company, Buffalo, U.S. America.)

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Cochineal Scarlet G.<br>[Combination of Aniline with Naphtholsulpho-Acid derived from Naphthylamido-sulpho Acid (1·5).] | *Conc.*:—Fibre reddish-brown.<br>*Dil.*:—Cold—very little action : heated—fibre and liquid coloured. | *Conc.*:—Fibre quickly decolorised, finally yellow.<br>*Dil.*:—Cold—fibre orange ; heated—fibre and liquid decolorised. | *Conc.*:—Fibre bluer ; on addition of water—no change.<br>*Dil.*:—Very little action ; heated—fibre and liquid coloured. | *Conc.*:—Very little change, after some time yellower.<br>*Dil.*:—Cold—fibre reddish-orange ; heated—fibre decolorised, liquid orange. | Cold—fibre yellower ; heated—same as cold, liquid coloured more than fibre. | Fibre reddish-brown, finally decolorised. | Removes some dyestuff from the fibre. | Ammonium acetate removes some dyestuff from the fibre. |
| Cochineal Scarlet R.<br>[Combination of Toluidine with Naphtholsulpho Acid (1·5).] | *Conc.*:—Fibre brownish-red.<br>*Dil.*:—Very little action ; heated—fibre and liquid coloured. | *Conc.*:—Fibre quickly decolorised, finally yellow.<br>*Dil.*:—Fibre orange ; heated—fibre and liquid almost colourless. | *Conc.*:—Fibre impure bluish-red ; on addition of water—fibre almost decolorised (brownish red), liquid almost colourless.<br>*Dil.*:—Cold and heated—very little action, liquid almost colourless. | *Conc.*:—Very little change ; after some time yellow.<br>*Dil.*:—Cold—fibre orange-red ; heated—fibre decolorised, liquid orange. | Duller and yellower than in Coch. Scarl. G ; heated—liquid coloured more than fibre. | Fibre first brownish-red, then orange, finally decolorised. | Removes some dyestuff from the fibre. | Ammonium acetate removes less dyestuff than in Coch. Scarl. G. |
| Cochineal Scarlet 2 R.<br>[Combiation of Xylidine and Naphtholsulpho Acid (1·5).] | *Conc.*:—Fibre brownish-red.<br>*Dil.*:—Heated—very little action, liquid a little coloured. | *Conc.*:—Quickly decolorised ; fibre finally yellow.<br>*Dil.*:—Fibre orange ; heated—fibre and liquid almost colourless. | *Conc.*:—Impure bluish-red, bluer than in Coch. Scarl. G ; on addition of water—fibre very little coloured (brownish), liquid almost colourless.<br>*Dil.*:—Very little action, liquid very little coloured. | *Conc.*:—Very little change.<br>*Dil.*:—Cold—fibre orange-red ; heated—liquid orange, fibre colourless. | Cold—duller and yellower than in Coch. Scarl. G ; heated—liquid coloured more than fibre. | Fibre first brownish-red, then orange, finally decolorised. | Removes some dyestuff from the fibre. | Ammonium acetate removes less dyestuff than in Coch. Scarl. G. |
| Wool Scarlet G.<br>[Combination of Aniline with Naphtholdisulpho Acid S.] | *Conc.*:—Very little action.<br>*Dil.*:—Heated—fibre and liquid coloured, shade somewhat yellower. | *Conc.*:—Quickly decolorised, fibre finally yellow.<br>*Dil.*:—Fibre orange-red. Heated—fibre greenish-yellow, liquid colourless. | *Conc.*:—Very little change ; on addition of water—no change, liquid hardly coloured.<br>*Dil.*:—Fibre and liquid yellower. | *Conc.*:—Fibre a little yellower.<br>*Dil.*:—Fibre orange-red. Heated—fibre colourless, liquid orange-red. | Shade yellower, liquid coloured more than fibre. | Duller, finally decolorised. | No action. | Ammonium acetate has very little action. |

| — | Hydrochloric Acid. | Nitric Acid. | Sulphuric Acid. | Soda-Lye. | Ammonia. | Stannous Chloride + Hydrochloric Acid. | Alcohol. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Wool Scarlet R.<br>[Combination of Toluidine with Naphtholdisulpho Acid S.] | *Conc.*:—Very little change.<br>*Dil.*:—Heated—shade yellower, fibre and liquid coloured. | *Conc.*:—Quickly decolorised, fibre finally yellow.<br>*Dil.*:—Fibre orange-red. Heated—fibre greenish-yellow, liquid colourless. | *Conc.*:—Very little change; on addition of water—no change, liquid hardly coloured.<br>*Dil.*:—Fibre and liquid yellower. | *Conc.*:—Fibre yellower.<br>*Dil.*:—Cold—fibre orange-red. Heated—fibre colourless, liquid orange-red. | Weaker and duller than in Wool Scarl. G. | Fibre duller, finally decolorised. | No action. | Ammonium acetate has very little action. |
| Wool Scarlet 2 R.<br>[Combination of Xylidine with Naphtholdisulpho Acid S.] | *Conc.*:—Very little change.<br>*Dil.*:—Heated—fibre and liquid coloured, shade yellower. | *Conc.*:—Fibre quickly decolorised, finally yellow.<br>*Dil.*:—Fibre orange-red. Heated—fibre greenish-yellow, liquid colourless. | *Conc.*:—Very little change; on addition of water—no change, liquid hardly coloured.<br>*Dil.*:—Fibre and liquid yellower. | *Conc.*:—Fibre yellower.<br>*Dil.*:—Cold—orange-red. Heated—fibre colourless, liquid orange-red. | Fibre very much duller and weaker than in Wool Scarl. G. | Fibre duller, finally decolorised. | No action. | Ammonium acetate has very little action. |
| Buffalo Rubine.<br>[Combination of Naphthylamine with Naphtholdisulpho Acid S.] | *Conc.*:—Fibre reddish-violet.<br>*Dil.*:—Heated—very little change, fibre and liquid coloured. | *Conc.*:—Fibre brownish-red, finally yellow.<br>*Dil.*:—Fibre dullish red. Heated—fibre yellow, liquid colourless. | *Conc.*:—Fibre blue; on addition of water—fibre bluish-red, liquid violet.<br>*Dil.*:—Very little action. Heated—liquid coloured. | *Conc.*:—Very little action.<br>*Dil.*:—Fibre and liquid ruby-red. Heated—fibre and liquid almost decolorised. | Cold—fibre dullish red. Heated—liquid coloured more than fibre. | Fibre dullish red, finally decolorised. | No action. | Ammonium acetate removes some dyestuff from the fibre. |
| Cotton Scarlet 3 B.<br>[Combination of Amido-azo Toluene with Naphtholdisulpho Acid S.] | *Conc.*:—Fibre bluish-violet.<br>*Dil.*:—Heated—very little action. | *Conc.*:—Fibre olive-green, quickly changing to brown, and finally to a weak orange.<br>*Dil.*:—Fibre violet-brown. Heated—fibre yellow. | *Conc.*:—Reddish-brown; on heating—violet. On addition of water—fibre first reddish-violet, then brownish-violet; liquid hardly coloured.<br>*Dil.*:—Heated—very little action, liquid colourless. | *Conc.*:—Fibre bluish-violet.<br>*Dil.*:—Fibre bluish-violet, then violet; liquid coloured. | Fibre first bluish-violet, then violet. | Fibre reddish-violet, finally decolorised. | No action. | Ammonium acetate has no action. |
| Brilliant Yellow.<br>[Nitro compound corresponding to Naphthol Yellow S, obtained from Naphtholdisulpho Acid S.] | *Conc.*:—After some time almost colourless.<br>*Dil.*:—Fibre very weak greenish-yellow. | *Conc.*:—Fibre weaker yellow.<br>*Dil.*:—Heated—very weak greenish-yellow. | *Conc.*:—After some time almost colourless.<br>*Dil.*:—Cold—fibre almost colourless. Heated—fibre colourless, the colour returning on washing out. | *Conc.*:—Fibre weaker yellow.<br>*Dil.*:—Fibre weaker yellow, liquid coloured. | Very little action. | Fibre weaker yellow, finally decolorised. | Removes some dyestuff from the fibre. | Ammonium acetate removes much dyestuff from the fibre. |
| Brilliant Red.<br>[Combination of α-Naphthylaminesulpho Acid L (1·5) with β-Naphthol.] | *Conc.*:—Fibre bluish-red.<br>*Dil.*:—Heated—fibre duller, brownish-red. | *Conc.*:—Fibre first brownish-red, then poneean-red, finally red-orange.<br>*Dil.*:—Fibre reddish-brown. Heated—fibre yellow. | *Conc.*:—Fibre first impure red shade, then reddish-violet, changing to impure bluish-red on being heated. On addition of water—fibre first brownish-red, then brown; liquid hardly coloured. | *Conc.*:—Fibre brownish-red.<br>*Dil.*:—Fibre brownish-red, liquid coloured. | Very little action. | Fibre first brown, finally decolorised. | Removes some dyestuff from the fibre. | Ammonium acetate has very little action. |

—J. L. B.

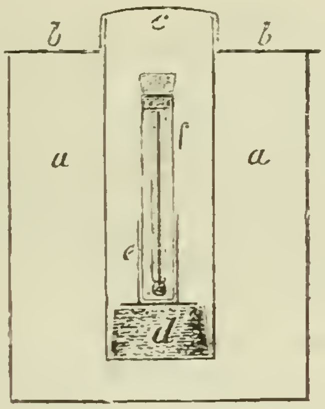
### *Petroleum Burning Oil, Testing of.* R. Kissling. Chem. Zeit. 1895, **19**, 2037.

The author discusses the value of the solidifying point in determining the illuminating power of an oil (see under II., page 1036). He has used the solidifying test daily for at least 20 years, not because it allows conclusions to be drawn as to the burning and illuminating power, but because the separating out of the paraffin may give rise to great inconvenience. Stored, for instance, in barrels in cold weather, the solid paraffins will separate out, and are with difficulty redissolved.

The assertion of Schweitzer that solid paraffins affect the illuminating power, are less easily absorbed, and soon clog the wick, is not borne out by facts, as the example of the wax candle will show.

Apart from inorganic and sulphur constituents of the oil it is chiefly the high-boiling liquid portions of high specific gravity and high percentage of carbon (the amount of solid paraffin being always small) that affect the rising in the wick and the spreading of the charred portion of the wick end. The quantity of this high boiling portion can only be ascertained by fractional distillation.

In conclusion, the author describes a simple apparatus for estimating roughly the amount of solid paraffins. The method adopted may be seen by the figure.



The vessel (*a*) made from two concentric tin cylinders contains a mixture of ice and salt. In this is placed the cold chamber (*c*) fitted with a cover, and fitting into the cover (*b*) of the outside vessel; (*d*) is a cork plug upon which a small tin cylinder (*e*) stands, and in which the glass cylinder (*f*) containing the oil to be tested is placed. Into the latter a small thermometer is introduced, the bulb of which hangs about 1 mm. above the bottom of the glass cylinder.

In making a test with this apparatus, the glass cylinder is taken out from time to time, and the degree determined, at which paraffin crystals are formed at the bottom of the vessel. Results exact to ± 0·25°, can easily be obtained by this method.—H. M.

### *Water in Acetone.* H. Schweitzer and E. E. Lungwitz. Chem. Zeit. 1895, **19**, 1384.

The presence of small quantities of water in acetone may be detected by mixing the acetone with an equal volume of petroleum ether (boiling between 40° and 60° C.) If water be present the liquid separates into two layers, one of which consists mainly of water and acetone, the other of petroleum ether and acetone. The test is at present only a qualitative one as the quantity of the aqueous layer is not proportional to the quantity of water present. The authors suggest that a method for separating acetone from water on the commercial scale might be founded on this behaviour of aqueous acetone with petroleum ether.—T. E.

### *Boric Acid in Wines, Detection of.* A. Villiers and M. Fayolle. J. Pharm. Chim. 1895, 6, Ser. **2**, 241.

The residue of 25 c.c. of wine is ignited to complete combustion of the carbon, and, if necessary, a small quantity of an alkaline carbonate added. The ash is moistened with sulphuric acid, and transferred as far as possible to a small retort, the residue being rinsed into the retort with methyl alcohol. The mixture is distilled until white acid fumes commence to come off, and the distillate is then ignited and the flame observed against a black ground, avoiding a strong light. 0·1 mg. boric acid colours the flame distinctly green. In French wines no trace of boric acid could be found, and possibly previous investigators have been deceived by traces of copper resulting from the use of copper vessels. In Algerian wines the presence of boric acid is perhaps due to direct addition (see this Journal, 1895, 889).—R. B. B.

### *Fatty Substances, Hydrocarbons, and Ethereal Oils, A New Constant for the Analysis and Identification of; also by Critical Temperatures of Solutions.* L. Crismer. Bull. de l'Assoc. Belge des Chimistes, 1895 [5].

Crismer proposes to employ the temperature at which fats, &c. dissolved in alcohol under pressure begin to separate out again from solution, for this purpose. He considers that this phenomenon accords with the modern theory of solution, that the dissolved body is evaporated into the intermolecular spaces in the solvent, and he has lately compared the turbidity produced in such a mixture of fat and alcohol with the fog resulting in a closed tube containing carbon dioxide under high pressure, when the temperature is reduced below the critical temperature of that substance.

The test is performed by introducing a few drops of the fat and a rather larger volume of 90 per cent. alcohol into a hard glass tube which is then fused, and, being attached to a thermometer, heated in a bath of concentrated sulphuric acid until solution occurs, and for 10° or so beyond that point. The meniscus between the two substances is at first convex but gradually approaches the horizontal as the temperature of solution is neared. On cooling down very gradually in the bath a separation or turbidity is observed, below the meniscus, and the temperature at which this occurs is the critical temperature of solution. The operator should interpose a glass shield between himself and the vessel, as a protection in case of explosion.

The critical temperatures of solution of various fats in 90 per cent. alcohol are given as follows:—

Butter, 99, 100, 101·5, 104, 105, 106; margarin, 122, 123·5, 124·5, 125; arachis oil, 123; cotton-seed oil, 115·5; sesamé oil, 120; olive oil, 123; almond oil, 120; rape oil, crude, 136, refined, 132·5; hemp-seed oil, 97; nut oil, 100·5; blubber oil, 111·5; castor oil, 0; resinified (oxidised), linseed oil, 70.—C. S.

### *Morphine, New Reactions of.* G. Bruylants. Bull. Soc. Chim. **13**, 497.

Of all alkaloids morphine possesses such a large number of highly distinctive reactions that its detection never offers any difficulty. It has, however, lately been asserted that the putrefactive bases, the ptomaines, yield similar reactions with nitric acid, ferric chloride, and Fröhde's reagent. But, as a matter of fact, in the absence of morphine, no such reactions are ever obtained under the conditions under which that base produces them. Two recently observed reactions of morphine deserve mention. The first is obtained by heating on the water bath morphine or one of its salts with a small quantity of concentrated sulphuric acid and subsequently adding a drop of Fröhde-Buckingham's reagent (1 centigrm. of molybdate per c.c. of sulphuric acid). A brilliant green coloration is obtained, which, after some time, again disappears. This test may also be conveniently carried out by heating the alkaloid with the sulphuric acid for 2 or 3 minutes, bringing a drop of it upon a plate of white porcelain, and adding to it a drop of the reagent. In the table on next page are recorded the reactions of the most important opium alkaloids with Fröhde's reagent under various conditions.

It is well known that on adding an aqueous solution of iodic acid to a solution of morphine in sulphuric acid, iodine is precipitated. On heating the solution of the alkaloid before adding the iodic acid, according to the proportions employed, a lilac coloration changing slowly into red, or a red coloration, is obtained.

| Name of Alkaloid. | I. Frohde's Reagent on the Sulphuric Acid Solution *before* Heating. | II. Frohde's Reagent on the Sulphuric Acid Solution *after* Heating. | III. Same as II., with addition of a little Sodium Nitrate. |
|---|---|---|---|
| Morphine....... | Lilac coloration | Green coloration. | Green coloration, changing to red, which soon disappears. |
| Apomorphine ... | Bluish green coloration. | Like morphine. | Like morphine. |
| Oxydimorphine . | Blue coloration | „ | Purple coloration. |
| Codeine......... | Dull green, changing into blue. | „ | Like morphine. |
| Narceine........ | Brown, changing into green, then into blue. | Dull green. | „ |
| Papaverine ..... | Green, changing into blue, then into red. | Green, changing into blue, then into red. | Green coloration instantly disappears. |
| Narcotine....... | Green, changing into olive. | Green | Purplish, changing into quickly disappearing red. |
| Meconine....... | Very fugitive, green coloration. | Greenish blue | Like papaverine |
| Cryptopine...... | Dull green, then olive. | Dark green | „ |

—C. O. W.

*Petroleum Oil, Criteria as to Burning Qualities.* H. Schweitzer, New York. Chem. Zeit. 1895, **19**, 1921.

*See under* II., *page* 1036.

*Water, Examination of, for Dyehouse Purposes, by Means of Trial Dyeings.* A. Lohmann. Färber Zeit. 1895, (24), 378.

*See under* VI, *page* 1045.

## *ORGANIC CHEMISTRY.—QUANTITATIVE.*

*Adulteration in Beeswax, Rapid Detection of.* G. Buchner. Chem. Zeit. 1895, **19**, 1422.

Adulterated samples of beeswax may give normal numbers when examined by Hübl's method for valuing this material, but may nevertheless contain great quantities of foreign fatty substances. The author proposes the following rapid method for the detection of such mixtures and for determining approximately the quantity of adulterant which they contain. 5 grms. of the sample are treated with 100 c.c. of 80 per cent. alcohol and the flask with its whole contents is weighed. The alcohol is gently boiled for five minutes with frequent shaking. The flask is cooled and the solution made up to its original weight by the addition of 80 per cent. alcohol. The solution is filtered through a ribbed filter and 50 c.c. of the filtrate are titrated with $\frac{n}{10}$ alcoholic potash, using phenolphthalein as an indicator. The figures in the table were obtained with various waxes, fats and mixtures.

The figure 11·3 (see Table) can be used as a basis for calculating the composition of the mixture giving it. Thus the adulterated sample marked I. in the Table has an acid number, 21·4; the acid number of the suspected sample is 11·3; therefore, the said sample contains 53 per cent. of the factitious wax; this result compares well with the amount actually present, viz., 50 per cent. Where the quantity of wax adulterant is smaller, due correction must be made for the acid number of pure beeswax. For example, the calculated composition of the mixture having an acid number of 8·42 is 39 per cent. of composition I. and 61 per cent. of beeswax; with the correction applied, however, the numbers are changed to 28 per cent. and 72 per cent., approximating to the actual values, viz. 25 per cent. and 75 per cent.

| | Material. | Acid Number. |
|---|---|---|
| | Pure beeswax (yellow).............. | 3·6—3·9 |
| | „ (white).............. | 3·7—4·1 |
| | Palm wax.......................... | 1·7—1·8 |
| | Carnauba wax ..................... | 0·76—0·87 |
| | Japan wax......................... | 14·93—15·3 |
| | Stearin (from tallow) ............ | 1·1 |
| | Rosin............................. | 150·3 |
| | Stearic acid...................... | 65·8 |
| Giving normal results when examined by Hübl's method. | I. Composition from stearic acid, stearin, and ceresin (paraffin wax) ...................... | 21·40 |
| | II. Composition from stearic acid, Japan wax and ceresin ...... | 17·8 |
| | III. Composition from rosin, stearin, and ceresin.................. | 22·0 |
| | Commercial "beeswax" ............ | 14·74 |
| | „ „ giving somewhat abnormal Hübl number.... | 10·34 |
| | Pure beeswax + 25 per cent. Composition I. ........................ | 8·42 |
| | Pure beeswax + 50 per cent. Composition I. ........................ | 11·3 |

—B. B.

*Beeswax in Admixture with Factitious Waxes, Buchner's Method of Estimating.* R. Kissling. Chem. Zeit. **19**, 1682.

The amount of beeswax in a mixture of that substance, stearic acid, tallow, Japan wax, and cerasin, may be calculated, after determining the acid number of the mixture, from the formula $A = 3{\cdot}8\,x + 21{\cdot}4\,(1 - x)$, where $x$ represents the required quantity of beeswax and A the acid number found; 3·8 being the acid number of pure beeswax and 21·4 that of a factitious wax.

The results are approximate only, as the acid numbers of different waxy and fatty substances employed to intermix with beeswax, vary considerably, that of Japan wax, for instance, being 17·8.—E. B.

*Phosphoric Acid in Wine, Determination of.* R. Wirth. Chem. Zeit. **19**, 1786.

About 100 c.c. of the wine are heated until all the alcohol is driven off. The organic matter is then oxidised with about 30—50 c.c. of nitric acid of sp. gr. 1·2, under an inverted condenser. The contents of the flask are subsequently concentrated, and precipitated at 50° C. with molybdate solution. The precipitate after settling 2 hours at 50° C. is filtered, washed with dilute nitric acid, dissolved in ammonia, and precipitated with magnesia mixture with the addition of citric acid if necessary. If the oxidation with nitric acid be not complete, the solution may be evaporated to a small bulk and boiled with a concentrated potassium permanganate solution (30 grms. per litre) until a precipitate of hydrated manganese peroxide separates. This is then dissolved in hydrochloric acid, chlorine expelled by boiling, the liquid made slightly alkaline with ammonia, then acidified with nitric acid, and treated according to the method given above. A phosphoric acid determination can be carried out according to this process in 1—$1\frac{1}{2}$ days.—T. A. L.

*Boric Acid and Formic Aldehyde, Detection and Estimation in Milk.* R. T. Thomson. City Anal. Soc., Glasgow, 1894—95, [5], 3.

Boric acid is detected in the usual way by the turmeric reaction.

The following is a quick and accurate method for its estimation:—Evaporate 100 grms. of the milk with 1·2 grm. of caustic soda to dryness in a platinum dish, char thoroughly, heat with 20 c.c. of water, and add hydrochloric acid slowly until all except carbon is dissolved. Transfer to a 100-c.c. flask and add 5 grms. of dry calcium chloride. Neutralise exactly with a 10 per cent. solution of caustic soda, and add 25 c.c. of lime-water. Make up to 100 c.c., mix, and filter through a dry filter, from the calcium phosphate. Take 50 c.c. of the filtrate and add normal sulphuric acid until the pink colour with phenolphthaleïn disappears, add a little methyl orange, and then acid again, until the liquid turns pink. Now add fifth-normal soda until the liquid just assumes a yellow tinge.

All acids likely to be present now exist as salts neutral to phenolphthaleïn, except boric acid, which is present in the free state, and carbonic acid, which is expelled on boiling.

Cool the solution, add enough glycerin to give 30 per cent. of that substance in the solution, and titrate with fifth-normal soda, using phenolphthaleïn as indicator; each c.c. of soda used is equal to 0·0124 grm. of crystallised boric acid.

To detect formic aldehyde, distil 100 c.c. of the milk and collect the first 10 c.c. of distillate in a stoppered tube. Add 5 or 6 drops of ammoniacal silver nitrate solution, made by dissolving 1 grm. of silver nitrate in 30 c.c. of water, adding ammonia until the precipitate formed at first is re-dissolved, and making up to 50 c.c. with water. Allow the mixture to stand for 12 hours, when, if formaldehyde be present, a black colour is formed.

The author has shown by experiment that the first 20 c.c. of the distillate contain practically all the formic aldehyde.

A mixture of boric acid and borax is more effective for preserving milk than boric acid alone, but formalin is by far the most effective preservative.—A. S.

### *Ginger, Analysis of.* W. Skinner. City Anal. Soc., Glasgow, 1894-95.

In the testing of ginger, the moisture, total ash, ash soluble in hot water, alkalinity of soluble ash, total potash, and the cold aqueous alcohol, &c., and ethereal extracts should be determined.

To determine the cold-water extract, treat 2 grms. of ginger with 100 c.c. of cold water, let stand overnight, filter and evaporate 50 c.c. for the solids in solution.

The most useful criteria are the soluble ash, potash, and aqueous extract.

The amount of real ginger is approximately in proportion to the amount of soluble ash.—A. S.

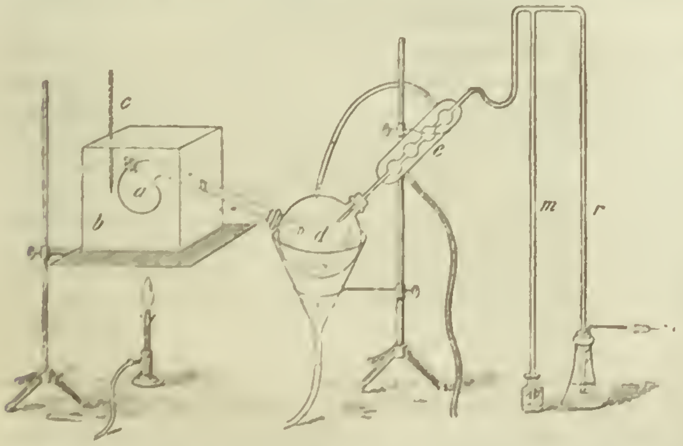
### *Vegetable Fibre in Feeding, or Linseed Cake, Pepper, &c. Estimation of.* R. Cusiter. City Anal. Soc., Glasgow, 1894–95, [5], 13.

The following was found to be the quickest method:—Boil 1 grm. of the sample (feeding cake, pepper, &c.) with 100 c.c. of 6 per cent. sulphuric acid (17° Tw.) for half an hour, filter, wash, and boil for another half an hour with 100 c.c. of 1 per cent. soda solution, filter through a weighed filter, wash, dry, and weigh.

Ignite the filter and fibre, deduct the weight of the ash from the previous weight, to obtain the weight of the fibre.
—A. S.

### *Glycerin, Estimation of, in Beer and Wine.* Partheil. Wochenschr. f. Brauerei, 1895, **12**, 1066—1067.

50 c.c. of wine or beer are mixed with a small quantity of potassium carbonate and evaporated to 10—15 c.c. The liquid is then filtered into a retort of 100 c.c. capacity and the filter washed with a little water. In the neck of the retort a bored cork is placed, through which a glass stopper is forced with the aid of vaselin. The retort is connected with the receiver *d*, which also has a condenser, *e*, attached, the fittings throughout being airtight. The retort is placed in an air-bath with a sheet-iron bottom and sides of asbestos cardboard cemented together with water-glass, whilst a similar piece of asbestos, in which a thermometer is fixed, serves as a movable lid. The distillation is taken nearly to dryness under ordinary pressure, the air-bath being maintained at 120°. The receiver is kept cool by the overflow water from *e*. When the distillation is finished, the retort is allowed to cool to 60°, and the apparatus evacuated by a water-pump. If possible, a manometer, *m*, and a safety flask, *r*, is fitted to the apparatus. When the tension of aqueous vapour is reached, the air-bath is raised to 180°, and the distillation continued for an hour and a half under a pressure of 25—30 mm. It is then allowed to cool under increased pressure; 10 c.c. of water are run into the retort, and the distillation carried as far as possible under the ordinary pressure at 120°. The whole of the glycerin will be found in the receiver *d*. The distillate, when coloured, is returned to the retort and again distilled. It is placed in a half-litre Erlenmeyer's flask, the receiver and condenser are repeatedly washed with water, until the volume is about 200 c.c. 6—8 grms. of sodium hydroxide are dissolved in the liquid, and a 5 per cent. solution of potassium permanganate added, until the green colour formed at first is changed to a permanent blue-black, after which it is warmed for an hour on the water-bath. The hot solution is just decolorised with $SO_2$, 20 c.c. of glacial acetic acid are added, and excess of $SO_2$ is removed by heating the liquid on the water-bath. Oxalic acid thus formed is determined in the usual way.—J. L. B.



### *Sulphur, Estimation of, in Organic Compounds, New Method for.* A. V. Asbóth. Chem. Zeit. 1895, **19**, 2040.

This is based upon the Hoehnel - Glaser method of estimating sulphur in sulphur ores by means of sodium peroxide.

It is carried out as follows:—

1 grm. of the powdered substance is mixed with 10 grms. of soda-ash and 5 grms. of sodium peroxide, and the mixture is heated very gently in a nickel crucible until it begins to fuse. The flame is then increased till the melt has become quite thin; allowed to cool, treated with water, the solution filtered, acidified, and heated with hydrochloric acid containing bromine, till the smell of bromine has disappeared. The sulphur may be estimated in the solution as sulphuric acid, by means of barium chloride.

The method may be used for estimating sulphur in liquids and extracts. Liquids are mixed with 5 grms. of sodium carbonate and evaporated to a syrup, 5 grms. soda and 5 grms. sodium peroxide are carefully added, and the mass mixed together carefully. The reaction is very energetic, so that care must be taken to avoid loss. The mass is then heated slowly to a high temperature, until all organic matter is burnt. The author claims that by this method, a sulphur estimation of a solid may be made in 2—2½ hours, and of a liquid in 6 to 7 hours.—H. M.

### *Iodine, Estimation of, in Organic Substances.* M. C. Schuyten. Chem. Zeit. 1895, 1143.

This method is applicable to iodine compounds of the fatty series, but gives low results with aristol, iodophenol, iodonaphthol, and other bodies, which allow a portion of the iodine to escape with the gaseous products of the reaction. Sufficient of the material to give from 0·03 to 0·05 grm. of iodine, is introduced into a 15-cm. test-tube, and is there covered with a layer of recently melted and finely-powdered bichromate; the two are well mixed by shaking, and covered with a 5—6 cm. layer of the potassium salt. The tube is next drawn out into a bent capillary, and is then heated slowly from above downwards, the upper part is cooled, and, in the neighbourhood of the capillary, is surrounded with a moist rag for the space of 3 cm. The iodine condenses on the cooled walls, and the heating of the mixture is continued until no more iodine escapes, and the tube remains clear between the fusion and the sublimate; the test-tube is then carefully cooled in a horizontal position to ensure that no flakes of iodine fall back into the mixture. The upper surface of the latter is remelted to expel any trace of recondensed iodine, and as soon as no further violet vapours are observed, the tube is drawn out and closed at the clear part. The tube is finally cleansed, washed out with potassium iodide solution, and the free iodine determined by titration. Such a determination occupies half an hour. Iodoform, iodol, and per-iodoethylene gave excellent results (quoted). Direct weighing of the iodine may be effected by connecting the portion of the cut-off tube containing the iodine with another tube containing calcium chloride and a little soda-lime, and allowing them to stand in a cool place, until the weight of the former is constant, indicating that all water has evaporated; the iodine is now expelled by heating, and the final loss of weight due to the removal of the iodine is ascertained.—W. G. M.

### *Albumin and Glue-Yielding Substances, Action of Alcoholic Soda Solution on.* W. Fahrion. Chem. Zeit. 1895, **19**, 1000—1002.

An acid, $C_8H_{16}N_2O_6$, regarded by the author as identical with the proteic acid obtained by Schützenberger by heating albumin with baryta-water under pressure, is said to be produced when hide is treated in the following manner:—10 grms. are digested on the water-bath with 50 c.c. of an alcoholic soda solution (8 per cent.) until nearly all is dissolved; the alcohol is evaporated, the gelatinous residue dissolved in hot water, and the solution cooled and filtered: the filtrate is heated, acidified with hydrochloric acid, cooled, and filtered; the filtrate is evaporated to dryness, and the residue dried at 110° until constant in weight; the extraction of this residue with hot absolute alcohol, and the subsequent evaporation of the alcohol leaves the "proteic acid as a sticky red-brown syrup. (See next abstract.)

The acid is insoluble in ether and in light petroleum, so that it can be separated from a mixture of fatty acids by means of this solvent. The author has shown that hydroxy-fatty acids are also insoluble in light petroleum (this Journal, 1893, 1064), but "proteic acid" is distinguished from these by its content of nitrogen.

The "dégras-former" of Jahoda and Simand (this Journal, 1891, 557; 1892, 639) has been shown by the author to consist of hydroxy-fatty acids (this Journal, 1893, 937), containing some nitrogenous impurity. He now endeavours to show that this impurity is "proteic acid," formed from the traces of hide fibre, always present in a genuine dégras, during saponification with alcoholic soda; its presence indicates that the dégras has been produced in the manufacture of leather.

Advantage may, perhaps, be taken of the fact that hide fibre is thus easily attacked and dissolved by alcoholic caustic soda, in the analysis of leather, and it may be hoped that by thus splitting up the leather, as it were, into its constituents—hide-fibre and tannin—or into derivatives thereof, much information may be obtained as to the manner in which the sample has been tanned. For the present the following scheme for the analysis of chamois leather and of glacé kid is given:—

Five grms. of the finely-divided sample are heated in a porcelain dish with 8 per cent. alcoholic soda solution. The liquid is washed into a separating funnel, acidified with hydrochloric acid, and, when cold, shaken with ether. The solid hydroxy-acids, the higher oxidation products of the jecoric acid, which is characteristic of the fish oils, are thus left undissolved; they can be dissolved in warm alcohol and then weighed. The ethereal solution, containing the unsaponifiable matter, the fatty acids, and the liquid hydroxy-acids, is evaporated and the weighed residue is treated with petroleum ether, which leaves the hydroxy-acids undissolved. The petroleum ether solution is shaken in a separating funnel with aqueous alcoholic soda solution, which extracts the fatty acids leaving the unsaponifiable matter in the petroleum ether. The alkaline solution of the fatty acids is evaporated to expel alcohol, the residue is dissolved in hot water, the solution decomposed by hydrochloric acid, and the fatty acids extracted with petroleum ether, which distils completely below 75°.

The following table gives the results of some analyses by this method. The hide substance is calculated by difference, and the small quantity of matter insoluble in alcoholic soda solution has been neglected:—

| —— | Water. | Ash. | Unsaponifiable Matter. | Fatty Acids. | Liquid Hydroxy-Fatty Acids. | Solid Hydroxy-Fatty Acids. | Hide Substance. |
|---|---|---|---|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. | Per Cent. |
| Chamois leather (sheep), I. | 18·66 | 8·28 | 0·49 | 4·15 | 0·37 | 0·53 | 67·52 |
| " " II. | 17·95 | 1·38 | 0·10 | 1·17 | Trace | 0·69 | 68·71 |
| " " III. | 17·60 | 4·38 | 0·30 | 3·10 | 0·28 | 1·00 | 73·34 |
| " (doe) | 15·15 | 6·03 | 0·49 | 4·16 | 0·45 | 1·37 | 72·35 |
| " (goat) | 15·18 | 3·83 | 3·03 | 0·28 | 0·61 | 0·56 | 76·51 |
| " (buffalo) | 20·54 | 3·21 | 0·19 | 0·46 | 0·11 | 0·56 | 75·02 |
| Glacé kid | 11·69 | 7·12 | 3·66 | 6·58 | 0·66 | 0·75 | 69·54 |

—A. G. B.

### *Action of Alcoholic Soda Solution on Gelatin and on Egg Albumin.* C. Paal and W. Schilling. Chem. Zeit. 1895, **19**, 1487—1488.

Fahrion has described a "proteic acid," obtainable by heating albuminoid substances with alcoholic soda solution (see preceding abstract). The authors have followed Fahrion's prescription, using gelatin as the raw material, and have prepared a compound of acid reaction having the properties of the "proteic acid." It proved, however, to be the hydrochloride of a powerful base, resembling the glutin-peptone hydrochloride which has been described by Paal and has been shown to be soluble in alcohol (Ber. 1892, **25**, 1202; Chem. Soc. Abstracts, 1892, 895). By the same method, the hydrochloride of albumin-peptone may be prepared; this contains 0·77 per cent. of sulphur, whilst, according to Fahrion, "proteic acid" from egg-albumin is free from sulphur.

The authors conclude that alcoholic soda solution effects a hydrolytic decomposition of albuminoids into peptones, and that Fahrion's "proteic acid" is not one and the same substance, whatever its source, but the hydrochloride of a peptone corresponding with the particular albuminoid used as raw material. The metallic salts of proteic acid described by Fahrion are merely complex mixtures of the chloride of the metal with unchanged peptone hydrochloride, free peptone, and metallic salt of the peptone. The peptones themselves are insoluble in alcohol, but their hydrochlorides are readily soluble.—A. G. B.

### *Sugar, Estimation of, in the Beetroot.* Almroth. Sucr. indigène, 1895, **46**, 384.

The author has made a series of comparative experiments on this subject, and has found, by means of Pellet's cold water digestion, 13·8, 13·9, 14 per cent. of sugar; cold and hot alcoholic extraction respectively gave 14·0, 14·1, 14·2, and 14·1, 14·0, 14·3 per cent.; while Pellet's hot aqueous digestion yielded 14·9, 14·7, 15 per cent. The author considers the latter the most accurate method, and states that the others are used to make it appear that less than the real quantity of sugar has been introduced into the factory, the losses being thereby apparently diminished.

—J. L. B.

### *Maltose and Dextrose, Estimation of, by Fehling's Solution.* R. Kusserow. Wochenschr. f. Brauerei, **12**, 574—575.

There is a disagreement between many analysts as to the precise amount of cuprous oxide which is reduced from Fehling's solution by maltose and dextrose. The author finds that slight differences in the method of carrying out the reduction produce differences in the amount of cuprous oxide formed which are quite sufficient to account for these discrepancies. The longer the mixed solutions are boiled the greater the reduction; if the solution is not actually boiled the amount of reduced copper is deficient. The author comes to the conclusion that if the reduction be always carried out under the same conditions, the same amount of reduction takes place and it is then possible to estimate the sugar with accuracy.—A. L. S.

### *Titration of Antipyrine. Iodophenyldimethylpyrazolone.* M. C. Schuyten. Chem. Zeit. 19, 1786.

By adding a standardised iodine solution (about 1·27 grms. per 500 c.c.) to an aqueous solution of antipyrine (0·01 to 0·05 grms. in 10—50 c.c.), the brown precipitate which first forms, dissolves and the liquid turns lemon-yellow, due to the formation of iodophenyldimethyl pyrazolone. The colour which must remain constant for an hour is compared with pure water and the amount of antipyrine is found by multiplying the quantity of iodine by the constant 1·45. Starch iodide is not recommended as an indicator.—T. A. L.

### *Glycerin, Testing for Dynamite Manufacture.* J. Lewkowitsch. Chem. Zeit. 1895, 19, 1423—1424.

Dynamite glycerin is a distilled product and should contain an insignificant amount of ash. This property and the absence of a precipitate with lead acetate serve to distinguish distilled from crude glycerin. The best varieties of dynamite glycerin are nearly chemically pure, but are distinguished from the highest grades by their yellow colour and somewhat greater content of ash and organic impurities. The following are the characteristics of a good dynamite glycerin :—

(1.) *Specific gravity* should be not lower than 1·261 at 60° F.; it is best determined in a specific gravity bottle.

(2.) *$CaO$, $MgO$, and $Al_2O_3$* must be absent.

(3.) *Chlorine* should be present in only trifling amount; *e.g.*, 1 c.c. of glycerin diluted with 2 c.c. of water should not give a strong milky turbidity with silver nitrate.

(4.) Arsenic must not be present in more than traces. Gutzeit's test is too severe. It suffices to make the sample just alkaline with ammonia and add silver nitrate; no yellow turbidity should appear.

(5.) *Organic impurities* should be tested for by diluting 1 c.c. of the sample with 2 c.c. of water and adding a few drops of 10 per cent. silver nitrate solution. In ten minutes the glycerin should not blacken nor even become brown.

(6.) *Total solid residue* should be determined by slowly heating a weighed portion to 160° C. Rapid heating should be avoided, as non-volatile polyglycerins may be formed. The best plan is to add a few drops of water from time to time in order to favour the volatilisation of the glycerin in the resulting steam. The total residue should not exceed 0·15 per cent. The ash may be determined in the same portion.

(7.) *Free Acid.*—The glycerin should not redden blue litmus paper. Volatile fatty acids, *e.g.*, butyric acid, may be recognised by the ethereal smell produced by heating the sample with alcohol and strong sulphuric acid. On leading nitrous fumes through the glycerin, no flocks (due to the conversion of oleic into elaidic acid) should separate.

(8.) A crucial test of the fitness of the glycerin for dynamite making consists in actually carrying out the manufacture of nitro-glycerin on a laboratory scale. 375 grms. of a mixture of sulphuric and nitric acids (1 part by weight of $HNO_3$ sp. gr. 1·5 with 2 of $H_2SO_4$ sp. gr. 1·845) is prepared and allowed to cool in a closed vessel. The exact quantity is weighed out in a beaker of 500 c.c. capacity and the beaker is placed in a large vessel through which a stream of cold water circulates. The rubber tube leading the water to the cooling vessel must be wired on to the tap lest it slip off and cause the water to splash into the nitrating liquid. Such an accident might lead to an explosion. The beaker should be thin so that it may be quickly broken with the thermometer used as a stirrer, should heating begin after mixing. When the temperature of the mixture is 12°—15° C., 50 grms. of the glycerin to be tested are allowed to fall drop by drop into the acid mixture, while the liquid is well stirred with the thermometer and the temperature is watched. The operation must be carried out slowly and cautiously, no further glycerin being added until the temperature of the mixture is below 25° C. A temperature of 30° C. should never be exceeded. When all the glycerin has been poured in, stirring is continued until the temperature has fallen to 15° C., when the mixture is transferred to a perfectly dry separating funnel (which may be previously washed out with strong sulphuric acid). If the glycerin be good the nitroglycerin quickly separates as an oily, somewhat turbid layer. The quicker and sharper the separation, the better the sample. Should flocculent matter appear in the nitroglycerin or should the separation not take place within 5—10 minutes, or should an intermediate layer persist between the two liquids, the glycerin is not fit for dynamite making. In a very bad sample the nitroglycerin remains diffused through the acid liquid for hours. The test may be made quantitative by re-weighing the vessel employed to contain the 50 grms. of glycerin, and by running off the acid liquid from the nitroglycerin and swirling the nitroglycerin round the separator to collect stray drops of acid which can then be drawn off; no shaking is permissible. The nitroglycerin is washed with water at 35°—40° C., then once or twice with 20 per cent. caustic soda solution and again with water. The volume of the nitroglycerin is read off in a 100 c.c. burette, and when multiplied by 1·6 gives the weight in grms. The method though rough is valid for technical purposes. The yield should be 207—210 per cent., the theoretical figure being 246·7 per cent.—B. B.

### *Estimation of Butyric Acid.* W. H. Willcox. Proc. Chem. Soc. 1895, [156], 202.

In the estimation of butyric acid in the presence of acetic and formic acids, the acids were neutralised by a known excess of calcium carbonate. Hydrochloric acid was added in sufficient amount to neutralise the free calcium carbonate and to liberate the butyric acid from the calcium salt. The solution was distilled, and when the greater part had passed over, steam was passed through the liquid as long as the distillate continued acid. The distillate, which contained the butyric acid, was boiled with pure barium carbonate, the solution filtered, and evaporated to dryness.

It was found that when dried at 100° C., the salt did not attain a constant weight even after it had been heated for several weeks, diminutions of about 2 mg. (with 1 to 2 grms. of salt) occurring after heat had been applied for three hours. This loss of weight did not occur at and below 80°.

The results show that in the estimation of mixtures of the volatile fatty acids, when butyric acid is present, the fraction of salts containing the butyrate must be dried at a temperature not exceeding 80° C.; if this temperature be exceeded, loss of weight occurs owing to the decomposition of the butyrate.

### *Gravimetric Estimation of Maltose by Fehling's Solution.* T. A. Glendinning. Proc. Chem. Soc. 1895, [155], 163.

The specific cupric-reducing power of maltose possesses a different value according to whether potash or soda be the alkali employed in the preparation of Fehling's solution. Under the conditions of experiment given, the reducing powers to be attributed to maltose are: soda, $K_{3\cdot86} = 61$. Potash, $K_{3\cdot86} = 64$.

On making comparative analyses of starch transformation products with the two kinds of Fehling's solution, identical results were obtained, provided the respective values of K were used.

No such difference occurs in the case of dextrose or of invert sugar.

## XXIV.—SCIENTIFIC AND TECHNICAL NOTES.

### *Solubility of certain Benzene Derivatives.* W. Vaubel. J. prakt. Chem. 52, 72—75.

The solubilities of about 40 benzene derivatives have been examined with a view of formulating a law with regard

to the influence of certain substituents. It is found that whilst the solubility in water of these derivatives is due to the presence of an amido, hydroxyl, or carboxyl group, the "dissolving power" is diminished by other substituents such as methyl, bromine, iodine, or the nitro group. In the substituted benzoic acids, a methyl or a nitro group, bromine or iodine, renders the substance least soluble when in the para position, whilst in the ortho position the effect is less marked. With amido and hydroxyl derivatives, however, the nitro group acts most energetically in the ortho and least in the meta position. Of the benzene di-derivatives, those in the meta position are most, and in the para least soluble. Carnelly and Thomson's rule, that in a group of isomeric organic substances the series of the melting points is in the same direction as that of the solubilities (the most fusible being the most soluble), does not seem to hold good, but no rule could be formulated for the exceptions. A comparison is also made of the specific gravities of the solutions in water of certain amido, diamido, hydroxy- and dihydroxy-benzene derivatives.
—T. A. L.

### *Relation of the Industries to the Advancement of Chemical Science. [The Cresols and Naphthols. Variation of Properties with Chemical Structure.]* W. McMurtrie, Ph.D., Amer. Assoc. for the Advancement of Science, August 1895.

It was pointed out in connection with the subject of the relation of chemical structure to the physical, chemical, and physiological properties of organic compounds, that H. Caro had called attention, in a recent address, to the facts that in those compounds having antifermentative, therapeutic, or toxic action, the influence varies in intensity with the position of the radicle in the molecule. Thus it was found that orthocresol is less active as an antiferment than the meta compound, whilst this, in its turn, is less intense in its action than paracresol; also α-naphthol is more poisonous and more actively antiseptic than β-naphthol.
—W. S.

### *Constitution of β-Anthraquinone.* K. Lagodzinski. Ber. **28**, 1422—1424.

In a previous paper (Ber. **27**, 1438) it was shown that 2-hydroxyanthracene gives a new anthraquinone, in which the two oxygen atoms are in the ortho position. With a view of deciding whether the substance was a 1.2 or a 2.3-anthraquinone, the author converted 2-hydroxanthracene into nitrosoanthrol, which, on reduction with hydric sulphide in an alkaline solution, gave amidohydroxyanthracene. From this a triacetyl derivative—

$$C_{14}H_8N(COCH_3)_2OCOCH_3$$

was obtained, which crystallised from dilute alcohol in large plates, melting at 164° C. On oxidation with chromic acid, this substance yielded a triacetylamidohydroxyanthraquinone, $C_{14}H_6O_2N(COCH_3)_2OCOCH_3$, melting at 181° C. and crystallising from benzene in light yellow flat prisms. On boiling with caustic alkalis this yields alizarinamide, which, according to Liebermann (Annalen, **183**, 206) has the following constitution: $C_6H_4(O_2)C_6H_2.NH_2(OH)(1:2)$. By the action of nitrous acid on alizarinamide, 2-hydroxyanthraquinone is formed. The nitrogen atom in alizarinamide therefore being in the α position, it follows that β-anthraquinone must have the constitution—

$$C_6H_4.C_6H_2(O)(O)\ [1:2],$$

since it is obtained by the oxidation of 1.2-amidohydroxyanthracene.—T. A. L.

### *Cane Sugar, its Distribution in Plants, its Physiological Importance, and the Soluble Carbohydrates which accompany it.* Schulze and S. Frankfurt. Zeits. f. Spiritusindustrie, 1895, **18**, 222.

The authors have detected cane sugar in many seeds, seed coverings, etiolated plants, green plants, leaves, stalks, roots, rhizomes, tubers, bulbs, flowers, and fruits. In wheat, raffinose was found in addition to cane sugar, and in rye they detected a new carbohydrate *sekalose* (β-levulin), which yields levulose on inversion.

The cane sugar present in seeds must be regarded as an important reserve material, and is probably destined to afford nourishment to the germinating plant. The germ of wheat contains no starch, whilst cane sugar is present in considerable quantity, and is utilised as soon as germination commences; and its importance lies in the fact that the germ is not at once able to draw upon the store of reserve material in the endosperm. The cane sugar does not disappear when the germ develops, as the young plant is able to produce cane sugar as soon as it can draw upon the reserve material of the endosperm. These views are in agreement with Brown and Morris's investigations on the germination of barley. The authors come to the conclusion that cane sugar is more readily available for the plant, and is therefore more valuable than starch, and the other polysaccharides. The question of the origin of the cane sugar cannot be definitely answered, but the authors hold Müller-Thurgau's view, that cane sugar appears as an intermediate product in the transformation of starch into glucose. It can, on the other hand, also become again transformed into starch, and thus it is not only a very valuable reserve material, but also, as the translocation form of starch, it plays a very important part in plants.—A. K. M.

### *Laccase, its Oxidising Power.* G. Bertrand. Bull. Soc. Chim. **13**, 361.

Laccase is a new ferment obtained from the lac-tree, of Tonkin, or from laccol. This new ferment is characterised by its property of inducing the oxidation of the substances upon which it acts. Thus, in its presence, 1 grm. of hydroquinone dissolved in 100 c.c. of water absorbed in three hours 25·4 c.c. of oxygen out of 174·9 c.c. of air; in another experiment, in four hours 32 c.c. of oxygen were absorbed out of 220·1 c.c. of air. In the absence of laccase, or with laccase the solution of which has been heated to 100° C. for five minutes, hydroquinone undergoes no alteration and absorbs no oxygen. The yield of quinone obtainable from a solution of hydroquinone and laccase, through which an air current is passed, is very satisfactory. The following solutions were prepared:—A. Hydroquinone, 2 grms.; water, 50 grms.; and crude laccase, 0·2 grm., yielded, after 15 hours, 1·66 grms. (83 per cent.) of quinone: whilst B. Hydroquinone, 3 grms.; water, 50 grms.; and crude laccase, 0·2 grm., yielded, after 30 hours, 2·34 grms. (75 per cent.) of quinone.

Treating pyrogallol in the same manner, purpurogallin is obtained, accompanied by evolution of carbonic acid. This reaction in some degree resembles an artificial respiration, and perhaps represents a phenomenon similar to the respiration in plants. The oxidation of gallic acid in the presence of laccase, is also accompanied by the evolution of considerable volumes of carbonic acid. Tannic acid, under the same conditions, is oxidised without hydrolytic change, but the evolution of carbonic acid is much less marked. In all the above experiments the intervention of micro-organisms was carefully guarded against; moreover, all the liquids acted upon were of a more or less antiseptic nature.—C. O. W.

### *Action of Hydrofluoric Acid upon Crystallised Silicon.* G. S. Newth. Proc. Chem. Soc. 1895, [155], 176.

It is generally stated that hydrofluoric acid is without action upon crystallised silicon; that whilst amorphous silicon is attacked by it, this acid is incapable of acting upon the crystallised element.

This statement, however, requires to be made with some reservation, for although it is doubtless true of the aqueous acid, and possibly of the liquid acid, it is not true of the gas.

If acid potassium fluoride be heated in a platinum retort, and the pure gaseous hydrofluoric acid so produced be allowed whilst hot to blow upon a little heap of crystallised silicon supported on a porcelain crucible lid, the silicon at once takes fire and burns brilliantly in the gas, forming silicon fluoride and hydrogen.

If the neck of the retort be more than an inch or two in length, it is necessary to heat it in order to keep the gas sufficiently hot, but if it be quite short, the temperature of the gas as it is disengaged from its compound is sufficiently high to enable it to attack the silicon.

The importance of this observation is to be found in the fact that the spontaneous ignition of crystallised silicon is generally regarded as in all cases a sufficient test for free fluorine; but it is evident that unless the temperature of the gas be below a certain point, the combustion of silicon is not a safe criterion.

## New Books.

Chemisch-technisches Repertorium. Uebersichtlicher Bericht über die neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie, mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Dr. Emil Jacobsen, 34. Jahrgang. 1895. Erstes Halbjahr. Zweite Hälfte. Mit in den Text gedruckten Illustrationen. Hermann Heyfelder, R. Gaertner's Verlagsbuchhandlung, Schönebergerstr. 26, Berlin, S.W. H. Grevel and Co., 33, King Street, Covent Garden, London.

The second issue for the first half-year of 1895, of Dr. Jacobsen's Repertory of Chemical Technology, containing reports of the progress of the following branches of chemical industry:—I. Foodstuffs. II. Paper. III. Photography. IV. Residuals, Manures, Disinfection, and Sanitation. V. Soaps. VI. Explosives and Matches. VII. Preparation and Purification of Chemicals. VIII. Chemical Analysis. IX. Apparatus, Machinery, Electro-technology and Thermotechnology. X. Appendix, with Adulteration of Trade Products, &c. XI. New Books. This number contains 182 pages of subject-matter, and is illustrated with numerous woodcuts.

Chemiker-Kalendar, 1896. Ein Hülfsbuch für Chemiker, Physiker, Mineralogen, Industrielle, Pharmaceuten, Hüttenmänner, u.s.w. Von Dr. Rudolf Biedermann. Siebzehnter Jahrgang. Mit einer Beilage. Verlag von Julius Springer, Berlin. H. Grevel and Co., 33, King Street, Covent Garden, London. Price 4*s.* 6*d.* post free.

The issue for 1896 has now appeared of this well-known pocket-book for chemists and analysts. It is strongly bound in waterproof cloth, and contains an Almanack for 1896 inside the cover, and a table of frequently used atomic weights and their multiples. A Chronological Table is given of the principal events in the history of the physical sciences, especially of Chemistry, and also a Notebook Calendar with blank pages for the different days of the year, wherein notes, data, &c. may be recorded. Tables next follow of specific gravities of Gases and Liquids, Salts and Alcohols; Tables also of Insolubilities and the Properties of Chemical Substances. The next branch is one of Condensed Analytical data, Volumetric Analysis, Spectrum Analysis, Gas Analysis, Physiological Chemical Analysis and Technological Investigations (in the additional volume or "Beilage") relating to:—I. Water. II. Assaying. III. Fuels. IV. Sulphuric Acid. V. Alkali. VI. Bleaching Powder. VII. Nitre and Explosives. VIII. Ceramic Arts. IX. Glass. X. Mortar and Cement. XI. Illuminating Gas. XII. Starch and Sugar. XIII. Fats and Oils. XIV. Tanning Agents. XV. Textiles, Paper. XVI. Photography. XVII. Colours and Dyestuffs. XVIII. Physiological-Chemical Analysis. In the "Beilage zum Chemiker-Kalendar, 1896," besides the above, various other tables are also given:—I. Leading Foreign Money Currencies. II. Series of Mathematical Tables. III. Weights and Measures. IV. Tables of Heat and Cold Measurements. V. Expansion and Contraction. VI. Tension of Vapours. VII. Barometry. VIII. Sound. IX. Light. X. Electricity. XI. Magnetism. XII. Diffusion and Capillarity. XIII. Elasticity, &c. XIV. Specific Gravity.

Tabular Survey of the Artificial Organic Colouring Matters and their Application in Dyeing and Calico Printing. By Dr. Adolf Lehne. Translated by T. K. Gajjar, B.Sc., M.A. With dyed Patterns of each individual Colouring Matter and printed Patterns. First Part. Caxton Steam Printing Works; also A. J. Combridge and Co., Esplanade Road, Bombay. Price Rs. 5. A. J. Combridge and Co., 31, Newgate Street, London, E.C. 1895. Price 6*s.*

This work is the translation of the original German "Tabellarische Uebersicht" already noticed in this Journal (See this Journal, 1894, 1231), and will be published in six parts corresponding to those of the German edition, the prices of each of which will be 6*s.* or Rs. 5. A Table of Contents, as well as a complete Index and the Translator's Preface, will be given in the last part. A supplementary part, containing a survey of new colouring matters and results of experiments conducted for the determination of the action of light and weather in Baroda and Bombay, is promised, and will be published after the completion of the six parts. The mounting of the dyed and printed specimens, and the general appearance of the work, greatly resemble those of the German edition already noticed in this Journal during the year 1894.

A Treatise on the Manufacture of Soap and Candles, Lubricants and Glycerin. By Wm. Lant Carpenter, B.A., B.Sc. Second Edition, Revised and Enlarged. By Henry Leask. E. and F. N. Spon, 125, Strand, London. 1895. Price 12*s.* 6*d.* Spon and Chamberlain, 12, Cortlandt Street, New York.

In its second edition this work has gained considerably in size, now filling 446 pages as against 344 in the first edition. The chapter on lubricants has been specially written by Mr. J. Veitch Wilson, and the Bibliographic table at the end of the volume has undergone some expansion. The contents may be summarised as follows:—I. Soap; Historical References. II. Theoretical Principles. III. Raw Materials: Sources and Preparation. IV. Ditto: Refining, Clarifying, and Bleaching. V. Ditto: Proximate Analysis. VI. Caustic Alkali and other Mineral Salts. VII. Household Soaps. The Process of Saponification. VIII. Treatment of Soap after Removal from the Soap-Copper: Cooling, Cutting, Drying, and Moulding. IX. Soap: Filling and Sophistication. X. Special Soaps. XI. Theory of Action of Soap. Its Valuation and Analysis. Distribution and Position of the Trade. XII. Lubricants. XIII. Candles. (This chapter is enlarged from 16 pages to 34 pages.) XIV. Processes for the Conversion of Neutral Fats into Fatty Acids. Manufacture of Commercial Stearin. XV. Candles and Night-Lights; their Value as Illuminants. XVI. Glycerin. The text is illustrated with 104 woodcuts.

The Handling of Dangerous Goods. A Handbook for the Use of Government and Railway Officials, Carriers, Shipowners, Insurance Companies, Manufacturers and Users of such Goods, and others, comprising Notes on the Properties of Inflammatory, Explosive, and other Dangerous Compounds, and the Modes of Storage and Transport thereof, with Official Classifications, Parliamentary Enactments, Particulars of recorded Accidents, &c. By H. Joshua Phillips. Messrs. Crosby, Lockwood, and Son, 7, Stationers' Hall Court, Ludgate Hill, London, E.C. 1895. Price 9*s.* post free.

This volume of 362 pages is arranged in three parts, Part I. being subdivided into nine sections, as follows:—Sect. I. Acids. II. Alkalis. III. Salts. IV. Gases. V. Inflammable Liquids. A. Coal-Tar and its Products. B. Crude Petroleum and its Products. C. Fixed Oils and Fats. D. Essential or Volatile Oils. E. Various Inflammable Liquids. VI. Inflammable Solids. VII. Miscellaneous Substances. VIII. Common Substances liable to "Spontaneous" Combustion. IX. Explosives. Part II. devoted to "Notes of Instructive Accidents with various Materials, illustrating their Nature"; and Part III. to "Special Railway Classification, Mode of Packing, and General Regulations for the Conveyance of Explosives and other Dangerous Goods by Merchandise Trains."

An Appendix concludes the work, containing a variety of Tables of Weights, Measures, Hydrometers, Thermometers, Specific Gravities, Insurance Data, Conditions, and Scale of Charges. An alphabetical index of subject-matter is provided.

A Short Manual of Analytical Chemistry, Qualitative and Quantitative, Inorganic and Organic. Following the Course of Instruction given in the Laboratories of the South London School of Pharmacy. By John Muter, Ph.D. Sixth Edition, illustrated. Simpkin, Marshall, Hamilton, Kent, and Co., Limited, 4, Stationers' Hall Court, London, E.C.; and Baillière, Tindall, and Cox, 20, King William Street, Strand, W.C. 1895. Price 6*s.* 6*d.*

Large 8vo. volume, containing 208 pages of subject-matter and alphabetical index. The text is illustrated with 56 wood engravings, and divided into—Part I. Qualitative Analysis; and Part II. Quantitative Analysis; the subsections or chapters being devoted to the following subjects:—Part I.—I. Processes employed by Practical Chemists. II. Detection of the Metals. III. Detection and Separation of Acid Radicals. IV. Detection of Unknown Salts. V. Detection of Alkaloids and certain organic bodies used in Medicine, with a General Sketch of Toxicological Procedure. Part II.—VI. Weighing, Measuring, and Specific Gravity. VII. Volumetric Analysis and Use of the Nitrometer. VIII. Gravimetric Analysis of Metals and Acids. IX. Ultimate Organic Analysis. X. Special Processes for the Analysis of Water, Air, and Food. XI. Special Processes for the Analysis of Drugs, Urine, and Urinary Calculi. XII. Analysis of Gases, Polarisation, and Spectrum Analysis, &c.

A Hand-Book of Industrial Organic Chemistry. Adapted for the Use of Manufacturers, Chemists, and all interested in the Utilisation of Organic Materials in the Industrial Arts. By Samuel P. Sadtler, Ph.D., Professor of Chemistry in the Philadelphia College of Pharmacy and in the Franklin Institute of the State of Pennsylvania. Second revised and enlarged Edition. J. B. Lippincott Company, Philadelphia, U.S.A.; and 10, Henrietta Street, Covent Garden, London. 1895. Price 1*l.* 5*s.*

Large 8vo. volume which bears evidence of considerable additions to the first edition of 1891 (this Journal, 1891, 956). The Bibliography has in the present edition in all cases been rewritten and brought up to date. The statistics have also been brought down to the present year, and a number of new statistical tables have been added. In the Appendix, two new tables have been added, giving the physical and chemical constants of the oils, fats, and waxes, classified for reference and comparison. The work contains the Prefaces, List of Illustrations, numbering 127, and of Diagrams, numbering 14, 517 pages of subject-matter, and an Alphabetical Index. A chapter is devoted to each of 14 branches of Chemical Industry, and each such chapter forms a complete treatise, arranged and sub-divided according to a special system. As an example of this scientific method of treatment, Chapter I., on Petroleum and Mineral Oil Industry, is herewith given in detail:—

Chapter I. Petroleum and Mineral Oil Industry. I. Raw Materials. II. Processes of Treatment. III. Products. IV. Analytical Tests and Methods. V. Bibliography and Statistics. II. Industry of the Fats and Fatty Oils. III. Industry of the Essential Oils and Resins. IV. The Cane Sugar Industry. V. The Industries of Starch and its Alteration Products. VI. Fermentation Industries. A. *Nature and Varieties of Fermentation.* B. *Malt Liquors and the Industries connected therewith.* C. *The Manufacture of Wine.* D. *Manufacture of Distilled Liquors or Ardent Spirits.* E. *Bread Making.* F. *The Manufacture of Vinegar.* VII. Milk Industries. VIII. Vegetable Textile Fibres. IX. Textile Fibres of Animal Origin. X. Animal Tissues and their Products. A. Leather Industry. B. Glue and Gelatin Manufacture. XI. Industries based upon Destructive Distillation. A. Destructive Distillation of Wood. B. Destructive Distillation of Coal. XII. The Artificial Colouring Matters. XIII. Natural Dye-Colours. XIV. Bleaching, Dyeing, and Textile Printing. Appendix. I. The Metric System. II. Tables for Determination of Temperatures. III. Specific Gravity Tables. IV. Alcohol Tables. V. Physical and Chemical Constants of Fixed Oils and Fats.

A Laboratory Manual of Organic Chemistry. A Compendium of Laboratory Methods for the Use of Chemists, Physicians, and Pharmacists. By Dr. Lassar-Cohn, Professor of Chemistry in the University of Königsberg. Translated, with the Author's sanction, from the Second German Edition, by Alexander Smith, B.Sc., Ph.D., Assist. Prof. of Gen. Chemistry in the University of Chicago. Macmillan and Co., London and New York. 1895. Price 8*s.* 6*d.*

The author thus defines the nature and the scope of the work:—"Of recent years several works have appeared in which all the methods for the preparation of certain classes of bodies are collected. But even these confine themselves almost entirely to the statement of the equations representing the chemical actions." "In the present volume an effort has been made to bring together the methods which may be employed for carrying out all the common operations, such as sublimation, reduction, and the preparation of nitro-bodies, and of sulphonic acids, &c., without reference to the particular substances employed." The book, an 8vo volume of 389 pages, exclusive of a final list of References and the Alphabetical Index, is illustrated by 42 wood engravings, and contains Translator's and Author's Prefaces, and a Table of Contents.

The general plan of the work may be laid down as follows:—I. General Methods.—I. Baths. II. Crystallisation. III. Decolourising of Liquids. IV. Distillation. V. Drying Solids and Liquids. VI. Extraction. VII. Filtration. VIII. Determination of Melting Points. IX. Determination of Molecular Weights. X. Sealed Tubes. XI. Sublimation. II. Special Methods.—XII. Condensation. XIII. Preparation of Diazo-Bodies. XIV. Preparation of Esters. XV. Fusion with Caustic Alkalis. XVI. Preparation of Halogen Compounds. *A.* Bromo-Derivatives. *B.* Chloro-Derivatives. *C.* Iodo-Derivatives. *D.* Fluoro-Derivatives. XVII. Preparation of Nitro-Derivatives. XVIII. Oxidation. XIX. Reduction. XX. Preparation of Salts. XXI. Saponification. XXII. Preparation of Sulphonic Acids. XXIII. Remarks on Organic Analysis.

Modern Copper Smelting. By Edward Dyer Peters, Jr. Seventh edition, rewritten and greatly enlarged. The Scientific Publishing Co., New York, and 20, Bucklersbury, London, E.C., 1895. Price 25*s.*

The appearance of the first edition of this work was noticed in this Journal, 1887, 751—752. The present volume contains prefaces, table of contents, 628 pages of subject-matter, illustrated with 85 engravings and several folding plates with plans and working drawings. The subject-matter is thus classified for treatment:—I. Copper and its Ores. II. Distribution of the Ores of Copper. III. The Sampling and Assaying of Copper. IV. The Chemistry of the Calcining Process. V. Preparation of Ores for Roasting. VI. Roasting of Ores in Lump Form. VII. Roasting of Ores in Pulverised Condition. VIII. Automatic Reverberatory Calciners. IX. Smelting of Copper. X. Chemistry of the Blast Furnace. XI. Blast-Furnace Smelting (with Carbonaceous Fuel). XII. Blast Furnaces constructed of Brick. XIII. General Remarks on Blast-Furnace Smelting. XIV. Pyritic Smelting. XV. Pyritic Smelting, History, Principles, Scope, Apparatus, and Practical Results. XVI. Reverberatory Furnaces. XVII. Bessemerising of Copper Mattes. XVIII. Electrolytic Refining of Copper. XIX. Selection of Process and Arrangement of Plant.

# Trade Report.

## *TARIFF CHANGES AND CUSTOMS REGULATIONS.*

(*From the Board of Trade Journal.*)

### France.

*Modification of Sugar Duties.*

According to the *Journal Officiel* for 9th November last, a Bill has been introduced into the French Chamber for the modification of the sugar duties in France.

The following is a translation of the principal articles of the Bill :—

1. The consumption duty to be levied on sugar of any origin shall be reduced to 40 francs per 100 kilos.

This duty will continue to be levied either on importation or on issue from the manufactory or depôt.

2. A surtax of 40 francs shall be levied on refined sugar either on importation or on issue from the refinery, with the exception of *vergeoises* not exceeding the standard of 98 degrees.

3. In the case of exportation, refined sugars in powder can only claim the drawback of the surtax if exported abroad direct from the manufactory under seal of the Customs.

In the preamble to the Bill it is noted that a crisis in sugar has been brought about by an increased and exaggerated over-production throughout the world.

The production of beetroot sugar in the various countries has risen from 2,223,000 tons in the year 1885–86 to 4,975,000 tons in 1894–95. Cane sugar, in the same period, has also developed, though in a less proportion, from 2,140,000 tons to 2,904,000 tons. The consumption of sugar, however, does not show the same development; it has increased only in the proportion of 250,000 tons yearly. Hence a disastrous fall in prices.

In the last 15 years the production of sugar in the principal sugar-producing countries of Europe has increased as follows :—In Germany, from 400,000 to 1,850,000 tons; in Austria, from 250,000 to 1,100,000 tons; in France, from 350,000 to 700,000 tons; in Russia, from 200,000 to 600,000 tons; and in Belgium, from 80,000 to 280,000 tons.

### *Tariff Changes.*

*Tracing Paper coated with an oily preparation and known as Dioptric Paper.*—The question having arisen as to the proper classification of *dioptric paper*, and if it should come under the heading of "papier sulfurisé" (No. 461 *ter*), it has been decided that, on the contrary, dioptric paper offers analogous points of resemblance to paper prepared with wax or paraffin, and is therefore to be classed with "papier de fantaisie" (No. 461).

### SWITZERLAND.

### *Alteration of Duty on Vaseline.*

With reference to the note on p. 171 of the August number of the *Board of Trade Journal*, the duty on "vaseline, not purified, in barrels or in boxes weighing more than 10 kilogs. each," should be frs. 0·50 instead of frs. 0·10 as there stated.

### *Customs Decisions.*

Crown patent drier is dutiable at 25 per cent. under Par. 48. Antitoxin is exempt from duty as vaccine virus under Par. 664.

## *EXTRACTS FROM DIPLOMATIC AND CONSULAR REPORTS.*

### THE BEER INDUSTRY OF AUSTRIA-HUNGARY.*

*Board of Trade Journal, December, 655.*

The production and consumption of beer has, during the last few years, been everywhere on the increase, and has become one of the most necessary articles of consumption, more especially in northern countries.

Twenty years ago, in Russia, Holland, Denmark, Sweden, and Norway, hardly any but imported beer was consumed, and the local production in these countries was at such a low ebb that official accounts did not even distinguish the amount received by the revenue from a beer tax. At the present time Russia produces about three million hectolitres (hectolitre = 22 Imp. gallons), Holland two and a half, Denmark two, and Sweden one.

The United Kingdom, Germany, America, and Austria-Hungary produce immense quantities of beer, and are ever on the watch for new openings for the exportation of the same. Twenty years ago the production of beer in Germany was about 23 million hectolitres; the United Kingdom, 21 million; the United States, 5 million; Austria, 9; Belgium, 2; and France, 1 million hectolitres. The figures at present are: Germany, 41; United Kingdom, 39½; United States, 36; Austria-Hungary, 17; Belgium, 10; and France, 10 million hectolitres—an increase in 20 years of upwards of 92 million hectolitres for the six countries above-named.

In Spain and Italy, and also in Australia, the production has largely increased.

The increase in production in Austria-Hungary is due, not only to the advantageous conditions under which the industry can be conducted, but, in a great measure, to the excellence of the beer itself.

The various authorities who have undertaken the analysis of Austrian beer from a hygienic point of view, have unanimously declared that it contains nothing but barley, hops, yeast, and water; and such declared opinions cannot but have had a good effect on consumers of beer, and contributed to an increase of production.

This continued increase in consumption, and hence in the production, has naturally tended to develop the industry of machines and utensils employed in the making of beer; and the manufacturers of such goods have received large orders during the last few years.

At the close of 1894 there were in all 1,802 breweries at work in Austria-Hungary. Of these 73 per cent. worked by machinery and 27 per cent. by hand; the production per brewery ranged from 640 hectolitres to 700,000 hectolitres.

By the octroi law of 25 May 1829, a consumption tax had to be paid by all beer-producing places in Austria-Hungary, except Trieste, which city paid instead an equivalent sum as compensation to the national exchequer.

In 1850 a general impost on beer was established for Hungary, Croatia, and Slavonia; and in 1879 this impost was extended to Dalmatia, Trieste, Bosnia, and Herzegovina. Since that year every hectolitre of beer, properly tested as to its quality and quantity, pays 16·7 kreuzer (Austrian money) per quintal.

Besides this fundamental impost (as it may be termed) on beer, there are also octroi duties in certain towns varying from 1·50 to 2 florins; provincial dues, also from 1 to 2 florins; and communal dues, which vary from 50 kreuzer to 3 florins. In Hungary a regular tax has been fixed, called a "consumption tax," of 5 florins per hectolitre.

All the above-named imposts are levied only on beer circulated for consumption. Beer for exportation is not liable to the above imposts, while dues which have been paid on beer actually exported are repaid, a properly authorised certificate as to the quality of the said beer having been previously obtained.

In 1891 the amount of beer produced in Austria-Hungary was 14,253,000 hectolitres; in 1892, 15,557,000 hectolitres; in 1893, 16,261,000 hectolitres; and in 1894, 16,772,000 hectolitres.

### IMPORTS OF SUGAR INTO NORWAY.

The following is extracted from a German consular report published in the *Handels Museum* :—

As an importer of sugar into Norway, Germany plays a very important part; refined sugar in loaves and cubes, as well as pounded, refined, and brown sugar, coming from that country. German refined sugar in loaves has gradually killed foreign competition, and Stettin and Breslau are the chief sources of supply; the imports of this kind of sugar have lately fallen off, owing to the cessation of the transit trade to Sweden. Since several sugar-factories have been established in Sweden, Norwegian merchants are no longer able to do lucrative business with customers there. Refined sugar cut into cubes also comes mostly from Stettin and Breslau. These German varieties enjoy special favour, as they are cheap and properly cut. Pounded refined sugar is imported from Brunswick and Halle. The importation of refined sugar from Austria-Hungary, which was formerly not inconsiderable, has now almost entirely ceased, as Austrian refiners cannot compete with the cheap German goods. Crushed refined sugar comes in increasing quantities from the Netherlands. Of brown sugar, the bright dry varieties comes from Germany, while as regards the dark, most kinds are imported from Liverpool and Greenock. Molasses, which used to be imported partly from Germany, now principally come from Great Britain and the United States, both these countries producing more cheaply than Germany. English molasses are also preferred, because they are made from cane-sugar.

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* Based on a memorandum of Signor Giacomo Zanoni, of the Italian Embassy at Vienna, published in the *Bollettino di Notizie Commerciali* for October 1895.

In 1889 the value of the total quantity of sugar imported into Norway was 4,795,600 kroner, the imports from Germany being valued at 1,576,400 kroner; in 1890, these figures became 4,937,500 and 1,902,600 respectively; for 1891, 5,070,900 and 1,983,100 respectively; in 1892, 5,580,500 and 2,191,500, and in 1893, 6,208,000 and 2,867,300.

(*Note.* 18 kroner = 1*l.* sterling.)

### Phosphate of Lime Deposits in the Spanish West Indies.

*Board of Trade Journal, December* 1895, 629.

The Secretary of State for Foreign Affairs has received information to the effect that a Spanish Royal Order, dated 8th November last, was published in the *Madrid Gazette* of the 11th instant, ordering the sale by public auction of the right to work the deposits of phosphate of lime (*fosfatos calizos*) in the Island of Caja de Muertos, adjacent to the Island of Puerto Rico. The sale is to take place two months after the date of notification, before the authorities of Puerto Rico.

Only private individuals who are Spanish subjects may compete, but foreign companies constituted in accordance with the requirements of Spanish law are eligible on depositing 1,000 pesos (200*l.*) in the Treasury at Porto Rico. The concession will be for a period of 20 years. Conditions may be seen at the Commercial Department of the Foreign Office between the hours of 11 and 6 daily.

## GENERAL TRADE NOTES.

### The Competition of the Industries of Japan with Imports from Europe.

*Board of Trade Journal, December* 1895, 659.

In a report on the foreign trade of Japan during 1894, published in the *Deutsches Handels-Archiv* for October, the productive capabilities of the different industries of Japan are discussed with special reference to their influence on German export trade.

Japanese products are, on account of the cheaper cost of their production, displacing German goods on the markets of Eastern Asia in the following groups of articles:—Matches, paper, soap, beer, glass goods, and leather goods.

In the case of the manufacture of soap in Japan, some compensation is afforded by the increased imports of caustic soda, palm oil, &c., and German manufacturers are exhorted to do their best to compete with Great Britain in the caustic soda trade.

As the Japanese consumption of beer increases, more breweries on the German system are established, and the fixtures for these have to be imported from Germany; the initial outlay on a brewery of fair size is not less than 500,000 yen. At present there are only three or four breweries on the German system in Japan, and German brewers are employed at these; it is very doubtful whether the Japanese would be able without their assistance to brew a beer which would for any length of time meet the requirements of consumers.

In consequence of these so-called German breweries in Japan, the imports of German and English beer have fallen off considerably, and will doubtless continue to diminish. But it is noteworthy that hops are being imported into Japan from abroad, and from Germany in particular, so that some compensation is beginning to be offered for the decreased imports of bottled beer from that country.

In the case of glassware, Japanese industry competes only in the commoner sorts, although many kinds of fine glassware are produced in Osaka and Tokio; the cheapness of production prevents the importation of the foreign article. But glass goods will never attain in Japan the importance they have in Europe, as the great mass of the people use porcelain and paper in many ways instead of glass.

The Japanese leather industry is in a flourishing condition, and the importation of foreign leather goods decreases every year. The cost of production is small, as labour is cheap, and the hides and skins are imported from neighbouring countries, China and Korea. The fact that the Japanese prefer cheap goods to dearer and more durable ones is the chief obstacle to foreign imports. It is surprising to notice in the bazaars and shops of Japan the pretty-looking leather goods of all kinds which are made to imitate every possible European pattern, but on investigation defects are soon discovered, owing to the use of badly tanned or worked leather.

On the other hand, it is especially noteworthy that as a result of the flourishing condition of Japanese industries, imports of raw metals, iron and steel plates, parts of machinery from Great Britain and Germany have increased. For example, it must not be forgotten that though the Japanese now build vessels of considerable size, the iron and steel plates, parts of boilers, and even the boilers themselves, as well as the machines, or parts of them, are imported from abroad.

The report concludes by observing that—although the products of Japanese industries exercise considerable influence on the consumption in Japan of German goods, the total volume of Japanese imports from Germany has not suffered, as the imports of raw materials and partly-manufactured goods show a steady increase.

### Sugar and other Products of Tahiti.

*Board of Trade Journal, December* 1895, 648.

A product of Tahiti which has shown remarkable development is that of cane sugar. In the month of June 1893 an old plantation quite near Papetoai, which had been abandoned, was turned over, and this estate was so well cultivated that it produced the first year 67 tons of a fine yellow sugar and 10,000 gallons of molasses. This is a great improvement on previous results and may be considered as good as the best sugar-producing countries can show. It is expected that this estate will have produced 100 tons during 1895; other estates 40 to 50 tons; so that the production will be almost equal to the consumption. Importation of sugar must shortly cease, partly for the above reason, *i.e.*, the increased production, and partly also on account of the protective duty of 25 centimes per kilogramme levied on all articles which are not of French origin. It seems only right that Tahiti, the cradle of the sugar cane, should produce enough for its own wants; hitherto the 100 tons of sugar it requires have been imported from Hawaii, the Fiji Islands, and Queensland.

The most important articles of commerce in 1894 were:—

*Imports.* — Salted provisions (8,300*l.*), wheat flour (8,200*l.*), printed cotton goods (5,500*l.*), besides tissues of various sorts, raw sugar, and wood.

*Exports.*—Copra (46,900*l.*), cotton seed (40,600*l.*), cotton (8,600*l.*), and vanilla (3,900*l.*).

### Imports of Cement into Switzerland.

The following table, says the *Handels-Museum* of November 7, shows how the imports of cement into Switzerland have developed in the last few years, the unit being a truck-load of 10,000 kilogs.:—

| — | 1888. | 1890. | 1892. | 1894. |
|---|---|---|---|---|
| Hydraulic lime.. | 1,292 | 1,622 | 1,672 | 2,452 |
| Roman cement.. | 1,401 | 1,830 | 1,961 | 2,124 |
| Portland cement | 1,035 | 1,620 | 1,682 | 1,944 |
| Total ..... | 3,728 | 5,072 | 5,315 | 6,520 |

In 1852, 11 truck-loads of hydraulic cement were imported; in 1860, 886; in 1870, 992; and in 1880, 4,564. This increase is at the expense of the use of white lime, which is now replaced by hydraulic cement. In spite of the considerable increase in the Swiss consumption of hydraulic cements, prices have continually decreased. In the case of Portland cement, this is to be attributed to the competition of German manufacturers, who place a portion of the large quantities they produce on the Swiss market at the lowest prices. In the case of hydraulic lime, the fall in prices is to be ascribed to the competition of native producers. Roman cement continues to come from France.

At a meeting of the Association of Swiss Manufacturers of Cement, Lime, and Gypsum, interesting information was given as to working and production. According to this, 42 of the largest manufacturers produced last year 11,835 truck-loads of Portland cement, 1,426 of Roman cement, 12,275 of hydraulic lime, and 700 of slag cement.

In these factories, water furnished 3,631 horse-power, and coal 562. 218 furnaces were in operation.

### REPORTS ON GERMAN CHEMICAL INDUSTRIES IN 1894.

*Ber. über Handel u. Industrie, Berlin*, 1894, 105—256.

*Spirits.*—The spirit trade was very unfavourable for all concerned. The potato crop in 1893 was exceptionally large, and the percentage of starch high; the production of spirit was consequently the largest since the new spirit tax law. Compared with the previous 12 months, there was an increase in production of 18 million litres during the year ending September 30th, 1894. The following statistics are from official sources:—

*Year ending September 30th, 1894.*

| Year. | Production. | Consumption. | Exports other than for Drinking Purposes. |
|---|---|---|---|
| | Litres. | Litres. | Litres. |
| 1891 | 292,028,400 | 213,879,500 | 17,600,000 |
| 1892 | 289,941,200 | 216,722,300 | 8,300,000 |
| 1893 | 304,245,200 | 221,579,200 | 9,500,000 |
| 1894 | 322,172,400 | 222,586,400 | 8,500,000 |

*Summary for the Year ending September 30th, 1894.*

| | | Approximate No. of Litres. |
|---|---|---|
| Stocks of spirit in Germany on Sept. 30, 1893 | | 25,000,000 |
| Production from Oct. 1, 1893, to Sept. 30, 1894 | | 322,000,000 |
| Total | | 347,000,000 |
| | Litres. | |
| Home consumption | 222,500,000 | |
| Used for denaturising, loss in storage, &c., and in distilling | 66,000,000 | |
| Exports other than for drinking | 8,500,000 | |
| Export of spirits for drinking | 4,000,000 | |
| | | 301,000,000 |
| Stock on Sept. 30, 1894 | | 46,000,000 |
| " " 1893 | | 25,000,000 |
| " " 1892 | | 26,000,000 |
| " " 1891 | | 29,500,000 |

In rectified spirit notwithstanding the large production with consequent low prices, both exports and home consumption declined. There appears to be very little prospect for the export trade. Considering, however, that in 1892-93 Russia exported 16½ millions and in 1893-94, 32 million litres, and that Austria-Hungary exported in 1891-92 about 33¼ million litres, later than which the amount is not shown; it seems probable that by increasing the bounty on spirit, the export trade might be greatly improved.

*Glass.*—The gloomy forecasts for 1894 were fully realised during the year. Excessive production kept prices low, and Belgian competition hampered the export trade. In mirror glass, a syndicate was formed by the six leading manufacturers, made the trade a practical monopoly, since imports were impossible owing to prohibitive duties and freights. Coloured glass declined at home, and Belgian competition prevented exports. Considerable reductions in the freights to German ports would be required to make an export trade possible.

Plate glass stocks accumulated, and 10 per cent. of the ovens were cooled down to clear out the surplus production. Prices were low. Prices of raw materials, especially chemicals, fell gradually, glauber salt falling even more than soda.

Little is expected from the new treaty with Russia, as Belgian competition is all powerful there; but trade prospects with the United States are better since the tariff alterations

—H. M.

### THE INDO-EUROPEAN TRADE IN PHARMACEUTICAL PREPARATIONS AND DRUGS.

*Chem. Ind.* **18**, 400--406.

The total value of the imports of drugs, medicines, and narcotics amounted in the year 1892-93 to 1,944,899 rupees, England's share of which was 1,664,504 rupees; Germany, 98,863; Spain, 86,200; France, 29,482; Austria, 23,444; Belgium, 21,014; and Italy, 15,542 rupees. The increase in the Spanish trade, almost double that of the previous year, is due to the increasing demand for Radix Pyrethri, a drug largely prescribed of late years by native physicians as a stimulant.

*Quinine.*—The Indian Government has commenced to supply to officials, a febrifuge manufactured from sikkim bark. Pure sulphate of quinine has also lately been prepared, and sold at the rate of 16 rupees per lb., and it is probable that as the production increases the medicine will be placed at the disposal of other sections of the community. At present Howard's quinine practically holds the monopoly. In 1893-94 the imports were 31,497 lb., valued at 343,775 rupees. Of the 32,158 lb. received in the preceding year, England contributed 30,267 lb., and Germany, 927 lb. Calcutta took about nine-tenths of it, Bombay about one-eighth, and a small quantity was re-exported.

*Ethereal Oils.*—This trade is steadily increasing, having risen from 4,413 galls. (71,532 rupees) in 1890-91 to 7,019 galls. (105,792 rupees) in 1892-93. England being the largest contributor with 865 galls. Germany supplied only 47, although the greater part of the English oil is said to be distilled in Leipzig. The chief oils dealt in in the Indian bazaars are: carraway, anised, fennel, citron, dill, peppermint, cinnamon, mace, and clove. Calcutta is the largest buyer, then Madras, and lastly Bombay.

*Cochineal.*—England supplied in 1892-93, 2,096 cwt. = 231,021 rupees. This was formerly an Indian industry, but was killed by the aniline dyes.

*Resin.*—England supplied 31,362 cwt. (132,400 rupees) of resin, only 174 cwt. being obtained from Germany. The Himalayan pine forests will in time be made available as a source of supply.

*Fatty Oils.*—The chief business is done with London, linseed and olive oils forming the staple trade. In 1892-93 out of 223,998 galls. (370,960 rupees), 222,766 galls. of linseed oil came from London, and 5,600 galls. of other oils (mainly olive) out of a total of 6,031 galls. (11,618 rupees). The almond oil sold in the bazaars is merely a mixture of sesame oil and essence of mirbane.

*Indigo.*—An area devoted to the cultivation of indigofera is estimated to be about a million acres, half of which is in Bengal; and there are about 2,760 large and 6,030 smaller factories for the preparation of indigo. Notwithstanding the competition of the alizarine dyes the export of indigo continues to steadily increase, having risen from 125,327 cwt. (32,140,174 rupees) in 1891-92 to 131,399 cwt. (41,821,281 rupees) in 1893-94. Of the latter quantity England took 52,578 cwt.; Egypt, 13,223; Germany, 12,572; America, 12,131; France, 11,951; and Austria, 11,038 cwt. Calcutta exported 76,398 cwt. and Madras 42,751 cwt.

*Curcuma*, the rhizome of the curcumalily, is exported to Europe as a dye; but as the colour is fugitive the exports fell from 123,824 cwt. in 1876-77 to 28,250 cwt. in 1990-91, since which time a revival has set in (last year's figures being 68,559 cwt. = 760,181 rupees), probably owing to the employment of this substance in the adulteration of mustard and as an aromatic. The chief centres of production are Bengal, Madras, Bombay, and the Punjab, and the area under cultivation was estimated in 1890 at 56,500 acres.

*Safflower* is another dyestuff driven out by the aniline colours, the exports having declined from 19,425 cwt.

(650,827 rupees) in 1874–75 to 990 cwt. (17,140 rupees) in 1892–93. Last year, however, an increase to 2,353 cwt. was recorded.

*Myrobolams*, the dried fruit of several of the *Combretaceæ* and *Euphorbiaceæ*, form an increasing article of export, the amount having risen from an average of 416,189 cwt. per annum in 1875–80 to 830,696 cwt. (4,151,612 rupees), in 1893–94, more than two thirds being sent to England. By far the greater part (nearly 508,000 cwt.) is produced in Bombay, Madras only shipping some 93,400 cwt., and Calcutta still less (66,214 cwt ).

*Pegu Catechu* (Cutch).—This dyeing and tanning agent is prepared from the wood of *Acacia Catechu* and should not be confounded with the Cambir catechu from the Malay archipelago which is extracted from *Uncaria Gambir*, though their chemical composition is very similar. Burma, Bengal, and the North-West Provinces, are the chief centres of the industry, but in the former country reckless felling of the timber had affected the supply and has led to the Forest Department prohibiting the felling of young trees. In 1892–93, 229,316 cwts., valued at 3,824,840 rupees, were exported, England taking about 98,000 cwts., and the United States some 92,400 cwts.

*Caoutchouc* from *Ficus Elastica*, a tree growing native in Assam, Bengal, and Burma, and also cultivated over a large area. The time of collecting the sap is now restricted to the hot season from December to April. Attempts are being made to acclimatise the American and African rubber trees. The trade last year amounted to 9,616 cwts., valued at 1,259,179 rupees, 7,712 cwts. being consigned to England, and 1,989 to the United States.

*Lac.* — Indian lac is not a vegetable product but a secretion of the lac insect (cocculacca) deriving nourishment from the branches of various trees into which it bores. Shellac forms the chief article of export, 7,272,138 rupees worth having been shipped in 1893–94. In the same year, 2,249,351 rupees worth of button lac, 80,785 of mixed kinds, and 1,031 of sticklac were also imported. England took shellac to the extent of over 4,000,000 rupees, and North America of over 2,000,000.

*Indian Gum Arabic* is an inferior gum from Acacia Arabica, and is only incompletely soluble in water, with a dark colour, and is used for adulteration.—C. S.

## *BOARD OF TRADE RETURNS.*

### SUMMARY OF IMPORTS.

| Articles. | Month ending 30th November. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals | 1,481,266 | 1,488,235 |
| Chemicals and dyestuffs | 421,196 | 461,828 |
| Oils | 642,351 | 816,346 |
| Raw materials for non-textile industries. | 3,683,795 | 4,103,954 |
| Total value of all imports | 35,234,149 | 38,971,161 |

### SUMMARY OF EXPORTS.

| Articles. | Month ending 30th November. | |
|---|---|---|
| | 1894. | 1895. |
| | £ | £ |
| Metals (other than machinery) | 2,128,450 | 2,658,478 |
| Chemicals and medicines | 708,077 | 737,786 |
| Miscellaneous articles | 2,444,388 | 2,740,465 |
| Total value of all exports | 18,083,087 | 19,540,333 |

### IMPORTS OF METALS FOR MONTH ENDING 30TH NOVEMBER.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| Copper :— | | | | £ | £ |
| Ore | Tons | 6,761 | 7,395 | 85,024 | 27,967 |
| Regulus | „ | 5,915 | 6,331 | 112,584 | 167,351 |
| Unwrought | „ | 5,029 | 3,079 | 203,353 | 138,585 |
| Iron :— | | | | | |
| Ore | „ | 303,128 | 289,229 | 195,375 | 189,656 |
| Bolt, bar, &c. | „ | 7,378 | 10,027 | 59,615 | 77,421 |
| Steel, unwrought | „ | 1,518 | 1,319 | 10,975 | 9,954 |
| Lead, pig and sheet | „ | 11,553 | 14,036 | 113,293 | 149,133 |
| Pyrites | „ | 39,298 | 50,734 | 67,513 | 80,842 |
| Quicksilver | Lb. | 82,392 | 21,524 | 7,050 | 1,948 |
| Silver ore | Value £ | .. | .. | 178,642 | 90,828 |
| Tin | Cwt. | 82,510 | 86,247 | 281,672 | 282,283 |
| Zinc | Tons | 4,369 | 5,164 | 66,182 | 78,995 |
| Other articles | Value £ | .. | .. | 149,988 | 193,272 |
| Total value of metals | | .. | .. | 1,481,266 | 1,488,235 |

### IMPORTS OF OILS FOR MONTH ENDING 30TH NOVEMBER.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Cocoa-nut | Cwt. | 22,292 | 36,875 | 29,489 | 40,823 |
| Olive | Tuns | 998 | 1,586 | 33.574 | 57,357 |
| Palm | Cwt. | 88,385 | 94,200 | 93,146 | 96,287 |
| Petroleum | Gall. | 16,839.555 | 21,721,489 | 244.573 | 403,088 |
| Seed | Tons | 2,711 | 3,165 | 59,004 | 59,930 |
| Train, &c. | Tuns | 1,472 | 2,388 | 26,013 | 39,174 |
| Turpentine | Cwt. | 68,591 | 33,018 | 67,311 | 33,471 |
| Other articles | Value £ | .. | .. | 89,241 | 86,216 |
| Total value of oils | | .. | .. | 642,357 | 816,346 |

### IMPORTS OF RAW MATERIALS FOR NON-TEXTILE INDUSTRIES FOR MONTH ENDING 30TH NOVEMBER.

| Articles. | | Quantities. | | Values. | |
|---|---|---|---|---|---|
| | | 1894. | 1895. | 1894. | 1895. |
| | | | | £ | £ |
| Bark, Peruvian | Cwt. | 3,285 | 1,222 | 7,538 | 1,647 |
| Bristles | Lb. | 407,765 | 287.994 | 52,360 | 39,304 |
| Caoutchouc | Cwt. | 24,195 | 29,496 | 254,360 | 324,588 |
| Gum :— | | | | | |
| Arabic | „ | 5,486 | 9,314 | 14,922 | 17.618 |
| Lac, &c. | „ | 12,444 | 9,295 | 65,026 | 52,757 |
| Gutta-percha | „ | 2,175 | 3,743 | 16,919 | 26,925 |
| Hides, raw :— | | | | | |
| Dry | „ | 22,964 | 40,014 | 52,188 | 100,541 |
| Wet | „ | 58,116 | 49,104 | 123,066 | 108,006 |
| Ivory | „ | 1,053 | 520 | 45,861 | 23,491 |
| Manure :— | | | | | |
| Guano | Tons | 3,370 | 2,112 | 17,214 | 11,775 |
| Bones | „ | 9,785 | 9,263 | 41,298 | 40,805 |
| Nitrate of soda | „ | 8,813 | 11,983 | 79,628 | 95,901 |
| Phosphate of lime | „ | 34,299 | 26,376 | 72,242 | 45,064 |
| Paraffin | Cwt. | 69.140 | 89.993 | 70,033 | 84,422 |
| Linen rags | Tons | 1,803 | 2,656 | 17,484 | 20,993 |
| Esparto | „ | 10,239 | 13,542 | 46,436 | 61,198 |
| Pulp of wood | „ | 27,592 | 32,198 | 159,274 | 162,487 |
| Rosin | Cwt. | 61,469 | 60,165 | 11,616 | 13,354 |
| Tallow and stearin | „ | 115,307 | 249,467 | 141,449 | 290,665 |
| Tar | Barrels | 5,609 | 3,867 | 5,004 | 3,292 |
| Wood :— | | | | | |
| Hewn | Loads | 174,220 | 163,562 | 350,087 | 317,533 |
| Sawn | „ | 479,439 | 529,320 | 1,000,259 | 1,099,346 |
| Staves | „ | 10,713 | 14,873 | 48,082 | 63,631 |
| Mahogany | Tons | 4,450 | 2,439 | 34,312 | 20,149 |
| Other articles | Value £ | .. | .. | 957,137 | 1,069,402 |
| Total value | | .. | .. | 3,683,795 | 4,103,954 |

Besides the above, drugs to the value of 72,960*l.* were imported, as against 65,767*l.* in November 1894.

### Imports of Chemicals and Dyestuffs for Month ending 30th November.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali............. Cwt. | 19,698 | 17,767 | 11,444 | 11.979 |
| Bark (tanners', &c.) „ | 24.739 | 31.760 | 9,043 | 12,312 |
| Brimstone........ „ | 19.336 | 48,078 | 4,332 | 10,176 |
| Chemicals...... Value £ | .. | .. | 125,692 | 101,436 |
| Cochineal......... Cwt. | 385 | 853 | 2,324 | 5,741 |
| Cutch and gambier Tons | 2,242 | 1,645 | 45,142 | 31,621 |
| Dyes:— | | | | |
| Alizarin........ Value £ | .. | .. | 24,435 | 32.411 |
| Anilin and other „ | .. | .. | 35,648 | 42,880 |
| Indigo............ Cwt. | 784 | 2,048 | 11,936 | 28,910 |
| Nitrate of potash. „ | 23,827 | 22.635 | 22,291 | 20.416 |
| Valonia........... Tons | 2,250 | 2,825 | 27.262 | 31,234 |
| Other articles... Value £ | .. | .. | 101,647 | 132,712 |
| Total value of chemicals | .. | .. | 421,196 | 461,828 |

### Exports of Metals (other than Machinery) for Month ending 30th November.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Brass............ Cwt. | 8,349 | 9,105 | 32,055 | 38,997 |
| Copper:— | | | | |
| Unwrought..... „ | 31,157 | 54.723 | 67,240 | 133,569 |
| Wrought....... „ | 24.343 | 26,408 | 65,274 | 74,404 |
| Mixed metal.... „ | 27,518 | 29,991 | 59,395 | 65,760 |
| Hardware..... Value £ | .. | .. | 172.593 | 174.666 |
| Implements...... „ | .. | .. | 101,987 | 119,035 |
| Iron and steel..... Tons | 235,042 | 253,234 | 1,681,259 | 1,783,440 |
| Lead............. „ | 3,251 | 2,923 | 38,580 | 37,290 |
| Plated wares... Value £ | .. | .. | 44,673 | 44 693 |
| Telegraph wires .. | .. | .. | 49,438 | 70,459 |
| Tin............... Cwt. | 11.419 | 10,774 | 40,859 | 37,010 |
| Zinc.............. „ | 18,263 | 21,071 | 11,887 | 14,423 |
| Other articles .. Value £ | .. | .. | 63,210 | 64,732 |
| Total value......... | .. | .. | 2,428,150 | 2,658,478 |

### Exports of Miscellaneous Articles for Month ending 30th November.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Gunpowder...... Lb. | 643,000 | 512,700 | 18,636 | 13,318 |
| Military stores.. Value £ | .. | .. | 100,057 | 143,718 |
| Candles.......... Lb. | 2,057,100 | 2,057,900 | 34,225 | 33,139 |
| Caoutchouc..... Value £ | .. | .. | 106,451 | 113,851 |
| Cement.......... Tons | 26,283 | 31,469 | 42,803 | 51,562 |
| Products of coal Value £ | .. | .. | 117,910 | 143,656 |
| Earthenware ... „ | .. | .. | 161,344 | 176,182 |
| Stoneware...... „ | .. | .. | 13,429 | 11,125 |
| Glass:— | | | | |
| Plate........... Sq. Ft. | 121,640 | 80,974 | 6,729 | 5,540 |
| Flint........... Cwt. | 6,945 | 8,935 | 18,903 | 21,561 |
| Bottles......... „ | 53,904 | 67,719 | 24,492 | 31,589 |
| Other kinds.... „ | 18,804 | 17,480 | 14,476 | 13,681 |
| Leather:— | | | | |
| Unwrought .... „ | 11,351 | 12,625 | 102.112 | 127,250 |
| Wrought..... Value £ | .. | .. | 24,995 | 30,680 |
| Seed oil.......... Tons | 4,415 | 3,982 | 91,770 | 80,215 |
| Floorcloth ..... Sq. Yds. | 1,669,900 | 1,605,700 | 59,193 | 65,682 |
| Painters' materials Val. £ | .. | .. | 116,661 | 132,597 |
| Paper ........... Cwt. | 75,640 | 75,209 | 124,340 | 122,479 |
| Rags............. Tons | 4,642 | 3,954 | 26,706 | 21,000 |
| Soap............. Cwt. | 48,841 | 75,392 | 54,834 | 80,043 |
| Total value.......... | .. | .. | 2,444,388 | 2,740,465 |

### Exprots of Drugs and Chemicals for Month ending 30th November.

| Articles. | Quantities. | | Values. | |
|---|---|---|---|---|
| | 1894. | 1895. | 1894. | 1895. |
| | | | £ | £ |
| Alkali........... Cwt. | 721,026 | 644,136 | 171,928 | 155,607 |
| Bleaching materials „ | 130,459 | 138,183 | 49,654 | 47,195 |
| Chemical manures. Tons | 16,547 | 19,723 | 144,522 | 125,247 |
| Medicines....... Value £ | .. | .. | 86,270 | 99,832 |
| Other articles... „ | .. | .. | 258,703 | 309,905 |
| Total value.......... | .. | .. | 708,077 | 737,786 |

# Monthly Patent List.

* The dates given are the dates of the Official Journals in which acceptances of the Complete Specifications are advertised. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the said dates.

## I.—GENERAL PLANT, APPARATUS, and MACHINERY.

### Applications.

22,582. E. B. Caird and T. J. Rayner. Improvements in air-cooled condensers. November 26.

22,587. A. R. Scarlett. *See* Class XVII.

22,713. J. Y. Johnson.—From The Verein Chemischer Fabrik. Improvements in apparatus for drying superphosphates and the like. November 27.

22,900. W. P. Abell. Improvements in centrifugal machines for drying sugar and other granular substances. November 29.

22,920. W. E. Heys.—From J. Hundhausen. Improvements in the method of and apparatus for separating insoluble substances from liquids. November 30.

22,924. W. E. Heys.—From J. Hundhausen. Improvements in the method of and apparatus for drying sensitive substances. November 30.

23,224. J. Bowing. Improvements in the manufacture of retorts and ovens. December 4.

23,294. W. H. Northcott. Improved appliances for separating liquids from gases. December 5.

23,315. E. Bürgin. Recipient for gases and liquids under high pressure. Filed December 5. Date applied for June 6, 1895, being date of application in Switzerland.

23,332. W. J. Davy. An improved rheostat. December 5.

23,385. G. Platt. Improvements in metallurgical furnaces. December 6.

23,575. W. Daintith. Improvements in apparatus for grinding or reducing bark, bones, ash, saltcake, metal ore, or other materials. December 9.

23,585. A. H. Wright. Improvements in bagasse filters. Complete Specification. December 9.

23,664. F. Ljungström. Improvements in evaporating or heating apparatus. December 10.

23,989. W. R. Herring and M. Graham. Improvements in apparatus for charging inclined retorts. Complete Specification. December 14.

24,007. J. Y. Johnson.—From E. Bailly. Improvements in machines for crushing or reducing lime, cement, minerals, and the like. December 14.

### COMPLETE SPECIFICATIONS ACCEPTED.*

1895.

104. J. A. Yeadon and W. Adgie. Revolving retorts or furnaces. December 11.

695. J. Pinfold. Filtering apparatus. November 27.

827. N. Yagn and S. Bessonoff. Distilling apparatus. November 27.

1807. E. Gearing. Furnaces for producing carbide of calcium and the like. November 27.

2437. D. B. Morison. Apparatus for generating gas, such as acetylene. December 11.

4129. C. Zimmermann. Apparatus for drying superphosphates and other granular materials. December 11.

11,088. H. H. Lake.—From P. I. Buaas. Apparatus for sterilising milk and other liquids. December 18.

13,317. A. Goodwin and T. Clay. Apparatus for raising and forcing liquid and semi-liquid substances. December 4.

14,434. T. Atkins and T. A. Harris. Apparatus for filtering waste oils or other fluids. December 11.

15,197. T. Scott. Evaporators for obtaining common salt and for analogous purposes. December 18.

16,297. A. M. Hewlett. Furnaces. December 18.

17,746. H. Gabe. Apparatus for decomposing calcium carbide. November 27.

18,857. C. Tissier and H. J. Ernaux. Filtering apparatus for purifying and sterilising liquids, fluids, gases, and vapours. November 27.

19,626. H. Windoff and H. Schneider. Apparatus for vaporising spirit and the like for lighting or heating purposes. December 11.

20,817. R. J. A. Hankow. Refrigerators or cooling chambers. December 11.

## II.—FUEL, GAS, AND LIGHT.

### APPLICATIONS

11,848*b*. H. H. Lake. From E. N. Dickerson. An improved method of and apparatus for supplying combustible gas for illuminating purposes. Complete Specification. Filed November 21, date claimed June 18, 1895.

21,883. E. Andreoli. Improvements in the production of ozone. Complete Specification. November 18.

21,890. C. Weygang. Improvements in the manufacture of artificial fuel. November 18.

21,927. N. Báron. An improved method of increasing the lighting power of petroleum. Complete Specification. November 18.

21,931. M. B. Engel. An improved gasifyer for liquid hydrocarbons. November 18.

22,012. J. S. Taylor and C. Davies. A new or improved article of manufacture applicable for use as fuel, firelighters, or the like. November 19.

22,055. J. Purves and H. L. W. Hyde. A new process for making gas, and apparatus therefor. November 20.

22,515. G. W. Gwyer, jun. Improved means for thoroughly mixing the gases for limelight production, and in apparatus therefor. November 25.

22,915. R. F. Strong. Improvements in coal briquettes and in the manufacturing thereof. November 30.

23,022. H. L. Toms and A. C. Jackson. Improvements in and relating to incandescent burners. December 2.

23,051. O. Heimann. A new process for making porous coke. December 2.

23,057. G. Seeligmann. Improvements in lighting material and apparatus. Complete Specification. December 2.

23,076. E. Jumeau. A new process for collecting particles and dust of waste coal, anthracite, and lignite, and forming the same into combustible bricks or cakes. Complete Specification. December 2.

23,170. F. Thuman. Improvements in gas generators. December 3.

23,235. S. Pitt. From La Société Internationale du Procédés A. Seigle. Improvements in apparatus for treating heavy hydrocarbons by means of heat, especially applicable for distillation and the manufacture of oil-gas. Complete Specification. December 4.

23,330. E. Smith. Improvements in or relating to candles. December 5.

23,436. J. Y. Johnson. From The Badische Anilin and Soda Fabrik. Improvements in and apparatus for refining crude petroleum and analogous oils by means of fuming sulphuric acid. December 6.

23,521. G. Trouvé. Improved apparatus for producing, storing, and utilising acetylene gas. December 7.

23,522. J. Lyon-Field. Improvements in and apparatus for the manufacture of candles. December 7.

23,639. T. Birnbaum. Improvements in means or apparatus for burning illuminating gas. December 10.

23,955. J. W. Lee. An improved gas carburetter. December 13.

24,008. P. Barrière. Improvements in the preparation and production of bodies for use in what is known as incandescent gas lighting. December 14.

24,015. C. Wurster. Improvements in the combustion of carbohydrates of high boiling point in incandescence burners and apparatus therefor. Complete Specification. December 14.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

16,342. G. B. Ellis.—From T. L. Willson. Improvements in the production of metallic carbides and in illuminating gas. December 4.

1895.

940. B. H. Thwaite. Improved process for generating oil-enriched and luminous water-gas, and in apparatus therefor. December 18.

2017. C. W. Pinkney. Apparatus for furnaces for producing gas from carbonaceous matter. December 4.

2437. D. B. Morison. *See* Class 1.

2732. O. Kroll. Manufacture of refractory bodies for use in gas and other burners. December 4.

17,795. W. L. Voelker. Incandescent gas lamps. November 27.

21,549. W. Smoth, jun. Preparing peat and peat briquettes for fire-lighting, heating, and analogous purposes. December 18.

## III.—DESTRUCTIVE DISTILLATION, TAR PRODUCTS, ETC.

### COMPLETE SPECIFICATION ACCEPTED.

1895.

2188. R. V. Horsfall. Improvement in plant for distilling, cracking, or gasifying oils, tars, or any liquid hydrocarbons. December 18.

## IV.—COLOURING MATTERS AND DYES.

### APPLICATIONS.

21,919. H. H. Lake. — From Farbwerk Muhlheim. Improvements in the manufacture of sulpho acids of the naphthalene series and of colouring matters derived therefrom. Novmber 18.

22,114. O. Imray.—From P. Remy. Manufacture of azo, diazo, and polyazo colouring matters with phenylen and toluylen oxamic acid. November 20.

22,417. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of dyestuffs for cotton. November 23.

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* *See* Note (*) on previous page.

22,481. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of a compound of salicylic acid and hexamethylenetetramine. November 25.

22,482. O. Imray.—From The Society of Chemical Industry in Basle. Manufacture of orange colouring matters by electro-chemical process. November 25.

23,054. C. D. Abel.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of derivatives of the triphenylmethane series. December 2.

23,132. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of azo dyestuffs. December 3.

23,312. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Manufacture of sulphuretted colouring matters dyeing nonmordanted fibres. December 5.

23,523. I. Levinstein and Levinstein, Lim. The manufacture or production of new azo colouring matters. December 9.

23,531. A. Ashworth. Improvements in the production of colouring matters. December 9.

23,853. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of basic blue dyestuffs. December 12.

### Complete Specifications Accepted.

1895.

1392. O. Imray.—From The Farbwerke vormals Meister, Lucius, and Brüning. Manufacture of alpha-amido-alizarine sulphonic acid. November 27.

1414. H. H. Lake.—From Wirth and Co., Agents for A. Leonhardt and Co. Improvements in the manufacture of colouring matters. November 27.

1963. G. W. Johnson.—From Kalle and Co. Manufacture and production of para-amido-benzyl-alcohol and homologues, and analogues thereof and derivatives therefrom. December 4.

2401. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. Manufacture or production of colouring matters. November 27.

2504. Read, Holliday, and Sons, and R. Holliday. Production of new blue colouring matters for dyeing and printing. December 11.

2900. H. E. Newton.—From The Farbenfabriken vormals F. Bayer and Co. The manufacture or production of colouring matters. December 11.

3414. J. Imray.—From La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis. Manufacture of the colouring matters termed thio-catechines. December 4.

3415. J. Imray.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of azo dyes. December 4.

3416. J. Imray.—From The Actien Gesellschaft für Anilin Fabrikation. Manufacture of azo dyes. December 4.

3612. La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis and R. Vidal. Manufacture of compounds designed for dyeing and printing. November 27.

## V.—TEXTILES, COTTON, WOOL, SILK, Etc.

### Applications.

21,857. J. Ingleby and E. Ostlere. Improvement in or in connection with the manufacture of linoleum, cork carpets, and similar fabrics, and apparatus or machinery therefor. November 18.

22,183. G. E. Wright and W. Monk. A method of and apparatus for cleansing and recovering grease and oil from cotton and other waste and wool. November 21.

22,184. G. E. Wright and W. Monk. An improved method of and apparatus for degreasing, scouring, washing, and drying wool and other fibrous materials. November 21.

22,817. C. Wetherwax. Improved method of and apparatus for removing gummy and other matters from vegetable fibres. Complete Specification. November 28.

23,882. W. G. Heys.—From G. Mulard. Improvements in scouring and degreasing wool. December 13.

23,942. W. P. Thompson.—From E. Claviez. An improved process for the manufacture of yarn or thread from paper, and apparatus therefor. December 13.

### Complete Specification Accepted.

1895.

20,433. H. E. Newton.—From J. H. Wingfield. Removal of suint from wool, recovering or separating certain constituents from the suint, and obtaining certain valuable products therefrom. December 4.

## VI.—DYEING, CALICO PRINTING, PAPER STAINING, and BLEACHING.

### Applications.

22,185. M. H. Smallwood. Improvements in apparatus for bleaching, washing, dyeing, and drying yarn in the cop. November 21.

23,466. G. White. An improvement in dyeing spot, random, or any other parti-coloured dyed yarns. December 7.

23,592. S. Pitt.—From L. Cassella and Co. Process for rendering wool dyeings fast to "potting" or spungeing. Complete Specification. December 9.

### Complete Specifications Accepted.

1895.

584. H. R. Lewis amd C. Gelstharp. *See* Class X.

2676. T. Pickles. Improvements in the printing of cotton or linen warps or warp yarns, in connection with sizing or other treatment thereof for weaving purposes. December 11.

2764. T. Pickles. Improvements in the dyeing of cotton or linen warps or warp yarns, in connection with sizing or like treatment thereof for weaving purposes. December 11.

3123. L. Cresswell. Dyeing or colouring asbestos cloth or fabric. December 11.

14,704. E. Cabiati. A process for saving dyestuff in dyeing with indigo blue. December 11.

## VII.—ACIDS, ALKALIS, and SALTS.

### Applications.

21,997. T. L. Willson. Improvements in the production of metallic cyanides and other nitrogen compounds. Filed November 19. Date applied for, April 19, 1895, being date of application in United States.

22,037. D. A. Péniakoff. Improvements in the manufacture or production of alkaline silicates or silicates of the alkaline earths, and of chlorine or hydrochloric acid. November 19.

22,038. D. A. Péniakoff. Improvements in the manufacture or production of alkaline aluminates of the alkaline earths, and of sulphurous acid. November 19.

22,039. D. A. Péniakoff. Improvements in the manufacture or production of aluminates and of sulphurous acid, and of chlorine or hydrochloric acid as bye-products. November 19.

22,715. R. England. Improvements in or connected with the concentration of sulphuric acid. November 27.

22,765. F. G. Powell, A. Powell, M. E. W. Powell, and R. H. R. Powell. Improvements in the manufacture of vinegar. November 28.

22,771. F. Bale. Improvements in decomposing and volatilising ammonium chloride, and obtaining therefrom ammonia, hydrochloric acid, and chlorine, and in the apparatus used. November 28.

22,880. B. Kosmann. An improved process of extracting culinary salt from brine. November 29.

23,550. H. R. Angel. Improvements in the manufacture of caustic soda. December 9.

23,572. W. P. Thompson. From The Chemische-Werke vormals H. and E. Albert. Improvements in and connected with the manufacture of alkaline phosphates and caustic alkali. December 9.

23,580. C. Keliner. Improvements in the manufacture or production of metallic cyanides, particularly cyanide of potassium and of sodium. December 9.

23,591. C. Kellner. Improvements in the manufacture or production of alkaline chlorates. December 9.

23,819. R. Main and W. Donald. Improvements in treating nitrates for the production of nitric acid, and the recovery of bye-products. December 12.

23,902. F. W. Maxwell and G. Millard. Improvements in the construction and arrangement of apparatus for the manufacture of bisulphide of carbon. December 13.

### Complete Specifications Accepted.

### 1894.

16,342. G. B. Ellis.—From T. L. Willson. *See* Class II.

16,705. T. L. Willson. Improved metallic carbides, applicable for use in the production of acetylene, and means for producing the same. December 4.

2625. T. Twynam and F. E. Matthews. Recovering ammonia from sewage effluent and other weak ammoniacal liquors. December 11.

3485. O. Imray.—From The Chem. Fab. Rhenania. Production of caustic lyes of the alkalis. December 18.

19,192. F. Valentiner. Obtaining pure concentrated nitric acid from dilute or impure solutions. November 27.

## VIII.—GLASS, POTTERY, AND ENAMELS.

### Applications.

21,874. The Sanitary Pottery Company. Sanitary pottery. November 18.

21,939. J. Morton. An improved continuous kiln for burning bricks, sanitary pipes, and the like. November 19.

22,021. J. W. Martin. Improvement in glass and similar tiles, and in the method of fixing same. November 19.

22,054. J. Gordon. Improvements in and relating to the glazing of bricks, tile, and other surfaces. November 20.

22,380. W. Birrell. A new or improved process for etching and decorating glass. November 23.

23,936. F. L. Hancock. Improved manufacture of glass, in sheet or other form, for constructive, decorative, and other useful purposes. December 13.

### Complete Specifications Accepted.

### 1895.

13,520. F. S. Tomey. Manufacture of thermometer tubing. November 27.

17,931. G B. Ellis.—From M. Hirsch. Manufacture of glass. November 27.

19,804. J. H. Croskey and J. Locke. Manufacture of wire glass. December 18.

19,844. M. J. Owens and E. D. Libbey. Glass-blowing machines. November 27.

19,845. M. J. Owens and E. D. Libbey. Glass-blowing machines. November.

21,630. C. Bruart and P. Lambot. New material for polishing glass. December 18.

## IX.—BUILDING MATERIALS, CLAYS, MORTARS, AND CEMENTS.

### Applications.

21,870. F. Hinton and J. Day. Improved fireproof floors. November 18.

21,901. G. F. Thomson. Improvements in the manufacture of artificial stone roofing, and other tiles and enamel, and in apparatus therefor. November 18.

21,902. G. F. Thomson. Improvements in the method of treating stone. November 18.

22,201. B. Löhr. Process for producing compound asphalt and concrete slabs or plates, or compound plates or slabs of two similar substances. Complete Specification. November 21.

22,490. A. J. Boult.—From J. Isecke. Improvements in or relating to the manufacture of artificial stone and apparatus therefor. November 25.

22,873. O. Schwarz. Improvements in the formation an connection of plates or blocks for building purposes, and apparatus for manufacturing the same. November 29.

23,018. E. Coulon and J. J. Defalque. Manufacture of artificial stones. December 2.

23,145. E. H. Hurry and H. J. Seaman. New or improved process and apparatus for the manufacture of Portland and other similar cement. Complete Specification. December 3.

23,400. J. V. Boyd-Wilson. Improvements in and relating to the floorings and ceilings of buildings and the like. December 6.

23,405. W. White. Improvements in plastic materials. December 6.

23,773. M. M. Dessau. Improvements in or relating to paving-blocks and slabs. December 11.

23,916. J. P. Deane and W. Herbert. An improved composition for the manufacture of building and other materials. December 13.

23,980. P. Jantzen. An improved method of and apparatus for making artificial stone blocks or plates. Complete Specification. December 14.

23,981. F. Ludewig. A new or improved composition for preventing the formation or accumulation of moisture, nitre, or acids in or upon walls and other like surfaces, said composition being capable of being made into artificial stones or bricks for building purposes. Complete Specification. December 14.

### Complete Specifications Accepted.

### 1895.

1256. R. W. Hitchins. Improved machinery for the production of slabs of plaster, cement, or composition. November 27.

1960. C. Major. Fireproof and ventilating floors. December 4.

17,054. G. Bellamy, F. Rolleston, and S. W. Jewell. Manufacture of bricks or blocks for building and paving. December 18.

20,151. A. G. Wright. Fireproof floors and ceilings. December 4.

## X.—METALLURGY, MINING, Etc.

### Applications.

21,866. L. B. Dixon. Improvements in the decoration of articles by the deposition of metals. November 18.

22,041. F. A. Ellis. Improvements in the soldering or brazing of metals, particularly applicable to aluminium alloys. November 19.

22,043. R. L. Sentinella. Improvements in and relating to the purification of copper, copper-alloys, gold, and other precious metals. November 19.

22,092. C. Mason. Process for the prevention of articles made of suitable metals or alloys rusting after they are electro-plated. November 20.

22,115. G. T. Holloway and C. C. Longridge. Improvements in the extraction of gold from antimony ores and other substances. November 20.

22,137. W. Woolf and J. Andrews. A new or improved metallic alloy, and process for producing the same. November 20.

22,340. H. F. Julian. Improved process for extracting metals from solutions. November 22.

22,351. A. Julien. Improvements in the manufacture of aluminium. November 22.

22,491. W. H. James. Improvements in or relating to the extraction of precious metals from their ores. November 25.

22,606. J. H. Darby. Improvements in the manufacture of steel. November 26.

22,727. J. Gjers. Improvements in the manufacture of cast steel and homogeneous iron. November 27.

22,732. C. A. Burghardt and G. Rigg. Improvements in a process and apparatus for the electrolytic production of metallic zinc from ores of zinc, and metallic zinc and metallic copper from zinc ores containing copper, and the production of oxygen gas in the cases specified. November 28.

22,812. H. S. Maxim. An improved process of extracting gold from refractory auriferous ores. November 28.

22,839. H. Platt. Improvements in apparatus for hardening and tempering steel wire. November 29.

22,866. A. F. B. Gomess. Improvements in the extraction of copper from its ores by electrolysis. November 29.

22,930. J. B. Torres. Improvements in extracting gold, silver, and other metals from ores and other compounds containing them, and in apparatus therefor. November 30.

23,008. W. P. Ingham. Improvements in the treatment or preparation of iron ores, or refuse materials containing iron, for smelting purposes. December 2.

23,032. R. Stone. Improvements in the method of extracting and hardening gold, silver, copper, lead, and other metals from rocks, ores, quartz, or other substances, also in machinery for carrying out same. December 2.

23,045. J. A. Kendall. Improvements in or connected with the manufacture of sodium and potassium. December 2.

23,052. H. R. Lewis and C. Gelstharp. Improvements relating to the extraction of gold and other metals from ores, tailings, slimes, and other compounds containing the same, to apparatus therefor, and to the preparation of solvents for use in such extraction. December 2.

23,152. E. J. Post. Improvements in the process and apparatus for plating articles or covering the same with metal. December 3.

23,342. W. J. Moy. Improvements in metallic sodium fluxes. December 5.

23,385. G. Platt. *See* Class I.

23,414. H. Langen. An improved process of separating metals having different melting-points. Complete Specification. December 6.

23,457. T. M. Ash and H. N. Weldon. An improved process for coating or plating non-metallic articles with metals. December 7.

23,492. W. H. James and C. J. Norris. Improvements in or relating to the extraction of precious metals from their ores. December 7.

23,543. T. Parker and J. Pullman. An improved process for treating sulphide ores containing zinc and other metals. December 9.

23,556. E. A. Ashcroft. Improvements in the treatment of compounds or ores containing zinc. December 9.

23,564. A. Schanschieff. Improvements in alloys applicable for solders, electrical safety plugs, fire alarms, heat indicators, and the like. December 9.

23,612. E. Tee. Webbed steel. December 10.

23,665. L. Mond. Improvements in apparatus for treating nickel ores and other materials containing nickel with carbon mon-oxide, partly applicable to other purposes. December 10.

23,707. H. S. Blackmore. Process for producing, decomposing, converting, or transforming compounds, and reducing metallic compounds so generated to metallic state. Complete Specification. December 10.

23,817. R. Baumann. Improvements in means for facilitating the smelting of brass and other metal turnings and similar fine-metal scrap. Complete Specification. December 12.

23,935. H. R. Angel. Improvements in the reduction of refractory sulphide ores. December 13.

23,950. C. Parnacott. Improvements in the manufacture of metallic alloys. December 13.

23,998. R. Morris and W. T. Gent. Improvements in the deposition of copper and other metals from solutions containing them, and in means or apparatus employed therein. December 14.

### Complete Specifications Accepted.

### 1894.

23,855. P. H. Bertrand. An improved method of producing magnetic oxide on wrought or cast iron. December 4.

24,782. W. H. Hyatt. A method of extracting gold without the use of water by means of a combined air blast and mercury, and apparatus for effecting same. December 18.

### 1895.

584. H. R. Lewis and C. Gelstharp. An improved method or process and apparatus for obtaining chlorine and zinc in the treatment of ores containg zinc or blende, and other metals and metalloids. December 11.

1155. C. D. Abel.—From M. M. Rotten. Manufacture of alloys of iron with other metals. December 18.

1676. T. B. Marchant and J. Woolley. Electrical storage batteries. December 4.

1731. C. A. Faure and F. King. Secondary batteries. December 18.

## XI.—ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.

### Applications.

21,920. J. Greenwood. Improvements relating to the electro-deposition of zinc and other metals upon iron and steel tubes. November 18.

22,120. T. W. Allan, A. Powell, and C. J. Tibbits. Improvements in electric accumulators or storage batteries. Complete Specification. November 20.

22,142. P. Falle. An improved electric battery. November 20.

22,207. C. Kellner. Improvements in electrodes suitable for electrolytic apparatus. November 21.

22,233. M. Engl and F. Wüste. Improvements in accumulators and their electrode plates, partly applicable to primary batteries. November 21.

22,408. W. Durant and T. W. B. Durant. Improvements in dry voltaic batteries. November 23.

22,505. F. Dannert, H. Windolff, and J. Zacharias. Active material for electric accumulators. Complete Specification. November 25.

22,506. F. Dannert, H. Windolff, and J. Zacharias. Electric accumulator. Complete Specification. November 25.

22,574. C. J. Grist. Improvements in the manufacture of insulating compositions for electrical purposes. November 26.

22,575. F. H. Judson and C. W. Silcock. Improved carbon plates with or without terminals. November 26.

22,899. J. E. Bousfield.—From G. Dorville and Co. Improvements in and connected with secondary batteries. November 29.

23,002. F. H. Perry. Improvements in electrical batteries. December 2.

23,097. R. Heathfield and W. S. Rawson. Improvements connected with the electrical deposition of zinc. December 3.

23,165. A. C. Miles and B. F. de Morgenstern. Improvements in and relating to galvanic batteries. December 3.

23,459. E. Andreoli. Electro depositing on and stripping gold from cathodes. Complete Specification. December 7.

23,852. S. S. Bromhead.—From La Société Anonyme des Anciennes Salines domaniales de l'Est Actien Gesellschaft. Diaphragms or partitions for electrolytic purposes formed of carbonates of alkaline earths. Complete Specification. December 12.

23,952. H. Fewson. Improvements in and relating to electric batteries. December 13.

### Complete Specifications Accepted.

#### 1894.

16,686. C. Vogt. Construction of galvanic cells. December 11.

23,590. H. T. Barnett. Gas batteries. December 4.

#### 1895.

297. C. F. Claus., jun., and H. S. Sutton. Improvements in the electrolytic treatment of tin and its separation from alloys and mechanical mixtures. December 18.

7600. W. Rowbotham, H. Levetus, and S. I. Levetus. Primary batteries. December 4.

13,730. W. Rowbotham and H. Levetus. Primary batteries. November 27.

14,158. W. Rowbotham. Primary batteries. November 27.

15,371. W. Rowbotham. Primary batteries. November 27.

17,269. C. E. C. Jungnickel. Dry cells. November 27.

18,038. H. Leitner and E. Reicher. Electrodes. December 18.

20,214. E. S. Boynton. Tubular galvanic batteries. December 4.

20,215. E. S. Boynton. Double-fluid galvanic batteries. December 11.

20,216. E. S. Boynton. Galvanic batteries. December 11.

20,306. J. Langelaan. Electric power storage batteries or accumulators. December 11.

20,431. J. J. Rooney. Secondary batteries. December 11.

## XII.—FATS, OILS, AND SOAP MANUFACTURE.

### Applications.

22,183. G. E. Wright and W. Monk. *See* Class V.

22,332. J. B. McArthur. Improvements in liquid disinfectant soap. November 22.

23,106. W. T. Whiteman.—From The Cleveland Linseed Oil Co. Improvements in purifying oil extracted by solvent from linseed or similar substance. December 3.

23,159. J. F. Lester and A. Riccio. Apparatus for separating oleaginous matter from a solvent. Complete Specification. December 3.

23,469. T. J. Carter and S. Boswell. Improvements in filtering and purifying oil. December 7.

23,997. C. Weygang. Improvements in the manufacture of saponaceous products from petroleum. December 14.

### Complete Specifications Accepted.

#### 1894.

24,103. S. Banner. Improvements in the treatment or oxidation of fixed oils, fats, and the like, and the application thereof as a menstruum for paint, varnish, oilcloth, and the like. December 18.

25,324. E. Andreoli. Treatment of drying oils. December 18.

#### 1895.

11,948. V. Camiz and A. Bettoni. Apparatus for the recovery and purification of waste oil. December 11.

19,890. A. J. Boult.—From T. J. Lovett. Manufacture of a lubricating compound. December 18.

20,433. H. E. Newton.—From J. H. Wingfield. *See* Class V.

## XIII.—PAINTS, PIGMENTS, VARNISHES. RESINS, INDIA-RUBBER, Etc.

### Applications.

21,863. J. Plummer. Process to make hydrated oxide of lead. November 18.

22,068. F. Green and J. H. Lake. The G and L impermeable compo for preventing damp walls, and for distempering and decorating purposes. November 20.

22,460. O. H. Hamilton. Improvements in the production of basic carbonate of lead or "white lead." November 25.

22,512. O. M. C. Heyl. Improvements in vulcanising rubber. November 25.

22,797. W. Howarth and A. Marchbank. A new or improved blacking. Complete Specification. November 28.

23,137. R. Langhans. Improvements in the manufacture or production of coatings composed of oxides of the earth metals. December 3.

23,155. A. T. Hall. Improvements in the preparation of colour wash or distemper paints. December 3.

23,202. C. W. Jurany. A process of manufacturing varnish. December 4.

23,207. A. J. Dale and T. G. Dale. A new or improved paint for resisting acids and alkalis. December 4.

23,249. H. Williamson. Improved means for obtaining pigment and the like colours as required, also for other purposes or uses. December 4.

23,427. A. W. Cramer and B. I. Milligan. Improvements in the manufacture of material suitable for insulating purposes. December 6.

23,570. A. Ulph. An improved moth-proof paint. December 9.

23,969. C. D. Ismay. Improvements relating to the manufacture of white lead. December 14.

### Complete Specifications Accepted.

#### 1894.

17,145. W. B. Priest. Manufacture of lead pigments or lead compounds for use as pigmentary materials. December 11.

24,103. S. Banner. *See* Class XII.

#### 1895.

5254. A. Imschenetzky. Manufacture of fireproof and insulating compounds. December 11.

20,243. E. Hornung. A substitute for india-rubber, gutta-percha, and substances of a like nature, and process for manufacturing the same. December 18.

## XIV.—TANNING, LEATHER, GLUE, AND SIZE.

### Applications.

22,714. C. Knees and D. W. Alexander. Improved process for tanning hides. Complete Specification. November 27.

23,214. H. A. Leverett. A new process for rapidly tanning hides and skins. December 4.

23,291. W. Sander.—From L. Lessmann. An improvement to preserve sole leather and make it absolutely watertight. December 5.

23,310. A. Brogard. Process for the removal of lime from hides and skins after treatment in the lime bath. December 5.

24,442. F. Blenkins and F. G. Bate. Coloured gelatine sheets. December 18.

### Complete Specifications Accepted.

#### 1894.

24,877. P. C. D. Castle. *See* Class XVI.

#### 1895.

8040. W. L. Wise and E. Moritz and Co. Apparatus for treating skins in the manufacture of leather. December 11.

20,123. M. Lewin. Tanning. December 11.

## XV.—AGRICULTURE AND MANURES, ETC.

### APPLICATIONS.

22,160. W. Barclay. A process for the production of blood and slag manure. November 21.

23,068. W. T. Forbes. A new or improved method of preparing peat for use as a fertiliser. December 2.

## XVI.—SUGARS, STARCHES, GUMS, ETC.

### APPLICATIONS.

22,859. A. Wohl. Improvements in extracting sugar from its solutions. November 29.

23,171. G. Kassner. Improvements relating to the separation of sugar from sacchariferous solutions, juices of plants, and the like. Complete Specification. December 3.

23,555. R. Haddan.—From R. M. y Olivares. A method of producing a vegetable gum adapted to replace gum arabic. Complete Specification. December 9.

### COMPLETE SPECIFICATIONS ACCEPTED.

1894.

22,568. G. Gin. Improvements in the method of and apparatus for purification of saccharine syrups or liquids. November 27.

24,877. P. C. D. Castle. Utilisation of waste or nearly waste product, and the manufacture of a useful gum or gummy compound therefrom. December 11.

24,511. R. C. Garton and C. H. Meyer. An improved method of manufacturing from starch or starchy substances a material suitable for use in brewing and for other purposes. December 18.

1895.

3049. W. P Thompson.—From H. A. J. Manoury. Manufacture of sugar. December 4.

21,314. A. L Tedesco. Process for manufacturing pure dextrose. December 18.

## XVII.—BREWING, WINES, SPIRITS, ETC.

### APPLICATIONS.

22,035. J. B. Grisez. A process for the aëration, oxidation, and oxygenation of wort. Filed November 19. Date applied for June 22, 1895, being date of application in France.

22,587. A. R. Scarlett. Improvements in the manufacture of malt and in apparatus therefor, partly applicable to drying or otherwise treating granular substances with air generally. November 26.

23,236. A. W. Ball. A new process for rendering malt wort neutral in the manufacture of extract of malt and in brewing beers. December 4.

### COMPLETE SPECIFICATION ACCEPTED.

1894.

24,511. R. C. Garton and C. H. Meyer. *See* Class XVI.

## XVIII.—CHEMISTRY OF FOODS, SANITARY CHEMISTRY, AND DISINFECTANTS.

### APPLICATIONS.

### *A.—Chemistry of Foods.*

22,344. A. F. Jaro. An improved method of and apparatus for preserving milk. Complete Specification. November 22.

22,886. C. M. U. Dahle. An improved process for the preservation of fish liver. Complete Specification. November 29.

22,887. C. M. U. Dahle. An improved process for the preservation and preparation for transit of fish liver. Complete Specification. November 29.

22,968. A. E. Cole. Improvements in Swiss or condensed milk. November 30.

22,989. L. P. J. Revel and J. M. Campagne. An improved process for the preservation of meat, fish, and other animal substances, and the manufacture of foodstuffs therefrom. November 30.

23,215. T. Hyatt. Improvements in preparing and roasting substitutes for coffee. December 4.

23,503. W. P. van Wyk. Improvements in or connected with the manufacture or preparation of cocoa or chocolate powder. December 7.

### *B.—Sanitary Chemistry.*

21,856. G. Watson. Improvements in furnaces for the destruction of town refuse. November 18.

22,132. H. L. Doulton and R. Meldrum. Improved process and apparatus for purifying water. November 20.

22,496. H. E. Newton.—From The Pinhoe Patent Refuse Destructor Co. Improved apparatus for the destruction of garbage, night-soil, and other noxious materials. November 25.

22,502. R. H. Reeves. Improved means and appliances for the treatment of sewage at precipitating and at outfall works. November 25.

22,545. E. W. Ives. Improvements in the means of extracting precipitated sludge or solids from the bottoms of inverted cone-shaped bottoms of precipitating tanks for sewage or waste water. Complete Specification. November 26.

22,762. R. Malabar and T. C. Coggins. Improved means of purifying liquids. Complete Specification. Filed November 28. Date applied for September 7, being date of application in Germany.

22,785. F. P. Candy. Improvements in apparatus or arrangements for use in connection with the treatment of sewage and other liquid matters by filtration and precipitation, and improvements in the preparation of filtering agents. November 28.

23,064. J. Hargreaves. Improvements in the treatment of sewage and in the "obtention" of valuable products. December 2.

### *C.—Disinfectants.*

22,332. J. B. McArthur. Improvements in liquid disinfectant soap. November 22.

22,364. C. C. Whitaker. Improvements in the manufacture of disinfectants and antiseptic compounds. November 23.

23,581. J. Reepmaker. A new insecticide product or composition. December 9.

23,824. A. McLeod. A disinfectant and deodorant powder. December 12.

### COMPLETE SPECIFICATIONS ACCEPTED.

### *A.—Chemistry of Foods.*

1895.

23. T. B. Milner. Icing liquid. December 4.

5124. J. Steiskal. Improved animal food and method of manufacturing same. December 4.

17,823. P. N. Jenkins. A new or improved method or process and apparatus for the preservation of perishable produce, such as meat, game, fish, and the like articles. December 4.

18,767. A. J. Boult. From H. Davidson. Apparatus for sterilising or pasteurising milk and other liquids. December 4.

20,798. R. L. Clarke. An improved method of malting wheat. December 18.

20,799. R. L. Clarke. Manufacture of wheat meal. December 11.

21,103. D. Gray, jun. Preparing fat for use as a comestible. December 18.

### *B.—Sanitary Chemistry.*

1895.

2140. P. Schottlander. Process for drying waste vegetable substances. November 27.

2625. T. Twynam and F. E. Matthews. Improvements in the recovery of ammonia from sewage effluent and other weak ammoniacal liquors. December 11.

20,366. G. C. Purvis. New or improved method in sewage precipitation. December 4.

### *C.—Disinfectants.*

1895.

360. J. Y. Johnson.—From Lasmolles and Frechon. A composition for treating the diseases of the vine and other plants. November 27.

788. S. A. Vasey. Improved compound forming an antiseptic, disinfectant, and deodorant. December 11.

19,418. H. Hiscott. An improved disinfectant or composition for antiseptic, disinfecting, sanitary, and other purposes. November 27.

## XIX.—PAPER, PASTEBOARD, Etc.

### Applications.

22,030. H. W. Reynolds. A new or improved material to be used in substitution of whalebone or horn, and process and apparatus for producing the same. November 19.

22,625. A. Zimmermann.—From The Chem. Fabrik and Actien vormals E. Schering. Improvements in the manufacture of water- and grease-proof paper. November 26.

23,598. C. Brodbeck. Improvements in the manufacture of fabrics from chemical cellulose. Complete Specification. December 10.

23,660. J. P. Wright. Paper floor-coverings. December 10.

### Complete Specifications Accepted.

1895.

1078. A. Cohn. Process for the manufacturing of machine paper with coloured longitudinal stripes. November 27.

2330. H. G. Forbes and E. M. Sommerville. An apparatus for water-marking paper. December 11.

16,498. G. J. Burns. Supporting and moving a web of paper or other flexible material for coating, drying, or other purposes. December 4.

## XX.—FINE CHEMICALS, ALKALOIDS, ESSENCES, and EXTRACTS.

### Applications.

22,251. B. Zahorski, F. Hurter, and J. Brock. Improvement in the treatment of impure bismuth for refining the same. November 21.

22,351. G. W. Johnson.—From C. F. Boehringer and Soehne. Improvements in the manufacture or preparation of vanillin. November 22.

23,489. J. F. Duke. Improvements in the manufacture of liquids, extracts of coffee, or other substances, and in apparatus for the purpose. December 7.

### Complete Specifications Accepted.

1895.

1624. J. Y. Johnson. From F. von Heyden. Improvements in the manufacture of vanilline. November 27.

2427. O. Imray.—From The Farb. vorm. Meister, Lucius, and Bruning. Manufacture of ethers of para-lactyl-amidophenol. December 11.

## XXI.—PHOTOGRAPHIC MATERIALS and PROCESSES.

### Applications.

21,989. H. E. Mendelssohn. Means for producing photographs resembling engravings. November 19.

22,138. A. Baumgartner. Improvements relating to the preparation of coloured plates for photographic colour printing. November 20.

22,692. G. Koppmann. Improvement in light-proof coloured positive-paper. November 27.

22,757. A. Musker. Improvements in drying photographic negatives and the like. November 28.

### Complete Specification Accepted.

1895.

2986. C. F. Oakley. Manufacture of photographic plates and films. December 18.

## XXII.—EXPLOSIVES, MATCHES, Etc.

### Applications.

21,995. W. F. Reid and E. J. V. Earle. Improvements in nitro-compounds. November 19.

22,327. H. Siebeck. Process and apparatus for igniting quick-matches or fuses. Complete Specification. November 22.

22,407. A. F. Hargreaves. Improvements in primers for detonating explosive compounds. November 23.

22,455. A. F. Ball. Improvements in time and percussion fuses. November 25.

22,698. W. J. Orsman. Improvements in the manufacture of explosives applicable for use in coal or other fiery mines. November 27.

23,242. R. Weyel. Method of manufacturing explosives for blasting purposes and for use as ammunition. Complete Specification. December 4.

23,440. W. Job and C. Job. A speedy, safe, and effective system or form of ignition in the use of matches. Complete Specification. December 7.

23,443. G. G. Andre and C. H. Curtis. Improvements in the manufacture of explosives. December 7.

### Complete Specification Accepted.

1895.

19,667. E. Dickson. An improved guwpowder. December 18.

## XXIII.—ANALYTICAL CHEMISTRY.

### Application.

22,303. G. Craig. A new or improved process for estimating the carbonic acid or other constituents in gases or products of combustion, and apparatus therefor. November 22.

### Complete Specifications Accepted.

1895.

662. G. W. Peipers. A new or improved process for determining the carbonaceous value of iron. November 13.

2308. J. A. Ewing. Apparatus for testing magnetic quality in iron. December 4.

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